

**CHINA'S INDUSTRIAL POLICY AND ITS IMPACT
ON U.S. COMPANIES, WORKERS AND THE
AMERICAN ECONOMY**

HEARING

BEFORE THE

U.S.-CHINA ECONOMIC AND SECURITY
REVIEW COMMISSION

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

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MARCH 24, 2009
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UNITED STATES-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION
WASHINGTON : MAY 2009

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April 24, 2009

The Honorable ROBERT C. BYRD
President Pro Tempore of the Senate, Washington, D.C. 20510
The Honorable NANCY PELOSI
Speaker of the House of Representatives, Washington, D.C. 20515

DEAR SENATOR BYRD AND SPEAKER PELOSI:

We are writing to report on the U.S.-China Commission's March 24 public hearing on "China's Industrial Policy and its Impact on U.S. Companies, Workers and the American Economy." The Floyd D. Spence National Defense Authorization Act (amended by Pub. L. No. 109-108, section 635(a)) provides the basis for this hearing, as it requires the Commission to report to the U.S. Congress on "the national security implications and impact of the bilateral trade and economic relationship between the United States and the People's Republic of China."

In the hearing, the Commission examined the adoption by China of a detailed industrial policy intended to advance specific economic goals. The Commission heard testimony concerning the effects of those industrial policies on the Chinese economy and on the economies of China's major trading partners, particularly the United States. Witnesses were asked to consider possible responses by the U.S. government to China's industrial policy, especially in those instances where Chinese policies may violate international trade rules or otherwise harm U.S. interests.

China's industrial policy is characterized by three main goals: 1. the creation of an export-led and investment-led manufacturing sector; 2. the creation of jobs sufficient to reliably employ the Chinese workforce; and 3. an emphasis on fostering the growth of industries such as manufacturing and high technology products that add maximum value to the Chinese economy. China adopts, modifies and abandons other economic policies in order to meet these primary goals. For example, low wage jobs in the textile industries may be supported by government policies in order to provide employment for minimally skilled workers.

China's industrial policy is promulgated through a top-to-bottom process that has been outlined in 11 successive five year plans adopted by the State Council and implemented by the central and provincial governments at the direction of officials of the central government and the Communist party. Subordinate and elaborative policies, such as the 15-year "National Outline for Medium and Long Term Science and Technology Development Planning (2006-2020)," supplement the five year plans.

China has wielded a variety of tools to accomplish its ends. It has variously designated "pillar" or "strategic" or "heavyweight" industries of which government is to retain ownership or control. In many cases the government pursues policies to significantly aid their development. These industries include telecommunications, information technology, aviation, automobile manufacturing, construction, energy, and

steelmaking, in addition to Chinese banks. Other industries specially favored by governments in China include biotechnology, wholesale marketing, computer chip design, and software.¹ These industries receive special support from the government, including low interest loans and loan forgiveness from government-owned banks at the direction of government officials. The government also deploys such indirect subsidies as lax enforcement of intellectual property rights and worker protections. Direct aid includes subsidized fuel, land, infrastructure improvements, and electricity. China also levies a value added tax on imports and rebates the tax on exported goods. While general rebates of indirect taxes are permitted by the rules of the World Trade Organization, it nonetheless results in a 17 percent tax levied on U.S. imports into China. Serious questions have been raised about the trade-distorting impact of the selective use of such tax rebates. Unfortunately, WTO panels have ruled repeatedly that attempts by Congress over three decades to provide an income tax credit for U.S. exports violate the organization's trade rules.

China's industrial policies have had a profound effect on the U.S. economy. The trade deficit with China in goods reached \$266 billion in 2008, resulting in slower U.S. economic growth and fewer jobs here than if the trade relationship were more balanced between imports and exports. Witnesses differed as to the degree that the overall U.S. trade deficit would decline if the trading relationship between the two countries were brought into balance. But it is significant that the U.S. deficit with China represented 33 percent of the total U.S. trade deficit with the world and 42.6 percent of the deficit with non-oil exporting countries.² In addition, it is not just the size of the deficit that policymakers should examine, but the changing nature of its composition. The United States in 2008 ran a record \$72.7 billion trade deficit with China in advanced technology products.

In addition, export-led growth policies pursued by China and other Asian nations have inevitably led to excess capacity in many products, notably steel and automobiles, which has contributed to declining jobs and production in many market-oriented countries, including the United States. Witnesses were unanimous in their conclusion that the undervalued Chinese currency serves as an indirect subsidy to Chinese exporters by lowering the final cost of their exported products and as a hindrance to U.S. companies attempting to export to China since the undervalued Chinese currency makes U.S. exports relatively more expensive.

China has manipulated the process of setting industry-wide standards in order to benefit its indigenous industries and to protect them from foreign competition. That has been the case with China's telecommunications industry, one of four industries that the Commission examined in depth in the hearing. Others included nanotechnology, optoelectronics, and information technology. These four industries also were beneficiaries of China's practice, plainly identified in its 11th five year plan, of encouraging the transfer of foreign technology to China.

¹ U.S.-China Economic and Security Review Commission, testimony of George Haley, University of New Haven, New Haven, Connecticut, March 24,

² Department of Commerce, Bureau of the Census.

As part of this effort, China has been successful in attracting U.S. corporations to locate some of their production and research facilities there, but also in transferring technologies to their Chinese joint venture partners.

China is investing heavily in the computer and telecommunication sectors. It has reorganized and consolidated the telecommunications industry into three giant service providers while at the same time restricting the entry of foreign providers to the Chinese market. While these companies are largely operating in the domestic market, they hold considerable potential as international competitors to U.S. and European telecommunications companies. In fact, state-owned and state-invested enterprises account for about 23 percent of China's exports while foreign-invested enterprises account for more than 55 percent of China's total exports in 2008, according to one witness, citing figures released by China's government.³

Witnesses offered a number of suggestions to counter the effects of China's industrial policy and to improve America's ability to compete. Among them were methods to counter China's underpriced currency, subsidies to favored industries, intellectual property theft, and the use of indigenous standards to block U.S. products. Witnesses also emphasized the need to place a stronger emphasis on education in the United States, particularly in science and technology. The Commission will evaluate these and other recommendations obtained during its hearings and incorporate them in its recommendations to Congress that will be contained in its *2009 Annual Report to Congress* to be published in November 2009.

Thank you for your consideration of this summary of the Commission's hearing. We note that the full transcript of the hearing plus the prepared statements and supporting documents submitted by the witnesses can be found on the Commission's website at www.uscc.gov, and that these can be searched by computer for particular words or terms. Members of the Commission are available to provide more detailed briefings. We hope these materials will be helpful to the Congress as it continues its assessment of U.S.-China relations and their impact on U.S. security.

Sincerely yours,



Carolyn Bartholomew
Chairman



Larry M. Wortzel, Ph.D.
Vice Chairman

cc: Members of Congress and Congressional Staff

³ U.S.-China Economic and Security Review Commission, testimony of Terry Stewart, Stewart and Stewart, Washington, D.C., March 24, 2009

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CHINA'S INDUSTRIAL POLICY AND ITS IMPACT ON U.S. COMPANIES, WORKERS AND THE AMERICAN ECONOMY

TUESDAY, MARCH 24, 2009

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

The Commission met in Room 236, Russell Senate Office Building, Washington, DC at 9:02 a.m., Chairman Carolyn Bartholomew, Vice Chairman Larry M. Wortzel, and Commissioners Patrick A. Mulloy, and Daniel M. Slane Hearing Cochairs), presiding.

OPENING STATEMENT OF CHAIRMAN CAROLYN BARTHOLOMEW

HEARING COCHAIR SLANE: Good morning, everyone. Welcome to today's hearing on "China's Industrial Policy and its Impact on U.S. Companies, Workers, and the American Economy."

Today's hearing will be cochaired by Commissioner Patrick Mulloy and me. Congress has given our Commission the responsibility to monitor and investigate the national security implications of bilateral trade and economic relations between the United States and China.

We fulfill our mandate by conducting hearings and undertaking related research, as well as sponsor independent research. We also travel to Asia and receive briefings from other U.S. government agencies and departments. We produce an annual report and provide recommendations to Congress for legislative and policy changes.

This is the third hearing from the 2009 reporting year, a year with a new administration in Washington. The new administration will have to deal with a lot of critical issues in 2009, along with the worst economic crisis the world has seen in the past 60 years.

I'd like to welcome our panelists and kindly ask that each speak for no more than seven minutes. This will allow the maximum time for questions and answers.

Now, I'd like to introduce Commissioner Mulloy.

**OPENING STATEMENT OF COMMISSONER PATRICK A.
MULLOY, HEARING COCHAIR**

HEARING COCHAIR MULLOY: Thank you, Mr. Chairman.

I'm very pleased to have the opportunity to cochair today's important hearing. I also want to thank members of Congress who have been very supportive of the work of this Commission.

Oftentimes, we have members come and testify to start off the hearing, but there's so much going on in the Congress right now that it was difficult. But some of them sent over statements for inclusion in the record.

Let me read from Congressman Mike Michaud who is the head of the House Trade Working Group. He tells the Commission:

“Your work has been invaluable to those in Congress who are concerned about the economic, political and security implications of the U.S. relationship with the People's Republic of China.”

Senator Sherrod Brown will be coming by later this afternoon to make a statement.

Since taking power in October 1949, China's communist government has pursued an industrial policy. It wasn't very successful in the beginning because it was trying to do it within China. Deng Xiaoping in '78 decided that they needed to seek foreign technology, foreign investment, and foreign markets.

Back in 1981 when I first went to China, there were hardly any cars on the street. Today, China may make more automobiles than the United States of America. So something is working over there, and it's quite evident that this policy has implications for the United States of America.

So, today, we want to explore the overall nature of China's industrial policy and we want to look at the role that foreign direct investment and China's use of incentives to attract foreign investment have played in building their strategic and pillar industries.

We want to thank our witnesses who have all submitted very good testimony. The commissioners have had a chance to read it, and

we'll take it into account both in today's hearing and then when we write our annual report for the Congress. So we appreciate your being here. Now let me turn it back to my cochairman, Commissioner Slane.

OPENING STATEMENT OF COMMISSIONER DANIEL M. SLANE HEARING COCHAIR

HEARING COCHAIR SLANE: Thanks. Thank you, everyone, for coming, and we want to express our appreciation to the Senate Armed Services Committee for providing today's hearing venue, and a special thanks to our staff for the great job they did in putting this hearing together.

A transcript of today's hearing will be published on our Web site, which is uscc.gov, and today's written testimony will be posted on the Web site as well, and by the end of November, our 2009 Annual Report will appear on the Web site and in the form of a bound paper copy. Today's hearing will provide a wealth of information for that annual report.

For those of you who will be with us the entire day, I'll note that there will be a break for lunch at 1:00 p.m., and we will resume promptly at two. There's a snack bar and carry-out in the basement of the Russell Senate Office Building. There's also a cafeteria in the basement of the Dirksen Building that is connected to the Russell Building by a long hallway, and I have to warn everybody that the microphones are always on so please don't embarrass yourself.

Now let me introduce our first panel. Our first panel for today is going to address, among other things, the evolution of industrial policy in China. In particular, we're interested in hearing about China's pillar and strategic industries in general.

Alan Wolff leads Dewey & LeBoeuf's International Trade Practice Group which represents clients involved in some of the most important trade issues of our day.

Mr. Wolff has a long and distinguished career in international trade that includes over 25 years as a Managing Partner with Dewey Ballantine. Before that, Mr. Wolff worked as General Counsel and Deputy U.S. Trade Representative for the Carter administration.

George Haley is a Professor of Industrial Marketing at the University of New Haven where he teaches in the Graduate and Executive Programs.

Dr. Haley is also the founding Director of the Center for International Industry Competitiveness. Dr. Haley is an expert on emerging and industrial markets including the historical, cultural and legal environments in which the Chinese business strategy is

formulated.

Clyde Prestowitz is founder and President of the Economic Strategy Institute which deals with international trade policy, economic competitiveness, and the effects of globalization.

Prior to founding ESI, Mr. Prestowitz served as a Counselor to the Secretary of Commerce in the Reagan administration. Mr. Prestowitz regularly writes for leading publications, including the New York Times, the Washington Post, Fortune and Foreign Affairs, and wrote a great book on China.

Thank you.

We'll start with Mr. Wolff.

PANEL I: OVERVIEW OF CHINA'S PILLAR AND STRATEGIC INDUSTRIES

STATEMENT OF MR. ALAN WM. WOLFF PARTNER, DEWEY & LEBOEUF LLP WASHINGTON, DC

MR. WOLFF: Good morning and thank you to Commissioners Slane and Mulloy and the other commissioners this morning.

I appreciate the opportunity to be before you this morning. There is too little focus on industrial policy in this country, the industrial policies of other countries. We were not very well focused on what the Europeans were doing with Airbus. We as a country were not very focused on what the Japanese were doing with electronics and a number of other industries, and that was to our cost, I think, as a country and to our industrial base.

I think that the work you are doing is extraordinarily important. This subject is important for China as well because there is a misallocation of resources that takes place with industrial policy that the Chinese should be focused on as well.

There is no definition of "pillar industries" as a generic term in that each Chinese municipality, every province, has a series of industries that it treats as pillar industries. I think that looking at autos, steel, and the industries that are cited in the Medium and Long-Term Science and Technology Plan, the 15-year plan from the Ministry of Science and Technology in China, that would be a pretty good list. And the specific projects and sectors are listed in my testimony.

There are very elaborate papers that are being issued by the Ministry of Science and Technology and other Chinese ministries, which in effect create what the Chinese government sees as the necessary support for their pillar industries, their strategic industries.

For my testimony, I've misappropriated Deng Xiaoping's saying that, "I don't care if it's a white cat or a black cat; it's a good cat as long as it catches mice."

In fact, I'm using it in the reverse of the way he was using it because "black" to him was capitalism, and to me "black" is what might be WTO inconsistent or cause a problem for China's trading partners.

So there is a duality to Chinese policies. They fall into two categories:

There are policies that we have to match—namely the emphasis on science, technology, engineering, math education. Clearly, that is in the President's Budget, and it is in the stimulus package, and it is something that you can't fault.

Science and technology parks. The Chinese have a vast number of these. They are very large. If you look at what Research Triangle did for North Carolina, which was a phenomenal success--for North Carolina was 49th in the country in terms of per capita GDP, and is now in the upper ranks as a result of Research Triangle Park, in large part, and the resulting attraction of industry.

My first trip to China included a lecture I gave at Pudong University in 1988. If you look across the river from Shanghai, Pudong was just an empty field. It is no longer empty.

Of the black policies, of the three areas which I chose as examples--one is product standards using as an illustrative practice encryption. It is going to be a major cause of friction between the United States and Japan and Europe, on the one hand, and China on the other. The use of standards is going to be very trade-distorting. We already experienced the WAPI, Wireless LAN, example as a problem, but we are going to have very serious problems going forward.

China has declared that its MLPS, Multi-Level Protection System, in which it grades the level of encryption that is necessary, making banking and finance a level three, that requires Chinese indigenous technology, indigenous patents.

If we did that the same thing, China wouldn't be trading with the United States to any great extent. If we just said, well, we want everything coming into this country in a whole variety of areas to have American technology and American patents, then if we reciprocated what China is saying that it will do--the regulations are not fully in effect yet--China would have major trade problems with the United States.

I also have looked at information technology equipment and looked at the means that China uses to exclude foreign competitors from its market, and it's not just the use of subsidies. It is an

industrial organization, not quite like keiretsu, but there are relationships which provide a very serious protection. So the problem is a combination of subsidies as well as protection.

A third example I gave was oil country tubular goods. One could have chosen something else, but we at our firm studied this product sector in some detail. It was a primary industry of concern to China. It got enormous policy support--many billions of dollars of subsidy and protection. And the result is that the United States industry will, in fact, suffer injury at some point if it hasn't already.

And it includes, as we saw in Europe, debt-to-equity swaps, not perhaps dissimilar from what we're doing with AIG, except for one thing, and that is our intent is not to have AIG emerge dominant in the world as the leading financial services provider, whereas, what the Chinese are doing, as the Europeans did in past times, is try to have their industries emerge as dominant suppliers.

In terms of the implications of China's policies, one study that we did recently indicates that the results are very mixed, that American semiconductor producers, for example, are not increasing the location of their R&D location to China very much because of concerns over intellectual property.

While the semiconductor executives responding to our survey didn't say this, I would suggest that it was not just the lack of intellectual property protection, it was government policy that was a matter of concern. So China is having, I would say, mixed results.

In sum, I think our government has to know more. You are performing an extraordinarily important role in that process, but I think the Commerce Department and other agencies in the U.S. government should spend a good deal more attention on what's going on abroad that reshapes our economy.

Thank you.

[The statement follows:]

**Prepared Statement of Mr. Alan Wm. Wolff
Partner, Dewey & Leboeuf LLP
Washington, DC**

[This testimony is not intended to represent the views of Dewey & LeBoeuf or its clients.]

The invitation to this hearing listed ten specific questions which I will attempt to address in the context of the work that I and our firm has done to date:

There is no single, permanent definition in China of a "pillar industry." Beijing municipal authorities announced in 2008 that for it tourism would be a pillar industry in the post-Olympics period. The same for

Xinjiang. Coal mining is Shanxi's pillar industry. Automobile manufacturing is said to be the pillar industry for the Chinese economy. Also biotechnology. For Chongqing, information technology. For Nanchang, the semiconductor industry. But also pillar industries for all or part of China are variously: petrochemicals, non-ferrous metals, insurance, telecommunications, banking, wholesale, and utilities. So to some extent, being a "pillar industry" is synonymous with being "important enough to be supported by central, provincial or local government policy".

As the focus at this Hearing is the impact on United States industries and workforce of China's supportive policies, a more relevant class of China's pillar industries for today's discussion are those that are now or will in the future offer competition to American industries. Aside from automobiles, which are likely to arrive on these shores from China in the not terribly distant future in large numbers as they did from Japan and Korea, I would turn to the Medium and Long Term Science and Technology Plan of the Ministry of Science and Technology (MOST) for guidance as to areas of primary interest. A key aspect of the Medium and Long Term S & T Plan is to make intensive investments in "strategic products".

Under China's S&T Plan, key projects cover a number of priority sectors:

- core electronic components,
- high-end general chips and basic software;
- the technology for manufacturing extremely large integrated circuits;
- new-generation broadband wireless mobile telecommunications;
- high-end numerical controlled machine tools and basic manufacturing technology;
- development of large oil and gas fields;
- large nuclear power plants with advanced pressurized water reactor, high-temperature gas-cooled reactors;
- control and treatment of pollution in water bodies;
- nurturing new, genetically modified biological species;
- development of important new drugs;
- control and treatment of major contagious diseases such as AIDS and viral hepatitis;
- large aircraft; high-resolution earth observing system;
- manned space flights; and
- lunar exploration projects.

Detailed, elaborate papers address the policies which are believed to be necessary to achieve the project goals. Over ninety-nine of these papers have been planned, called "Guiding Opinions". A sampling indicates the breadth of their coverage:

- Accelerating Creation of Independent, 'Well-known' Chinese Brands;
- Supporting Technology Innovation of Small and Medium-sized Enterprises;
- Issuance of Corporate Bonds for Qualified High-Tech Enterprises;
- Regulation on Management of Start-up Investment Funds and Debt Financing ability of Start-ups;
- Suggestions on Establishing and Improving Regional Intellectual Property;
- Standardizing Foreign Acquisition of Key Chinese Enterprises in the Equipment Manufacturing Industry;
- Building Research-orientated Universities;
- Promoting the Development of State Supported High and New Technology Industry Development Zones;
- Establishing Guidelines and Funding for Venture Capital Investment;
- Creating Tax Policies Supporting the Development of Start-Ups; and

- Establishing ‘Green Channels’ for High-level Talents Who Have Studied Abroad to Return to China.

The comprehensiveness of these papers is remarkable by any measure. They are designed to at least equal the results achieved by more evolved market economies that have had a head start of decades and in some cases of over a century. This requires China to acquire a financial, educational and legal infrastructure in record time to support an economy whose growth is to be based on innovation.

How much intervention and of what kind?

*I don't care if it's a white cat or a black cat.
It's a good cat so long as it catches mice.*

Deng Xiaoping

A key question everywhere is what kind of state interventions best serve national interests and are deemed constructive by a country's trading partners. Globalization has put all nations into one world economy with fewer national barriers separating one trading partner from another. The origins of the current economic crisis stem in part from an excessive rate of savings in some countries, most prominently China, and in too high a propensity to borrow (and invest poorly) among other countries, most prominently, the United States. Global imbalances may have their roots in relative rates of savings, but combined with industrial policies, they have a differential impact on various sectors of each economy. Promotion of a given sector by one country will not in fact result in a win-win result as seen from the vantage point of those companies located in another country who are trying to compete in that same sector. (Ask Boeing about Airbus.)

Chinese government policies have a dual nature -- that is that there are promotional policies which are broadly considered to be acceptable by China's trading partners (white cat analogues) and other Chinese policies that are a matter of real concern (black cat analogues). About this latter category, a key question is whether the policies which harm others are in fact good for China. Another question is whether each black cat measure is consistent with China's WTO commitments, including those contained in its Protocol of Accession. In the category of black measures fall inadequate protection of intellectual property, national standards that act to insulate the Chinese market from the rest of the world, potential use of competition policy as an industrial policy tool, discriminatory government procurement, and subsidization that excessively distorts trade and investment patterns.

Taking the most recent past first, it is worth focusing on the much-praised series of Chinese stimulus packages. China has put into place a series of measures that appears to be intended to preserve, as governments wish to do, maximum benefits at home. China's Ministry of Industry and Information Technology (MIIT) currently plans to assist its electronics and information industries: electronics, telecommunications and Internet; via a number of key projects: integrated circuit, flat panel display, TD-SCDMA, digital TV, computer and next generation Internet, software and information service. According to reports, the measures to be used include direct state financial support, tax breaks, and measures to expand domestic demand. The Shanghai IC Industry Association is seeking additional investment from the government in IC companies. For the mobile phone and household electrical appliance industries, it is expected that there will be lower tax rates, additional subsidies, cash grants and increased state-bank lending.

Foreign industry concerns center on aspects of China's stimulus package that go beyond limited subsidies to encompass measures which limit competition: by emphasizing procurement by government and state-owned enterprises of products incorporating indigenous Chinese intellectual property, requirements for government purchases of software that is only interoperable with Chinese software, further emphasis on

use and development of indigenous standards and use of exclusive information security standards. None of these concerns are new.

a. the drive toward indigenous innovation.

We must aim to be at the forefront of the world's S&T development, speed up the building of a national innovation system, and strengthen an original innovation capability.” . . .

Hu Jintao

One of the chief driving forces of Chinese policy, aside from maintaining a strong growth rate annually for the sake of political stability and the welfare of its people, is the desire to build an independent technological base. For the last three decades, China relied heavily for its economic development on foreign direct investment, and still welcomes it with some limitations. Relying on foreign investment and imported technology has not been abandoned, but the emphasis has shifted, as noted in the National Development and Reform Commission's *11th Five Year Plan for Use of Foreign Investment*:

[We shall] encourage foreign enterprises -- especially large-scale multinationals -- to transfer the processing and manufacturing processes with higher technology levels and higher added value and research and development organizations to China, ... to develop a technology spillover effect, and strengthen the independent innovation ability of Chinese enterprises. [emphasis supplied]

... [T]he overall strategic objective of use of foreign investment in China is to...change the emphasis in use of foreign investment from making up the shortage of capital and foreign exchange to introducing advanced technologies...

This emphasis is in turn captured and amplified in a wide variety of documents emanating from the various ministries:

Fundamental Principles: firstly, to combine the import of advanced technologies and the optimization of importing structure and raise the proportion of proprietary and patented technologies in product designing and manufacturing process;

It says much about China's success in its economic development strategy that it can stress home-grown, that is, indigenous innovation. Some of the policies that foster innovation are positive ("white cat") and others are negative ("black cat"), that is, trade and investment distorting, and possibly WTO inconsistent.

b. Positive (white cat) policies –

1. Human capital and the S & T Workforce

China graduates each year nearly 600,000 engineers. Much is made of this phenomenal output of engineers, and other STEM graduates. And much should be. These are impressive numbers. It is true that studies by Duke, McKinsey, Cao and Simon, indicate China's educational system:

- is outdated, suffers from having a Marxist focused curriculum,
- emphasizes depth over breadth,
- has a quantitative over qualitative focus,
- does not nurture creativity
- leads to “transactional vs. dynamic engineers”, and

- produces a shortage of “innovative” engineers.

But it cannot be concluded that of this vast population of annual graduates in engineering there is not a very talented top tier that is fully internationally competitive. Shocking evidence of this fact is seen in U.S. data showing that more than half Ph.D. candidates in engineering at present in U.S. universities are graduates from Chinese universities.

2. Science and Technology Parks

In creating S&T parks, China is emulating none other than the United States' experience. Menlo Park was the first research park, dating back to 1958, followed by Stanford Park, Research Triangle in North Carolina and then Waltham, Massachusetts, each in the 1950s. It is hard to read that description of Research Triangle Park today without thinking also of Pudong. In 1988, Pudong was a large empty field across the Huangpu River from Shanghai. Today Pudong contains a High Tech Park and the Zhangjiang Life Science Cluster, the latter comprised of 25 square kilometers, seventeen of which are developed. As of 2005, there were 110 research and development institutions and 3600 companies in the technology park, with more than 140 of them foreign. The park's total output exceeds 11.122 billion yuan, up 190% from the previous year. The park employs 100,000.

China announced six years ago that it would build 100 national university science parks by the end of 2005. More than half that number appears to exist today. "The university-based science parks, by joining with local governments and companies, were playing a positive role in speeding up the industrialization of academic research results, and pushing forward reform of the school teaching and management systems" according to one Ministry of Education official. China's parks are said to average in area about 150% of the size of America's largest park, Research Triangle.

Zhongguancun Science Park in Beijing covers four times the area of the Pudong Zhangjiang Park, about 100 square kilometers, with some 400,000 professionals and support staff, and 6000 companies, with production of well over \$14 billion yearly. It is heavily in IT, especially internet, and views itself as China's Silicon Valley. Suzhou Industrial Park developed in conjunction with the Government of Singapore, by the end of June 2008, attracted over 3299 foreign enterprises, including 77 Fortune 500 MNCs with cumulative contractual foreign investment of USD 33.96 billion, and domestic companies with total contractual investment of RMB 129.57 billion.

The impact of China's science and technology parks on China's trading partners is hard to gauge. For one thing, foreign firms have a very substantial presence in the parks. Secondly, just as Mao was said to have replied when asked what he thought the impact of the French Revolution: "It is too early to tell." What may emerge could be a number of Chinese "pillar" biotech and other high tech industries.

3. Taxation

While tax schemes can easily cross into black categories, the simple, nonpreferential corporate tax rate in China is substantially lower than that of the United States: 25% v. 39%. Rob Atkinson of the Information Technology and Innovation Foundation, citing World Bank data, lists the effective corporate tax rates as China 15.7% and United States 32.0%. The U.S. effective corporate tax rate before all the specific advantages that China may accord a favored investment is just slightly over double the U.S. effective rate.

b. Distortive (black cat) policies

Having as a goal the promotion of a more innovative economy and series of industry is laudable. The

promotion of indigenous technologies may be less trade and investment distorting, such as through science parks (again abstracting the idea of a park away from that of a subsidy), but there are measures that can cross a line and give rise to claims of market closure.

1. Product standards and encryption

One of the clearest statements of the relationship between standards setting and achieving indigenous innovation was issued by the Shanghai Municipal Government in September 2004:

- *[We shall] actively promote the formulation and implementation of technical standards with self-owned intellectual property rights and translate that technological advantage into a marketplace advantage to maximize the benefits of intellectual property rights.*

This kind of statement issued by a sub-national government is unique to China. Its meaning is clear, and it deserves to be taken seriously.

Further, as the State Council's Medium and Long Term Policy for Science and Technology notes:

- *[We shall] actively take part in the formulation of international standards, and drive the transferring of domestic technological standards to international standards...*

Taken together, these statements are a reasonable indication of the central tenets of Chinese standards policies at the domestic and international levels. As articulated here, the Chinese government is not seeking technology neutrality, or market driven outcomes, either through its domestic standard-setting activities or through its participation in the establishment of international standards. It is seeking commercial advantage. WAPI (WLAN Authentication and Privacy Infrastructure) was an extreme example. Product standards work hand in hand with "accreditation measures" to provide a protected market for products having independent innovation.

Since a substantial portion of leading edge procurement in China will occur under the auspices of the 16 key projects set out in the Medium and Long Term S & T plan, and much of the Chinese economy is state-owned, state-invested or otherwise highly state-influenced, which products are accredited may prove to be extraordinarily important in gaining or maintaining access to the Chinese market. It is worth mentioning in this connection that as part of its Protocol of Accession to the World Trade Organization, China pledged to have its state-owned enterprises procure only on a commercial basis.

An example of a seemingly coordinated approach that relies on standards setting, government procurement, and other policies, is the current Chinese government approach to encryption policy. Over the past year, various Chinese government agencies have issued new policies related to encryption technology and/or information security that will, if implemented, have a potentially profound impact on foreign information technology (IT) companies seeking to do business in China.

What is best for China and various Chinese interests, commercial and otherwise? The point of departure should be that setting a standard should not drive innovation, rather: innovation (creating something unique and in demand in the market) should drive the setting of standards. Misguided standards policies can not only interfere with Chinese goals but can do great damage done to non-Chinese companies as well.

2. Information technology equipment

One study that our Trade Group produced looked at a major Chinese competitor that I will call "CTC".

CTC frequently underpriced its U.S. and European competition by 50 percent. This could not be explained by natural cost advantages: Equipment and components were priced at world levels; labor-cost advantages exist but not to necessary degree to explain the differential; and capital costs would be expected to be higher than those of competitors, reflecting higher risk of new entrant.

CTC's profitability was not driven by parent-company operations. Indeed, profits had been reported to be higher than cash flow. Normally, income from operations is *less* than cash flow from operations. CTC's cash from operations could not explain the profits. We found that a significant portion of CTC's financing operations and profit sources occurred in its subsidiaries.

Part of the answer lay in Chinese government programs that promoted the Chinese information technology sub-sector through provision of R&D, favored procurement, provision of financing, requirements for local content, and other forms of assistance.

CTC was formed from elements of the People's Liberation Army. Important to its early viability was a very large contract from the PLA to provide services. In the early 1990s, the CTC continued to depend heavily on PLA contracts for both equipment and maintenance. Within a few years, non-PLA sales began to increase.

China's president pledged that:

The State shall become strongly involved [in the industry] to ensure its healthy development and make China's competitive product when turning to the outside world.

In the mid-1990s: CTC began the practice of creating local joint ventures (LJVs) with local governments and local information technology entities. This is a pattern whose significance is not initially fully understood by its foreign competition.

China's Vice Premier of the State Council visits CTC, accompanied by the presidents of the four commercial banks, and hears of CTC's financing problems. Instructions follow. Merchants Bank "begins widespread cooperation" with CTC and introduces a novel "buyers credit" program (perhaps not so different than Japan's financing the leasing of Japanese made computers nearly a generation earlier as Japan struggled to overcome foreign products' competitiveness in the Japanese market).

CTC named in 9th Five-Year Plan. Provincial and local government support for CTC is granted. In 1998, China Construction Bank provides increase in buyers' credit. In 1999, the Central government issues "encouragement guidelines" for service providers to source domestically. During this same period, the Central government begins the practice of directly assisting CTC win overseas contracts.

In 2000, China's 10th Five-Year Plan explicitly targets the principle equipment produced by CTC for "accelerated" development. It provides US\$450 million to CTC in buyers' credits, and US\$23 million for research. Within the next few years a Chinese government-owned "policy bank," provides CTC with a three-year *revolving* domestic buyers' credit.2000-03. Another "policy bank" provides CTC with US\$145 million in long-term loans. 2001

In 2004, China's Ministry of Information Industries (MII) and the Ministry of Commerce (MOFCOM) "hammer out" a set of policies designed to encourage domestic IT and information technology firms to expand overseas. The same year a policy bank provides CTC with US\$10 billion to "finance overseas

expansion.” Government officials state that a given percentage of equipment in China’s next-generation systems must be locally produced. Chinese authorities “encourage” service providers to source from participants in science and technology development programs.

CTC presents itself as having no government ties. But the Central Government controls the service providers and the provincial governments control the projects for which procurement is required.

Now, let us revert to a peculiar set of corporate relationships that affect procurement in the Chinese market for CTC’s products, and affect some third country procurement.

Each Provincial government forms a joint venture with the domestic Chinese competitor, CTC. The co-owned JV will bid for the provincial contract to supply goods and services. The purpose of this structure is described as follows: CTC has numerous local joint ventures to establish “communities with aligned interests” to “prevent the entrance of competitors by exclusion.”

The joint venture receives cash in the form of investment by the provincial government and also revenues from the provincial project in which it is a successful bidder. The JV in turn provides a revenue stream to CTC, the joint venture partner. CTC did not have to rely exclusively on its revenues from selling equipment to the JV. This explains the mystery first cited in this section, profits being higher than revenue from sales of equipment.

In addition to the above, with respect to expanding sales in third country markets, the Chinese government purchases equipment from CTC to make donations to foreign developing countries. The Central government also provides, through government-controlled banks, buyers’ credits to these foreign national information technology service provider customers. In some cases, the winning bidder in a third country transaction is a CTC JV partly owned by the foreign purchasing authority, replicating what takes place at home in China. In 2006, a major Chinese policy bank provided an additional US\$1.5 billion loan, the same institution that gave CTC the \$10 billion buyer's credit previously.

It is clear that this state support alters the conditions of competition in world markets.

3. Oil country tubular goods. [This section, on OCTG, is an edited version the work of Tom Howell and Bill Noellert of Dewey & LeBoeuf.]

The socialist system is better than the capitalist system in terms of fundamental political and economic systems, as public ownership is superior to private ownership ... In 1999 China’s steel output was 786 times that in the early years of the PRC ... What did we rely on? We relied on the Party’s leadership and the socialist system.

OCTG include drill pipe used in exploration; tubing (the tubes through which oil and gas pass to the surface); and casing, the circular pipe which encloses and protects tubing and forms a structural retainer for the walls of an oil or gas well. OCTG are required to provide access to oil and gas deposits located in earth, rock and ocean environments. OCTG are of central importance to some degree of energy independence of China, the United States and Canada. As depletion rates have increased in Canada and the United States the amount of gas and oil found per foot drilled has declined. Most of the remaining oil and gas deposits in the United States and Canada now lie deep below the surface of the earth or ocean and can be accessed only through intensive use of OCTG, which are designed to perform in extreme environments. To offset high depletion rates, drill rig operators are drilling more wells and using more intensive drilling techniques. As a result a large portion of the total world market for OCTG is attributable to drilling activity in the United States and Canada.

Chinese government policies and measures created a large and expanding industry to produce OCTG. The government of China has placed a high priority on expanding the indigenous OCTG industry to eliminate imported products in its domestic market and to establish a major presence in export markets. China has already installed more production capacity for OCTG than it needs to meet its domestic needs, and additional projects to add capacity are under way.

Due to the state-backed expansion of OCTG capacity in China, Chinese production of OCTG has grown from under 1 million tons in 1999 to 5.5 million tons in 2006 -- the year-over-year growth rate in Chinese output between 2005 and 2006 was 53.8 percent. China already produces more OCTG than it consumes and will add an estimated 3.2 million metric tons of new OCTG capacity between 2007 and 2009 -- enough to supply 90 percent of the U.S. OCTG market at the 2006 apparent consumption level of 3.56 million metric tons. The result of Chinese production rapidly outpacing consumption has been a large increase in Chinese net exports of OCTG. As recently as 2002 China was a net importer of over 230,000 metric tons of OCTG. By 2006 Chinese net exports were 849,000 metric tons, a change in net exports of OCTG of over 1 million metric tons in just four years. .

China has rapidly emerged as the principal exporter of OCTG to the United States, accounting for 54.7% of U.S. imports in 2008. China's share of the U.S. OCTG market tripled in two years, from 6.3 percent in 2004 to 19.3 percent in 2006, and Chinese export volume continued to increase throughout 2006 so that its share of the U.S. market in December 2006 stood at 30 percent. As existing known reserves of oil and natural gas in the United States are depleted, the energy sector must drill deeper and operate in more extreme environments to develop new sources of oil and gas. As a result, energy extraction efforts in the United States will become even more OCTG-intensive than they are today. If present trends continue, the prospect exists that the United States could become dependent on China to supply the basic equipment upon which its aspirations for energy independence are based.

The growth of China's steel industry, including the OCTG sub-sector, is entirely a reflection of decisions by central and regional government planners. Government organizations have defined objectives for establishment and expansion of specific steel enterprises pursuant to short, medium and long term plans for the economy. The enterprises tasked with carrying out these plans are themselves overwhelmingly state-owned entities. Government officials have marshaled the financial, technological and infrastructural resources to ensure that the plans have been carried out. Foreign steel producers have frequently provided technical and financial support, enabling China to create world class steel.

Financial support has been channeled to the steel industry primarily through the banking system, which is owned and controlled by the government of China. The government sets interest rates at levels that are lower than would exist in a market economy, giving rise to an excess demand for credit. Government officials direct the banks to channel their loans to enterprises and projects that are given priority in government plans. Because steelmaking projects have enjoyed such priority, financing has seldom proven an obstacle to industry expansion.

Many of China's steel mills would have faced difficulties surviving without repeated bailouts and infusions of government financial support. Billions of dollars of steel enterprises' debts have been written off to equity, taxes have been forgiven and new loans extended. Numerous so-called "debt-to-equity swaps" converted steel mill debts held by government banks into "equity" held by government asset management organizations. Because in most cases the government had an ownership interest of 100 percent in the mills prior to the swaps, its ownership interest did not increase in these firms.

The OCTG industry has benefited from all of the financial support measures applicable to the steel industry generally. With one exception, all of the major OCTG producers are state-owned enterprises. Outside of

Tianjin Pipe Group Corporation, a stand-alone pipe and tube producer specifically created by the government to end China's import dependency in pipe and tube products, all of China's principal OCTG producers are subsidiaries within steel industrial groups that have figured prominently in the five year plans of the central government and the five year plans of the governments of the regions in which they are located.

The Chinese steel industry reportedly has been shielded from many of the competitive pressures that normally confront privately-owned enterprises operating in a market economy and relying on market-based commercial financing. Prices have reportedly been stabilized through agreements among enterprises establishing output quotas and minimum prices. Compliance with such arrangements has reportedly been enforced by the government, which threatened to cut off bank loans to enterprises that do not adhere to price and output controls. In recent years China's OCTG producers have reportedly met periodically to stabilize market prices and "avoid vicious competition."

The steel industry has also been protected from external competition. The government of China has maintained the goal of replacing imported steel with domestic production since the mid-1980s and a succession of tax rebate measures has been implemented to create incentives for domestic users to favor domestic steel. Imports have been restricted through non-transparent administration of an import licensing system, the existence of which has been denied by the Chinese government. Imports have also reportedly been limited through government-to-government and industry-to-industry agreements establishing quantitative limits on Chinese steel imports. In the OCTG subsector, the government's efforts to replace imports with domestic production have been highly successful, with imports as a percent of domestic consumption plummeting from 82 percent in 1994 to 8 percent in 2006.

Protection of enterprises from competition almost inevitably leads to excess capacity, particularly when coupled with subsidized, low-risk financing. China's principal steel enterprises do not confront investment risks that face private firms operating in normally functioning markets. Rather, they have found that when they fall into a loss position and/or confront depressed prices, the state is likely to intervene to bail them out and to help them raise prices.

China's restraints on internal competition increase the risk of dumping in export markets. Given the sheer size of China's steel industry, the impact on international markets could be significant. China's steel exports have already begun to affect external markets, and China has in recent years agreed to limit its steel export volume to a number of major world markets, including the European Union and Korea. Chinese steel producers have also reportedly been asked by their Japanese counterparts to restrict export volume to Japan and have given assurances that Chinese steel "will not massively flow" into Japan. These measures could have a funneling effect on Chinese exports toward markets where such restrictions do not exist, such as the United States and Canada.

While dramatic expansion of China's OCTG capacity raises obvious concerns with competing foreign OCTG producers, it should also be raising concerns with Chinese policymakers. Expansion on this scale, driven by government policy decisions, is not in China's long run interest for several basic reasons:

- Government-directed investment leads to major resource misallocation and acts as a drag on economic growth.
- The creation of large-scale overcapacity results in the establishment of trade barriers abroad.
- Domestic adjustment to overcapacity is a painful and potentially destabilizing process.
- Excessive investments in heavy industrial sectors exacerbate environmental problems.

Excessive investments in heavy industries, which tend to produce a higher proportion of local pollutants and greenhouse gasses than other sectors, place an unnecessary burden on the environment in the regions where the investments take place. This can ultimately spill over into domestic and international criticism

The competitive equation: The effect of China's policies

- a. Policies to which objection is less likely to be taken.

Some government policies are unobjectionable – such as the promotion of STEM education. Others will raise questions about their consistency with China's international obligations. The impact of China's promotional policies will differ dramatically by sector, and each major industry sector deserves individual consideration. There are some bottom line judgments that can be made, however.

As one of China's goals is to enhance the international competitive position of many of its pillar industries by attracting both foreign investment and technology, it is useful to consider whether China is being successful in this regard through its use of financial incentives. Here the picture is mixed. While many foreign companies have research facilities in China, presumably many R&D facilities are end-product design centers which are placed in China to be close to the companies' manufacturing plants. These facilities are unlikely to generate core technologies.

It is difficult to track transfer of technology. Some transfers are no doubt negotiated as part of individual investment deals. Some is just follow the movement of engineers from jobs in foreign companies to jobs with indigenous Chinese companies. What one can track, through surveys, is the location of R&D expenditures by an industry. In a study recently completed by our International Trade Group for the Semiconductor Industry Association, we found through our survey of major U.S. semiconductor producers that the growth in U.S. company R&D outlays was almost negligible in China over the last several years. The primary growth in these expenditures was in Europe (thought to be primarily Central Europe) and in "rest of world", which in this case did not include China.

Even though the financial incentives were higher in China as a percent of R&D spending, the survey found that "the perceived inadequacy of intellectual property protection in China has limited U.S. industry R&D spending in that country significantly." Direct cash benefits did not overcome other locational factors.

Most companies surveyed indicated that they would not locate their most advanced and critical R&D activities in China, despite encouragement and even pressure by the government to do so, and regardless of the availability quality and size of incentives, due to concerns about the inadequacy of intellectual property protection in that country. While intellectual property protection issues occasionally arise in other jurisdictions, industry respondents indicated that in general sufficient safeguards could be devised to permit certain R&D activities to take place. No jurisdiction other than China was identified as particularly problematic from this perspective.

While most of the incentives in China consist of direct financial support, the tax treatment for R&D is favorable. The Dewey Semiconductor R&D study notes that:

Under China's law of taxation in effect in 2007, qualifying semiconductor manufacturers were entitled to receive a 5-year tax holiday with respect to corporate income tax beginning in the first year the business was profitable, and another 5 years of taxation at half the applicable rate pursuant to Several Policies to Encourage the Development of the Software and Integrated Circuit Industry (Circular 18, June 24, 2000). Although a new Enterprise Income Tax Law came into effect in 2008, that law provides a five-year transition period for businesses receiving

preferential treatment under the old regime. In addition, the new law provides that firms qualifying as high-technology companies are entitled to a permanent reduced rate of 15 percent. In addition, qualifying semiconductor manufacturers are entitled to a full exemption from income tax for five years from the first year of positive accumulated earnings and a 50 percent reduction for the following five years under the new law. This combination of tax abatements has led Semiconductor Manufacturing International Corporation [not a U.S. company] which has been operating in China as its principal locus of operations since 2000 to disclose in 2007, "Our income tax obligations to date have been minimal."

This favorable treatment for investors is on top of a general corporate tax rate that is, as noted previously, lower than that in the United States, and a rate that has been decreasing over time. Nevertheless, there is no significant allocation of the total U.S. semiconductor R&D being redirected to China.

There are a number of factors affecting the attractiveness of China as a destination for foreign direct investment. In overall ranking of countries in terms of global-based innovation competitiveness, the Atkinson Study (Information Technology & Innovation Foundation, February 2009) using a wide variety of measures – including higher education, number of researchers, amount spent of corporate and government R&D venture capital, broadband deployment, business climate, FDI, GDP/adult, etc.— places the United States 6th and China 33rd. But before complacency sets in among Americans, the Atkinson Study also notes that China, of the 40 countries (including the EU) reviewed, moved its score up most over the last decade and that the United States least.

Of the various general measures of where investment should be located, among the most telling, the U.S. ranks 5th in business climate and China ranks 36th. This comports with our firm's study regarding location of American semiconductor R&D expenditures. Availability of talent is a factor: Atkinson looks at the percent of the workforce (adults age 25-34) with graduate degrees – 39% for the U.S., 9% in the case of China. This would be more compelling as an explanation were it not for the fact that China's population is 3.4 times that of the United States. So in fact the absolute numbers in the adult workforce with advanced degrees in the two countries could be about the same. In terms of availability of qualified workforce, the constraint in China may not necessarily be supply, although on this, the data is mixed. Atkinson notes that in 2006 the United States had 9.7 researchers per 1,000 employed, while China had only 1.5. (But the percent change for China for the period 1999-2006 was 111% while the gain for the United States was only 8%.)

With respect to semiconductors, as process R&D tends to be associated with place of production (this may well be true for other R&D-intensive industries as well), it is important to note that, overall, the share of worldwide wafer fabrication capacity in the United States has declined from 42 percent in 1980 to 16 percent in 2007, reflecting the growth of indigenous semiconductor industries in several Asian countries. China has increased its share of global production to about 8%, and the trend is clearly upward. Location of fabrication facilities is closely linked to available financial incentives. .

The Dewey & LeBoeuf study looked solely at U.S. semiconductor company placement of R&D, and while this may be a good proxy for foreign investment in China of R&D funds, it is not an indicator of Chinese company and government investment in R&D generally. According to the Atkinson Study, in terms of corporate investments in R&D as a percent of GDP, the U.S. outranked China -- 1.7% to 1.0%, but it should be noted that China had increased its corporate R&D by 160% during this period while the U.S. figure had dropped by 5%. Looking at government R&D as a percent of GDP (in 2006), Atkinson found the U.S. ranked 4th at 0.76% with China in 19th place at 0.35% of GDP expended on R&D. But China had increased its expenditure ratio for R&D by 20% in the seven years covered by the study, while the U.S. increased its investment in R&D by only 1%. The bottom line is that China is improving its

position relative to the United States by many measures, although the United States has a substantial lead at present.

The likely policy response to the above-outlined Chinese policies is to match them or exceed them, not to complain of them.

b. Policies of Concern.

Break the technological monopoly of developed countries Assist domestic enterprises in obtaining information on international technology market. . . . [S]upport and encourage them to apply for domestic and overseas patents for re-innovated technologies; (Issued by several ministries, Shang Fu Mao Fa [2006] No.13),

There is a fair amount of transparency in China, dramatically better than it was ten years ago. This allows one to get a sense of a number of policies that should be of concern not only to foreign competitors seeking to sell in China, invest in China or who will be or are competing with Chinese goods in third country markets. Some policy directions may well be harmful to Chinese development and China's goal of greatly increased "indigenous innovation" as well.

Among the policy tools that should be of greatest concern are:

- The creation of exclusionary standards that can wall off the Chinese market, creating national champions that are not internationally competitive, potentially diminishing China's rate of GDP growth if Betamax-style standards impair the degree to which IT, for example can contribute to the rate of GDP growth. To be enhance economic development, standards must be market-driven not market constraining.
- An intellectual property system that frightens off multinational companies from developing the latest technologies in labs based in China while risking ending up fostering what is many cases may be second-tier indigenous technological development.
- Potential use of the new antimonopoly law to protect domestic competitors rather than to enhance competition.
- Subsidies that excessively distort trade and investment. An example was the discriminatory VAT rebate for domestic manufacture of semiconductors which practice China terminated to be consistent with its WTO obligations.
- The temptation to force technology transfer which causes companies to shy away from placing the latest technologies in China. WAPI was one example.
- Buy-Chinese policies to attempt to foster "indigenous innovation", placing a bet that a more SOE-like form of industrial organization might work.

The bottom line

China policy makers have to a surprising degree opened its economy to foreign investment and market forces and this has led to an extraordinary level of economic growth. The central question going forward is whether China will opt for more state-planning in guiding investment and technology and whether this can be successful. The United States is sometimes aware that in its own history, when it had a national goal, the manned-space flight program or the Manhattan project, for example, it could force the

pace of technological development and that this has had major commercial effects as well. But the U.S. let the market direct the commercial outcomes. Early semiconductor development is attributed to government support, but it is the commercial market that is driving technology today and has done so for decades. China must find an appropriate balance. Walling itself off would prove not only contentious with its trading partners, on whose markets China must depend for prosperity and growth, but harm its continued development.

Much needs to be corrected about U.S. domestic policies in education and support for basic R&D. There will be areas where the United States should be watching what China is doing, and perhaps re-innovate (incrementally improve upon) what China has re-innovated of America's – and here I am thinking of research parks and emphasis on STEM education. There are other initiatives some of which are outlined above that bear watching for other reasons because United States commercial interests may be seriously adversely affected, as may Chinese economic development and growth.

The impact on the rest of the world of China's enormous effort to move forward on so many fronts will be hard to gauge until the policies have been in place for some time. As Mao was said to have replied when he was asked what he thought the impact of the French Revolution was, "It is too early to tell." It is not too early to tell what the impact is currently and is likely to be with respect to Chinese world market share of oil country tubular goods, for example. It may not be too speculative as to what the effects are going to be of Chinese automobile production, just as an extrapolation of U.S. experience with Japan and Korea (even accounting for numerous differences among those countries). What will happen with international competition in biotech, new energy products, software, other information technology products, large commercial aircraft and other areas of Chinese national priority? Much depends on the policies chosen by China and the responses chosen by the United States. Too little attention is being given by the U.S. government to these developments.

I have found on more than one occasion that there is more pluralism among Chinese ministries and other parts of the Chinese policymaking process than one would expect. A debate is possible in Beijing and in the provinces and municipalities between those seeking an autarkic path of development and those who still see an advantage in being a magnet for leading edge foreign investment and for more market-oriented solutions. It would be a profound error to be absent from that debate.

HEARING COCHAIR SLANE: Thank you, Mr. Wolff.
Dr. Haley.

**STATEMENT OF GEORGE T. HALEY, PhD
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DR. HALEY: I'd like to thank the commissioners, the Commission, its cochairs, Messrs. Patrick Mulloy and Daniel Slane, and the Commission staff for the opportunity to present this testimony today.

The questions before the Commission are important to the future economic well-being of the United States. In this statement, I'll

address what the Chinese pillar industries include, discuss the impact of policy, and analyze their competitive effects and ramifications for U.S. competitiveness.

Pillar industries are chosen on the basis of four criteria: they're whether an industry contributes to defense, to job creation, to technology acquisition, or to competitive advantage.

The following 16 industries constitute pillar industries for China as promulgated in China's Tenth and 11th Five-Year Plans:

Aerospace; autos and auto parts; banking and insurance; biotechnology; computer chip design and manufacture; computing and computer hardware; information technology; iron and steel; logistics, shipping and storage; machinery and mechanical equipment; oil and petrochemicals; software; telecommunications and telecom equipment; utilities and power equipment; wholesaling and retailing; and the building of strategic brand equity.

The central government offers special incentives for foreign companies to enter China in some of the pillar industries. For instance, autos and auto parts, telecom equipment, biotechnology, computer chip design and manufacture.

In many industries, provincial and local municipal governments also offer incentives. The government of Shenzhen, for instance, is offering ten billion yuan in subsidies to information technology industry.

In some instances, such as steel, the logistics, shipping and storage industry, and more recently in the acquisition of leading brands, foreign companies experience barriers and regulatory obstacles to entry.

China's support of its pillar industries has had dramatic effects on U.S. industries and the U.S. economy. Steel industry is an industry which China began investing in earlier than most. Hence, Table 2 from my written statement which focuses on the steel industry provides a lens to understand the effects that China's policies and its pillar industries are now having and will have in the future.

From 2003 to 2007, periods of economic growth in both U.S. and China, U.S. steel production grew from 93.7 million metric tons to 97.2. China's steel production, on the other hand, more than doubled from 222.3 million metric tons to 489 million.

In 2008, China's production grew additionally to 502 million metric tons, this even though China's economic growth rate shrank substantially.

Additionally, Chinese steel exports to the United States have increased dramatically. In 2008, Chinese steel exports to the U.S. were 20 times what they were in 2003.

Conversely, U.S. steel industry employment fell from 108,200 employees to 97,540 in 2007, or by 10,660 employees, which is 9.9 percent of the workforce.

With the steel industry's multiplier of 3.3, that means that 35,178 U.S. workers lost their jobs.

Labor costs cannot explain this trend. While Chinese hourly labor costs are 1/20th of the United States in the steel industry, U.S. steelworkers are 12 times more productive.

Transport costs to the U.S. more than make up for the differential. Where labor costs are a major factor, U.S. companies will not be able to compete. Where they are minor factors such as in the steel industry, they will suffer the same fate as the steel industry.

China's policies will limit the growth of U.S. industries, limit the growth and creation of U.S. jobs, and limit U.S. industries to higher value-added products and to those where perceived quality is a deciding factor in the purchase decision.

Chinese banks are used by the government in various ways. They provide low cost loans to both businesses and consumers. For example, low cost consumer loans are now being offered for the purchase of automobiles with 1.6 liter engines and smaller.

They're being offered to farmers for the purchase of vehicles with engines smaller than 1.3 liters.

They supplement the government spending. The government is only funding 25 percent of its economic stimulus plan, for instance. Banks and local governments are funding the balance. Banks were also ordered to make five trillion yuan or \$732 billion in new loans to support the economic recovery plan.

Other ways that Chinese companies benefit are through tax rebates, facilitation of government export documentation, government subsidies of normal business expenses like research, quality control, product and technology development, subsidized energy costs, government-engineered industry consolidation, share price stabilization, and subsidization of grand equity building efforts.

Chinese policies will affect global markets. Global markets will have an overall reduction in price, but tremendous price instability will occur due to government policies and changes in them.

Subsidized construction of excess capacity will cause severe price competition and force consolidation and closures within non-Chinese industries, provoking job losses inherent in such actions, and periodic skyrocketing of costs for raw materials, commodities, and inputs to industries, as has happened in recent years with iron ore, coal, oil and grains.

Only two days ago, the Financial Times reported that stockpiling

of copper by China State Reserves Bureau has driven up copper prices by 35 percent in the last three months.

The U.S. will be competitive in some industries, but only if several changes are made to U.S. industry and policy. There will have to be substantial consolidation in U.S. industries. It must occur to gain economies of scale to match Chinese scale and help offset Chinese subsidies and policies.

Substantial investment must occur in product and process innovation. Vertical integration up the supply chain must occur to control costs and increase reliability of supply. The market must perceive quality advantages in the U.S. products.

Changes take place in traditional U.S. government policies such as antitrust and the acceptability of collaboration between competitors in the same industry. And the market perceives a brand equity advantage in the U.S. product.

In summary, given the extent of Chinese subsidies and support for its pillar industries and leading brands, U.S. industry will face substantial difficulty competing in low labor input industries and be unable to compete in high labor input industries. US jobs will be lost.

U.S. industries and consumers will be faced with generally lower prices, but periodic bouts of severe price instability, especially in raw material and commodity costs.

Finally, as more Chinese brands become classified as leading brands, U.S. companies will be prevented from entering increasingly large portions of the Chinese economy.

[The statement follows:]

**Prepared Statement of George T. Haley, PhD
Professor & Director, Center for International Industry
Competitiveness, College Of Business, University of New Haven,
New Haven, Connecticut**

I thank the Commission, its Co-Chairs, Messrs. Patrick Mulloy and Daniel Slane, and the Commission's staff for the opportunity to present this testimony today.

The questions before the Commission today are important to the future economic wellbeing of the United States. In this statement, I will address what the Chinese pillar industries include, discuss the impact of policy, and analyze their competitive effects and ramifications for U.S. competitiveness

The Pillar Industries:

What pillar or strategic industries has China currently chosen to support? What criteria did China use to choose these Industries? Does the government of China offer special incentives to attract foreign investment to build such industries?

China chooses pillar or strategic industries on the following criteria:

- Defense
- Job creation
- Technology acquisition
- Competitive advantage

Several industries fall under more than one criterion. Table 1 lists the pillar industries under their different criteria, and in some instances, under more than one criterion. The following industries constitute pillar or strategic industries for China as promulgated in China's 10th and 11th five year plans:

- ♦ Aerospace
- ♦ Autos & auto parts
- ♦ Banking & insurance
- ♦ Bio-technology
- ♦ Computer chip design & manufacture
- ♦ Computing & computer hardware
- ♦ Information technology
- ♦ Iron & steel
- ♦ Logistics, shipping and storage
- ♦ Machinery and mechanical equipment
- ♦ Oil & petrochemicals
- ♦ Software
- ♦ Telecommunications & telecom equipment
- ♦ Utilities & power equipment
- ♦ Wholesaling & retailing
- ♦ Strategic brand equity

In addition to standard subsidies such as direct cash transfers to no-cost loans, etc., the central government has started offering subsidies in support of brand equity or support to specific brands of products. The central government does offer special incentives for foreign companies to enter China in some of the pillar industries, for instance autos & auto parts, telecom equipment, bio-technology, information technology and computer chip design & manufacture. In many instances, provincial and local municipal governments offer incentives. In some instances, such as with the steel industry and the logistics, shipping and storage industries, and more recently in the acquisition of leading brands, foreign companies experience barriers and regulatory obstacles to entry.

Policy Impact:

What impact has China's support of its pillar industries had on U.S. industries and the U.S. economy? How are state-owned banks used to support China's industrial policy? How do state-owned enterprises benefit from Chinese industrial policies?

The impact of Chinese governmental support has been varied and in some instances, quite dramatic. Table 2, which focuses on the steel industry, provides a lens for understanding these impacts. From 2003 to 2007, a period of economic growth in the U.S., especially in the construction industry, U.S. domestic steel production increased from 93.7 million metric tons to 97.2 million. When the recession hit in December 2007, 2008 U.S. production dropped to 91.5 million. The period from 2003 through 2007 also constituted a period of economic growth in China, and once again, especially in the construction industry. However growth in Chinese capacity and production of steel far outstripped growth in demand. Chinese steel production between 2003 and 2007 more than doubled from 222.3 million metric tons to 489 million, with double digit growth in each year. With the onslaught of the worldwide recession, growth moderated

substantially downward to 2.6 percent, but Chinese steel production rose to 502 million metric tons, regardless of the fact that the Chinese construction industry's growth has slumped to 7.1 percent, little more than half its growth rate of 2006, and not nearly enough to offset the growth in steel making capacity.

Table 2 also presents the extraordinary growth in Chinese steel exports to the U.S. Chinese steel exports to the U.S. in 2008 were twenty times its exports to the U.S. in 2003. Differences in relative labor costs between the two countries cannot explain this growth in exports. Though Chinese labor costs per hour in the steel industry are roughly one twentieth that of U.S. labor, labor represents only about ten percent of the total costs for steel. [Haley, U.C.V. (2008) *Shedding light on energy subsidies in China: An analysis of China's steel industry from 2000-2007*, Alliance for American Manufacturing.] Additionally, U.S. labor productivity in the steel industry is 12.1 times the labor productivity in the Chinese steel industry. Finally, Table 2 demonstrates that from 2003 to 2007, the U.S. steel industry lost 10,660 employees, or 9.9 percent of its workforce. Given the steel industry's job multiplier of 3.3, this represents a total loss to the economy of 35,178 jobs.

Chinese banks advance governmental policy in a number of ways. Presently, China's banks reinforce the government's effort to reignite the economy in two ways. First, Chinese banks have the government-mandated goal of providing a minimum of 5,000 billion Yuan (US\$731.6 billion) in new loans. Second, the government looks to the banks for a significant amount of the funding for its 4 trillion Yuan (US\$585 billion) stimulus package. The Beijing government will fund only one quarter of the stimulus package, and local governments and banks will fund the balance. Additionally, when it wants to stimulate a specific industry, such as autos, the government instructs the banks to offer extremely low-cost loans. In the late 1990's and early part of this decade, China stimulated the growth in the auto industry, and thus the growth of foreign direct investment from Western and Japanese auto companies, in this fashion. When the government later decided to raise interest rates, Western companies could not meet sales or profitability projections. Today, China has decided on a policy of stimulating sales of vehicles with small engines, less than 1.6 litres, and is offering low-interest loans, the elimination of a five-percent vehicle-buying tax, and for farmers buying trucks or cars with engines of 1.3 litres or less, additional subsidies of 5 billion Yuan (\$730 million) payable in lump-sum amounts, have been allocated. These subsidies and tax rebates are over and above the subsidies and other support measures the government is giving its auto companies during the present economic crisis.

The Chinese government has often subsidized state-owned enterprises without having the subsidies tracked to operating companies' books. Common practices include transferring the state-owned enterprise's best assets to an operating company subsidiary which then lists on a Chinese stock exchange. When the government decides that a company requires a subsidy, it makes a direct cash transfer, or a low-cost bank loan to the unlisted parent company, which then transfers the funds to its listed subsidiary. In this way, the subsidy never appears on the listed company's books.

State-owned enterprises benefit in many other ways. The State Council has allocated 10 billion Yuan (\$1.5 billion) in special funds to the auto industry over the next three years to support technology innovation, and the development of new-energy and electric vehicles and their parts. In addition, while not indicating the amount of funding, the State Council also announced that it would speed up the building of bases for the export of autos, support the building of brand equity and recognition of Chinese auto companies, and mandate a general enhancement of credit arrangements for the purchase of autos (January 14, 2009).

Examples of other benefits include the stabilization of share prices by the State-owned Assets Supervision and Administration Commission (SASAC); industry consolidation plans developed, mandated and supervised by SASAC (logistics, storage and shipping industry); funding of capital asset projects (utilities

and power industry); funding of technology development and quality enhancement projects (auto, aerospace, bio-technology, steel and telecommunications industries, among others); and funding, regulatory support and cultural pressure (by naming them “time honored brands”) in support of brand building for specified Chinese products both overseas and domestically (autos - Chery, appliances - Haier, computers - Lenovo, liquor - Maotai, candy – White Rabbit Milk Candy, and a host of other products).

American companies will still be able to compete in many industries globally; however, their market shares, costs, profitability and employment levels will be affected. Questions will arise on the long-term viability of some second-tier companies. The U.S. is not a low-cost producer. To be competitive, U.S. companies must contend on the basis of quality and brand equity. Hence, the Chinese government’s efforts to subsidize technology acquisition, quality control and brand equity constitute direct attacks on the U.S. companies’ market positions and competitive advantages. This, in concert with the Chinese government’s naming the wholesaling and retailing industries together with the logistics, storage and shipping industry as pillar industries, and moving to consolidate them into more efficient cross-nodal logistics and transportation giants, raises grave concerns. Competitive advantages of distribution and channel management often pose the most formidable challenges for companies to overcome. The Chinese government’s industrial policies have focused on the backbone of the value chain and distribution channel. Efficiency in the value chain and distribution channels will give Chinese companies significant advantages in China’s export markets that it does not presently have, and may deny U.S. companies equal access to Chinese markets. This same issue created a difficult competitive environment for many U.S. companies in Japan.

Competitive Effects:

How are China’s industrial policies likely to affect global markets and American competitiveness? What developments can we expect to see over the next five years?

China’s policies will probably contribute to severe disruption in global markets. Though the Chinese policies tend to reduce consumer prices, they do so in anti-competitive fashions. The use of government subsidies to control costs in Chinese industry, and to promote the acquisition of competitive advantages in brands and technology, creates situations where foreign companies cannot compete and are forced into closure.

The global steel industry reflects the effects of Chinese industrial policies. Due to the tremendous overbuilding of capacity and significant government subsidies from both central and local authorities, China is dominating world trade and production in steel. Over twenty U.S. steel companies have closed down operations, creating over 50,000 lost jobs in the U.S. alone. Globally and in the U.S., the steel industry has entered a period of consolidation that has caused more job losses as companies shed employees that have become superfluous. Chinese policies have also lead to Chinese auto-production capacity burgeoning to more than twice Chinese demand. To make profits, Chinese and foreign producers alike in China have to export and to fight for global market share. U.S. producers have slashed prices, cut U.S. based capacity and shifted production and employment overseas to remain price competitive.

Over the next five years, the story should repeat globally in the other targeted industries. The government is encouraging Chinese companies to increase capacity and skills in desired product-markets of all the pillar industries. Chinese building of chip fabs has contributed to a growing overcapacity in chip production, accentuated by the present world-wide recession, which has hit the computer industry and its suppliers particularly hard. The central and local governments’ incentives to draw investment and to build local competitors in the pillar industries, generally also build significant excess capacity. The excess capacity in turn forces both Chinese and global markets into severe price competition, creates razor-thin margins, and shifts competitive advantage to China and other countries willing to subsidize significantly

their industries. The government is investing heavily in building brand equity for Chinese brands. However, I do not believe these efforts will have significant effects within five years, given the government's inability to enforce quality and safety standards on many Chinese manufacturers. I do believe that in the longer term, the Chinese government's brand-building efforts will pose a significant threat to American interests in particular, due to the position of our products in world markets. Though not true in all product markets, generally, customers see American brands as more mass-market than European and Japanese brands. This market position makes U.S. products more vulnerable to Chinese brand building than their European and Japanese counterparts.

U.S. Competitiveness:

Will U.S. companies be able to compete with Chinese state-owned companies that are able to tap government resources – including tax abatements, discounted land purchases, low-rate financing, and other subsidies? What role does forced technology transfer from U.S. to Chinese companies play in China's industrial policy?

U.S. companies can compete in some industries and market segments. However, the companies will have to initiate significant changes in industry structure, in their corporate strategy (focusing on innovation, especially process innovation), possibly in U.S. government policy, and their margins for error will be razor thin. The steel industry, an industry that the government of the People's Republic of China (PRC) took an early interest in developing, provides a good template for the future.

The Chinese government has invested heavily in developing its steel industry since the 1990's. As has been demonstrated in several studies by both independent researchers and the International Trade Commission (ITC), China's steel industry has been the recipient of significant subsidies and other government support. Hence the steel industry provides a good starting point for investigating what companies from the U.S. and other industrialized countries must do if they are to survive, if not prosper, in the face of a Chinese onslaught.

Industry structure: The steel industry provides examples of the structural changes in response to global, mostly Chinese, competition over the past ten to fifteen years. First, tremendous consolidation has occurred in both the U.S. and global steel industry. Globally, steel giants of previously unimaginable size, such as Arcelor-Mittal, have arisen. In the U.S., three giants dominate the steel industry - US Steel, Nucor, and Arcelor-Mittal's U.S. subsidiary. However, the U.S. giants are medium-sized by global standards, each less than 1/5th the size of Arcelor-Mittal, and less than 2/3^d the size of each of the next three largest steel companies. US Steel is smaller than four different Chinese steel companies, Nucor smaller than five. Table 3 lists the 15 largest steel companies with their production capacity. To compete globally, further consolidation is desirable among U.S. steel companies.

Second, both product and process innovation have surged. Companies have developed super-light, super-strong steels and introduced these products into new vehicles. Super-light, super-strong steel allows the auto industry to replace more costly aluminum in autos, producing a lower-cost, structurally stronger vehicle with the same enhanced fuel efficiency achieved with aluminum. In the U.S., a joint research program between the American Iron and Steel Institute, the U.S. Army and Ford Motors developed the super-strong, super-light steel. However, Australia achieved much the same through a pre-competitive cooperative agreement, where companies in the same industries collaborate on research to develop technologies that are more costly or riskier than a single company can reasonably afford. Thus, the industry can focus on research crucial to its survival, but not necessarily of immediate interest to elements of national defense. Recognizing the success and potential threat of such strategies, China's State Council has declared that it will allocate special funds in its capital budget to promote the steel industry's technological progress, adjust its product mix, and raise the quality of Chinese steel (January 14, 2009).

Third, the steel industry around the world has attempted to gain direct control over supply of raw materials to control costs. Lakshmi Mittal has pointed to acquisition of raw materials as a primary goal of Arcelor-Mittal, as have Tata-Corus and the Chinese companies and government. Raw material costs have fluctuated wildly for much of the past decade, with demand and prices increasing significantly due to China's, and more recently, also to India's economic growth. By controlling sources of their own raw materials such as iron ore and coal, steel companies can reduce their costs and risk of doing business. Mexico's HYLSA (now owned by Techint of Argentina), which controls its own mines, and which for the last 15 years of its independence, had been the most profitable steel company in North America, provides a good example of the benefits of vertical integration.

Logistics, storage and shipping: These services form the backbone of value chains and distribution. Recognizing their importance to competitive advantage, SASAC has declared its determination to consolidate its logistics industry to make it much more efficient. It manifested this determination when in July of 2008 it consolidated over twenty logistics and trading companies under the umbrella of one of its asset-management corporations, the China Chengtong Group. SASAC places enormous importance on gaining efficiency and competitive advantage in logistical systems. Indeed, China Chengtong is one of the first two asset management corporations that SASAC created; the other is the State Development Investment Corporation (SDIC). The SDIC manages SASAC's holdings in power, coal and fertilizers. Prior to this merger of logistics and trading companies, SASAC had arranged the merger of three shipping companies (in April, 2008). With these mergers, among others, the number of companies that the national (Beijing) SASAC oversees drops to 130.

Innovation and technology: U.S. companies will have to engage in constant product and process innovations just to survive, as they will not be able to compete on price. As has been mentioned several times, the PRC is investing heavily in technological innovation and quality enhancement in virtually all of its pillar industries. With much of their R&D expenses paid for by the government, a major element in the cost of new products and technologies is being minimized for Chinese companies. The development and design of a new auto costs Western auto companies anywhere from 2 ½ to 7 billion dollars. When the Chinese government covers the Chinese companies' quality and technological enhancement costs, it subsidizes the costs involved in making an auto suitable for global markets.

Brand equity: The PRC government and SASAC have recognized the importance and the power of branding. A recognized, high quality brand name provides one of the greatest competitive advantages a company can develop. Beijing has established a China Branding Strategy Committee to coordinate the governmental efforts to boost recognition of Chinese brands. Sun Bo, the Director of the Quality Management Department of the General Administration of Quality Supervision, Inspection and Quarantine recognized the economic value of brands when he said, "Branding is a decisive factor in the world's economic development, and in some cases, an established world brand's overall value is even bigger than that of a middle-sized country." [Xie Chuanjiao, December 21, 2006, *China Daily*.] The government started its efforts to build a brand friendly business environment in China in 2001. Preliminary efforts dealt with educating business persons to recognize their competitors' copyrights, and went on to establish rankings of over 6000 branded Chinese products. The government has created a system whereby companies can apply for favored status for their brands. Beijing has declared some entirely domestic brands as "time-honored brands" making them cultural icons of the Chinese people. Favored brands that are also being exported, garner governmental support through export-tax rebates and facilitation of their export paperwork and documentation. In a recent policy statement (March 9, 2009), the Chinese government put on par the direct financial support for the export of favored, branded products with the support it gives to high-tech and agricultural products. Coca-Cola's recently (March 2009) failed attempt to acquire Huiyuan, a Hong Kong listed company that boasts a 42 percent share of the domestic market in

pure fruit juices, illustrates the importance of brand equity for China: China's Ministry of Commerce did not want Coca-Cola to acquire the brand rights of Huiyuan and expressed concerns about the loss of a leading brand.

Government policy: Historically, U.S. government policy has sought to limit its major companies' size and monopoly power, and to prevent cooperative arrangements between manufacturers in their strategic activities. To compete against huge Chinese companies supplemented by Chinese government subsidies and other supportive policies, U.S. companies will either have to acquire equal size, compete on brand equity, compete on significantly superior product quality or technology, or focus on small market segments. U.S. major companies will have to become at least as large as their Chinese competitors to attain equal economies of scale and to minimize price differentials. They would need to offset as much as possible the Chinese companies' additional advantages in subsidies and government support through superior management and productivity. Unless they develop truly significant cost reductions through innovations in production processes, they are unlikely to compete on price. U.S. industry will have to rely on superior quality and technology because of the Chinese industries' habitual tendencies to overbuild capacity and to drive down prices through over supply at the products' larger, mass-market segments. To do this, the government must establish policies to encourage R&D, especially production-process R&D, or face the prospect of continuing job losses in industry after industry.

Conclusions:

The margin for error for U.S. companies will become slimmer, and the potential for error will significantly increase. Thus risks of failure and job losses will become far greater. Research has shown that business competitiveness drawing exclusively on research and innovation becomes riskier as difficulties arise in developing the right products for markets. U.S. companies will also have difficulty competing in industries where the market cannot perceive, or does not value, differences in quality between U.S. and Chinese goods. Under those circumstances, U.S. companies cannot compete on any basis with China's heavily subsidized industries. Industries where the U.S. is presently highly competitive, pharmaceuticals, processed foods, electronics and agricultural goods, are industries where consumers have difficulty discerning quality. Consequently, Chinese industrial policies on pillar industries will probably affect these industries.

Direct subsidies to Chinese industries hinder U.S. companies' abilities to compete in mass markets where low price constitutes the primary strategy. These direct Chinese subsidies combine with indirect Chinese subsidies to utilities and other industrial suppliers, as has occurred with Chinese power companies. On February 23, 2009, for example, SASAC allocated 12.67 billion Yuan (\$1.9 billion) to five power companies. Its stated reasons included providing assistance to the power companies to support disaster reconstruction. However, opportunity costs come into play and if the government funds construction of new facilities in disaster-affected areas, capital for other building projects becomes more feasible. The government's funding policies reduce the power companies' costs across the board, and hence allow the power companies to pass on those reduced costs to all its customers. Another recent directive issued by SASAC on December 26, 2008, indicated that SASAC would require that power companies provide at least 50 percent of the capital for new projects. Previously, in a clear indication of just how heavily subsidized they were, state-owned power companies provided as little as 2 percent of the investment for new projects. The new state-owned capital management budget appropriated 54.78 billion Yuan (\$7.7 billion) for capital investment and management, of which 27 billion Yuan (\$3.8 billion) funds new projects and complements key state-owned enterprises' capital. Once again, because of chain cost reductions, these subsidies to supplier industries, such as the power industry, help not only the state-owned enterprises that directly receive the funds, but their customers as well, and harm the interests of U.S.-based producers and workers.

**Table 1
Pillar Industries by Chinese Governmental Criteria**

| | |
|---|------------------------------------|
| Defense & Security | Job Creation |
| Aerospace | Auto & Auto parts |
| Computer chip design & manufacture | Computer chip design & manufacture |
| Computing & computer hardware | Iron & steel |
| Iron & steel | Machinery & mechanical devices |
| Oil & petrochemicals | Information technology |
| Software | |
| Technology & Skill Acquisition | Competitive Advantage |
| Bio-technology | Logistics, shipping & storage |
| Computer chip design & manufacture | Banking & Insurance |
| Computing & computer hardware | Brand equity |
| Information technology | Machinery & mechanical equipment |
| Software | Wholesaling & retail |
| Telecommunications | Utilities & power equipment |

**Table 2
Steel Production in Millions of Tonnes***

| | US | Annual | China | Annual | World | Annual | US Steel Ind. | US |
|----------------|------|---------|-------|----------|---------|----------|---------------|---------|
| Imports | | Change | | Change | | Change | Employment | from |
| China** | | | | | | | | |
| 2008 | 91.5 | - 6.8 % | 502 | + 2.6 % | 1,329.7 | - 1.2 % | N/A | 7,449.5 |
| 2007 | 97.2 | - 1.4 % | 489 | + 15.7 % | 1,345.6 | + 7.6 % | 97,540 | 4,357.8 |
| 2006 | 98.5 | + 3.8 % | 418.8 | + 18.5 % | 1250.4 | + 10.0 % | 95,350 | 4,199.7 |
| 2005 | 93.9 | - 5.8 % | 349.4 | + 24.6 % | 1136.5 | + 6.3 % | 94,510 | 2,153.7 |
| 2004 | 99.7 | + 6.4 % | 280.4 | + 26.1 % | 1068.9 | +10.2 % | 96,620 | 1,866.6 |
| 2003 | 93.7 | + 2.2 % | 222.3 | + 22.4 % | 970.0 | + 7.3 % | 100,210 | 371.4 |
| 2002 | 91.6 | + 1.7 % | 182.2 | + 22.4 | 904.1 | + 7.6 % | 108,200 | 369.8 |
| 2001 | 90.1 | | 148.9 | | 839.9 | | | |

*Source: SteelontheNet; J. G. Trench (2004); China Daily on Line; World Steel Association; US Census Bureau

**in \$100,000's US

**Table 3
The Largest Steel Companies, 2008**

1. 116.4 Mton ArcelorMittal (Global)
2. 35.7 Mton Nippon Steel (Japan)
3. 34.0 Mton JFE (Japan)

4. 31.1 Mton POSCO (South Korea)
 5. 28.6 Mton Shanghai Baosteel Group Corporation (China)
 6. 26.6 Mton Tata Steel (India / Global)
 7. 23.6 Mton LiaoNing An-Ben Iron and Steel Group (China)
 8. 22.9 Mton Shagang Group (China)
 9. 22.8 Mton HeBei Tangshan Iron & Steel Group (China)
 10. 21.5 Mton United States Steel Corporation (United States)
 11. 20.2 Mton Wuhan Iron and Steel (China)
 12. 20.0 Mton Nucor Corporation (United States)
 13. 18.6 Mton Gerdau (Brazil)
 14. 17.9 Mton Gruppo Riva (Italy)
 15. 17.3 Mton Severstal (Russia)
- Source: World Steel Association

HEARING COCHAIR SLANE: Thank you, Dr. Haley.
Mr. Prestowitz.

**STATEMENT OF MR. CLYDE V. PRESTOWITZ
PRESIDENT, ECONOMIC STRATEGY INSTITUTE
WASHINGTON, DC**

MR. PRESTOWITZ: Thank you. Let me add my thanks also to the Commission for its invitation to testify, and let me also congratulate the Commission on the fine work that it has been doing.

Recently, I was in China at a banquet, and my seatmate at the table and I were discussing the aerospace industry, and he explained to me that in the future, China would not be buying airplanes from Boeing, and I asked why? And he said, well, because China will make them itself.

And that led to a discussion in which he made the comment that China is a big country with a lot of resources, and it can make everything. And I was struck by the comparison with earlier conversations I'd had in Japan years ago when the Japanese would say that they were a small country and with no natural resources and they had to export to live, and therefore, they had to make pretty much

everything, too.

I was thinking, well, in Asia, if you're small you've got to make everything, and if you're big, you got to make everything. This is by way of saying that what we're seeing in China is not new.

We've seen the adoption, beginning with Japan in the 1950s and then proceeding with the Asian Tigers, Korea, Taiwan, Singapore, and now we're at the last Tiger or maybe the Dragon with China.

All of them have adopted so-called "catch-up" export-led growth strategies which have common characteristics. They all focus on pillar industries. In Japan, they call them target industries. In Korea, they call them strategic industries, but they're pretty much always the same industries--steel, autos, machinery, electronics, aerospace, et cetera.

And it's no surprise that they're the same industries because those are the industries that typically are characterized by economies of scale, rapid growth in productivity, increasing technology intensity, and leading to higher productivity in national economies and higher standards of living, and it's worked. It worked in Japan, it's worked in the Tigers, and it's working now in China.

The elements of this involve undervalued currencies, various kinds of tax and investment incentives to guide investment into target industries, and an enormous focus on exports coupled with essentially compulsory domestic savings rates at levels around 50 percent. 50 percent saving levels have never been attained in the West except in wartime, and so you can look upon these as kind of strategic levels of saving.

They result almost inevitably in excess capacity in industry because investment in those industries is favored. Those industries build enormous capacity and the result typically is global excess capacity, which results in dumping, particularly into the most open markets, typically the U.S., but also the UK and other relatively open markets, and that, of course, leads to trade friction.

Both Alan and Dr. Haley have already, I think, detailed what happens in particular industries. We know that in the target industries of the past, U.S. companies have been pushed out. I chuckle frequently when I hear discussion of Japan's "lost decade." We talk as if Japan lost the--that its industrial policies didn't work, and that may or may not be true at some macro level.

But I note that the United States doesn't make much in the way of DRAMs anymore or machine tools, and a wide variety of consumer electronics, the U.S. industry is not present because it got pushed out as a result of the industrial policies of Japan and the Tigers, and now the Chinese industrial policies are having the same effect.

But I'd like to focus on two additional points and impacts of

industrial policy that I think haven't been adequately brought forward. One of them is the accumulation of chronic current account surpluses. The export-led growth strategy, the catch-up strategy, the neo-mercantilist growth strategy, inevitably results in the accumulation of large current account surpluses. We've seen this in Japan. We've seen it in the case of Taiwan, Singapore. We're seeing it now also in the case of China.

And those surpluses, of course, are balanced by large current account deficits in the U.S. and other relatively open markets, and that imbalance is not benign. That imbalance underlies the current economic crisis that we're suffering. In fact, it is the main cause of the current economic crisis that we're suffering.

And in order to get out of this crisis, it will not be possible for those imbalances to persist, which suggests that not only does there have to be an enormous adjustment in the U.S. economy, but it suggests that the continuation of the catch-up export-led growth strategy on a large scale by other large countries will prevent the extrication of the world from the current economic crisis.

The final point I'd like to make is that China's industrial policies have a somewhat different twist. In the case of Japan and Korea, for example, foreign investment, foreign direct investment, into those economies was really resisted. And even today, foreign companies have little investment in those economies.

China, on the other hand, has not only welcomed but has fostered and promoted foreign direct investment, and has done so as a way of effecting technical transfer. And in doing so has used various carrots in the form of tax incentives and capital grants and so forth to attract the investment, but also has been in a unique position, because of the large size and increasingly huge potential of its own market, to take the position vis-a-vis foreign companies that if they want to be in the Chinese market and enjoy its potential, they need to invest there; they need to transfer technology there.

And so, in a way, China has been able to capture significant investment and I would say significant mind share of the CEOs of global companies. In fact, in a perverse phenomenon, it seems that in a democratic society like the United States, the head of a major global company is a very important political player. The head of a major global company here in Washington has influence here in Washington and we can say is influential in not only economic but in the Washington political scene.

In Beijing, however, the same CEO tends to be deferential because of the fact he's not a player; he or she is not a player politically. They're a supplicant. And so, in a funny way, this

industrial policy also has broader political implications, and it goes in the direction actually of global companies becoming more responsive to the wishes and the policies of the authoritarian regimes than to those of the democratic regimes.

And I think those are two important impacts of the dichotomy between American neoclassical economics and Asian catch-up export-led economics that we need to be aware of.

Thank you.

[The statement follows:]

**Prepared Statement of Mr. Clyde V. Prestowitz
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I'd like to thank the Commission for the opportunity to speak today on the China's industrial strategy and its effect on the United States.

I have been watching China since the early 1980s and understand the important impacts it has had on the U.S. economy. From 1981-86, I was Assistant Secretary of Commerce, responsible for the Department of Commerce's East Asian and China trade offices and leader of the first U.S. trade mission to China. Under President Clinton, I was vice-chairman of the President's commission on trade and investment in Asia and since then have been a frequent visitor and witness to China's incredible growth.

Since the late 1970s, China has gradually opened the doors of its economy to the outside world. Since then China has experienced rapid and indeed extraordinary growth. This growth has been achieved in part through the Chinese government's adherence to a "catch-up," export-led growth strategy similar to that of Japan and the so-called Asian Tigers – Korea, Taiwan, and Singapore. Not only has the government turned country into an export giant, it has become an export leader in certain strategic industries. At the beginning of February 2009, the Chinese State Council unveiled plans to bolster ten pillar industries that have been most affected by the current economic crisis. So far, detailed rescue plans have been released for the automobile, steel, shipbuilding, machinery-manufacturing, electronics, information, textile and petrochemical industries. The support policies include expanding available credit for businesses, export rebates and tax rebates on imported components, and assistance in updating production technology.

To one unacquainted with China's industrial policies, this list of industries may seem at odds with a country that, while growing rapidly, is still relatively poor and whose main comparative advantage is its abundant labor supply. Products like consumer electronics or semiconductors are typically associated with much higher wage countries. In fact, the basket of goods produced in China is analogous in its technological advancement to that produced in a country with three times the per capita income. [Rodrick, Dani. "What's so special About China's Exports?" NBER Working Paper, January 2006, Pg 4] These industries were targeted and pursued not because they complement China's natural strengths, but because they can provide positive externalities in areas like education, science, technology or national security. The growth potential in each of these areas was obviously significant; consumer electronics is an industry that did not exist in China circa 1982 but within 20 years, consumer electronics has become the country's largest industry, representing over 3 percent of Chinese GDP and 15 percent of total world output in the industry. [2008 USTR Report to Congress on China's WTO Compliance, pg 6]

A key component of this strategy is achieving technology transfers by attracting foreign companies in the high-technology field to set up production and assembly facilities in China. Access to the Chinese market in some sectors requires foreign companies to enter into joint ventures with domestic manufacturers. Approval to enter into a joint venture may rest solely on the ability of a company to provide technology, and future improvements to that technology. Foreign companies do not always get the

freedom to select their joint venture partner, and may wind up working with a competitor – a competitor who will potentially have access to patents, production methods, and other intellectual property. In the case of consumer electronics, companies like Lenovo became the production partner for IBM's ThinkPad computers and once technology is transferred, become global powerhouses in their own right.

Unlike Korea and Japan, China has explicitly made inducing technology transfer via foreign investment a building block of its economic development. Thus China offers large capital grants and substantial tax abatement to selected foreign companies if they invest in China. Not only does China provide state support for its domestic and international industries through tax rebates and other types of funding, it also acts as gatekeeper in selecting which industries it will champion, and whether or not foreign companies may be selected to enter the market through a joint venture. China also uses moral suasion as a means of inducing foreign companies to invest and to transfer technology. This gives the Chinese government tremendous control over its market, and immediate access to technology it otherwise would have to develop independently.

For domestic businesses, state-owned banks undoubtedly play a major role in development. Within China there is no formal bond market, and thus no way for businesses to raise funds except through bank lending. The Chinese state-owned banks are providing loans based on government policies, funneling funds into strategic industries. This phenomenon does not look to end any time soon, as the most recent stimulus announcement calls for dramatically increased levels of credit for pillar industries.

Chinese industrial policy inevitably provides special treatment for domestic industries. Chinese industrial policy goes beyond identifying strategic industries in its domestic economy; it sometimes artificially prevents competition among its domestic producers, restricts foreign producer participation in certain domestic markets, and provides Chinese producers special advantages as exporters on the international market. China currently limits market access for some foreign goods and services, such as iron ore and auto parts, restricts exports through the use of quotas, license fees and minimum export prices, and implements unique national standards in high technology areas. The result of these policies is that China shores up its less competitive businesses, protecting them from any domestic or international competition, and promotes select industries that it wishes to make a pillar of its economy. [2008 USTR Report to Congress on China's WTO Compliance, pg 6] Foreign investment in these industries is also controlled, through vague and arbitrarily enforced business laws. As a result, manufacturers in the United States often cannot export their goods to China, and are effectively shut out of the world's largest market. U.S. producers that do export to China may be faced with local content requirements or taxes.

A good example of how global markets may be affected is in raw materials. China is a key producer of several raw materials, such as coke. Exports of coke, used for making steel, are limited to 12 million metric tons per year. There is also a 40% duty on all coke exports. China produced around 350 million metric tons in 2007, and all but 12 million were sold domestically. Not only does this limit the supply available to foreign downstream producers, but it also affects the world price. In 2008, the price per metric ton in China was \$350, whereas the world price was \$750. This \$400 difference gives Chinese steel producers a competitive advantage over international producers. [2008 USTR Report to congress on China's WTO Compliance, pg 36]

Applying this pattern across other industries, it is easy to see how China takes advantage of market forces for the benefit of its producers. The affect on global markets, particularly on U.S. and other producers, is detrimental at best and catastrophic at worst. These policies could easily put smaller producers out of business, pricing them out of the market. If this trend were to continue, over the next five years what we will see are smaller businesses in the United States, and eventually larger ones, pushed out of the market. Our consumers will be paying artificially high prices for goods. The breadth of American industries involved that use raw materials from China – including steel, semiconductors, ceramics, aircraft, and medical imagery – means that hardly any sector of our economy will remain unaffected.

China presents a great challenge to the United States in terms of remaining competitive. China has an almost inexhaustible supply of inexpensive labor, highly trained scientists and engineers, and a comprehensive competitiveness strategy. But actually, China's industrial policy is less significant than

America's lack of a strategy and its inability to maintain a highly trained work force; to interest and educate our students in the sciences and engineering; and to increase R&D efforts. For years our strategy has been not to have a strategy on the false assumption that market forces would always work to our advantage.

The next five years will be a critical time for the United States with respect to addressing competitiveness not only vis-à-vis China, but in general. If the United States does not get serious about making things in America and encouraging productive investment in America, it will not matter what impact China's policies have on the world market. The most level playing field will not make the United States more competitive if we cannot create or produce innovative goods.

We are certainly at a disadvantage when it comes to Chinese state-owned companies and their access to government resources. Looking at the steel industry again, domestic Chinese producers receive subsidies, tax rebates, and loans at low or zero interest. The "Steel and Iron Industry Development Policy" established by the National Development and Reform Commission provides for direct subsidization of the steel industry, in the form of tax refunds discounted interest rates, funding for research, restriction of foreign investment, and export credits. The steel industry as a whole receives a 50% income tax reduction. The government allocated \$6 billion in 2000 for upgrades within the industry, and to transform capacity. ["Specialty steel industry describes countless Chinese subsidies and their impact on capacity" *The Free Library* 16 April 2007. 20 March 2009 <[http://www.thefreelibrary.com/Specialty steel industry describes countless Chinese subsidies and...-a0181486550](http://www.thefreelibrary.com/Specialty+steel+industry+describes+countless+Chinese+subsidies+and...-a0181486550)>.] When currency manipulation is thrown into the mix, China has devised a policy to make its domestic steel industry almost impervious to outside market forces. China is now the world's largest stainless steel producer, and its capacity continues to grow.

These direct and indirect subsidies make it difficult for any foreign producers to compete with China. It is imperative America respond so as to ensure competitive industrial capability in the United States.

I have already addressed China's policy of forced technology transfer. It is a critical element of China's support for its strategic industries and has allowed the country to climb the value-added production ladder much more quickly than might otherwise be possible. China has stated that its new aim is to achieve independent innovation. By 2020, it wants to establish its own science and research teams, and perform innovative research in manufacturing, information technologies, aerospace, and defense. It has also announced that it is going to double R&D expenditures as a percentage of GDP. Although this should reduce the reliance China places on technology transfers, it will not eliminate it. Nor will these changes occur quickly. U.S. companies are still at the mercy of these forced technology transfers. Furthermore, they are frequently victims of trademark infringement and other forms of intellectual property theft.

The United States needs to be vigilant in responding to various Chinese policies and practices. But even more importantly, the United States needs to make sure that it is doing all it can to remain competitive, whether we are competing on a level playing field or not. This requires that we invest in domestic infrastructure and in R&D, that we invest in the education of our students, that we train a skilled workforce, and that we encourage investment in America by offering the same incentives as China and other countries. Although it is true that China stacks the deck in its favor, we cannot use Chinese industrial policy as a scapegoat for our own failings.

Panel I: Discussion, Questions and Answers

HEARING COCHAIR SLANE: Thank you very much.

Commissioner Wortzel has a question.

VICE CHAIRMAN WORTZEL: Gentlemen, thank you for being here and for your thoughtful remarks and written testimony.

I have a question for each of you, and we have five minutes, so I

hope you can keep within the time period.

For Mr. Wolff, if you can identify measures that appear to be means to bring about market closures, what remedies would you recommend? Can we turn to the WTO? Or are there unilateral or multilateral remedies that you would recommend?

I'll just run through all three because there's one each if I could. Is that all right? Thank you.

For Dr. Haley, when you see a particular province in China putting emphasis on one of a number of pillar industry technologies or industries, can you tell whether the provincial leadership made that decision on its own or whether the central government was involved in that decision? Are they splitting it around?

And then for Mr. Prestowitz, this is my weakest area, and over the years you've been here I'm learning, but could you describe the adjustments you would recommend in the U.S. economy and the measures that Congress might be able to enact to encourage the adjustment that you think the U.S. economy needs?

Mr. Wolff.

MR. WOLFF: Thank you.

The remedies would have to include a variety of approaches. Some aspects of what China is doing will be WTO inconsistent. There have been cases that have been brought. But in a whole variety of areas, the WTO disciplines are really inadequate. In the case of product standards, it is very difficult to prevail. In subsidies, if it is a domestic subsidy, they are not prohibited unless they substitute for imports, and that's the intent. So the WTO has its limitations although there will be cases brought.

Bilateral negotiations. It depends on leverage. In the pre-WTO world, there was a lot more leverage than there is today because of binding dispute settlement. In the long-term, what Hank Paulson was trying to do with respect to changing the savings rate in China, is a worthy objective, but it is not going to save us in the next decade or two. But it has to be worked on as well.

So it's going to take a whole series of approaches, but one thing I emphasized in my testimony is: knowledge is very important, and Clyde is right, that there's a divergence of interest between CEOs of a multinational company and the U.S. government's perception of U.S. national interests, and there has to be an independent base of knowledge and an ability to proceed even if some in the United States might not want us to proceed.

VICE CHAIRMAN WORTZEL: Thank you.

DR. HALEY: Okay. It depends on the industry. Sometimes the consolidation into particular provinces is led by the central

government, such as today, the central government is trying to lead the consolidation of the auto industry and the steel industry into specific provinces. At other times, it's led by the provincial or the municipal government itself such as IT in Shenzhen today. That's the choice of the provincial and municipal governments.

VICE CHAIRMAN WORTZEL: Thank you.

MR. PRESTOWITZ: Well, I think the adjustment that has to be made in the U.S. is primarily psychological. I think that for a long time we have been forming our policy on the basis of the assumption that globalization and the trend of globalization is in the direction of the neoliberal and neoclassical free trade economic premises in which we have largely based on our policy.

And it seems to me that it's evident that that's not the case; we've just had so much experience in the opposite direction. So it seems to me that the first thing that we need to do to adjust is to recognize that there is an alternative form of globalization out there and that it doesn't mesh well with our premises.

Now, if I were Congress, what would I do? I think the first really critical element is currency. The catch-up strategy is always characterized by a conscious directed effort to undervalue the exporter's currency. And I think there needs to be a response to that.

The G-20 meeting is coming up quickly. That is a good first place for the United States to begin insisting that there be a reset of currencies. Now, I actually think that the Chinese proposal that appeared in the press yesterday to move towards a new international currency is a good idea. I think we should embrace it.

The fact that the dollar is the sole or more or less the sole global currency, and that it's a floating currency, means that it can be manipulated. It also means that we can be irresponsible. It means, for Americans, savings don't matter, at least in the relative, in the short to medium term.

So I think this is a Chinese idea we should embrace and begin moving toward a new international regime with an international currency or a basket of currencies rather than just based on the dollar.

Second point, I would have a war chest. Every day, I pick up the newspaper and I see another major global corporation has announced a big investment in China or in Singapore or in Israel or someplace, and frequently these investments are being made by the highest tech of companies that are capital intensive, not labor intensive. You can't argue that they're making this investment in China because of low labor costs.

And yet they make the investment. You scratch your head; why is that? And the answer almost always is because they're getting a tax

holiday, they're getting a capital grant, they're getting other financial incentives that are not being matched by anything in the United States.

I would like to have a war chest with which the U.S. can match those offers and use that to negotiate some international discipline. We've done this in the past in the case of export subsidies, in which in the late 1980s we did have a war chest in order to encourage negotiation of discipline on subsidies in the Uruguay Round, and it worked to some extent. It wasn't perfect, but it worked to some extent. So I'd like to have a war chest.

We have a new Secretary of Commerce being vetted I think now by the Congress. And if I were on the Senate committees talking to the new Secretary of Commerce, I'd ask him, what's your attitude towards investing in America?

The President has said he wants to create green jobs. Has anybody, has the Congress, has anybody, done an actual analysis of what the implications for jobs are of the President's proposals for investment in green technology?

I can tell you that preliminary analysis by my Institute indicates that the more we spend on green technology, the bigger our current account deficit, our trade deficit, will become because we don't make the stuff; we don't make the wind turbines and windmills and solar panels and so forth.

And so a question is if we're going to begin investing in these technologies, are we going to do it in such a way as to encourage and induce the movement of that production and that technology into the United States? Is the Secretary of Commerce going to be conscious of that?

I think that the creation in the Congress of some--you have a Congressional Budget Office that kind of does independent analysis of the implications of budget and fiscal proposals. You could create an independent congressional trade office or congressional industry impact office to actually look at the likely impact on the U.S. economy, on investment, on the current account deficit, of various measures being proposed.

We negotiated in the late 1990s to bring China into the World Trade Organization and to give China MFN, Most Favored Nation, treatment.

Do you realize that no one in the Congress and that no one in the administrations at that time ever did an analysis of what the implications for the U.S. current account deficit would be of bringing China, granting China those positions? The analysis was just never done. It wouldn't have been hard to have anticipated that we were likely to have huge trade deficits with China and to have anticipated

the implications of that in terms of our present crisis. That analysis was never done. And so I'd like the Congress to have that kind of ability.

Thank you.

VICE CHAIRMAN WORTZEL: Thank you.

HEARING COCHAIR SLANE: Commissioner Wessel.

COMMISSIONER WESSEL: Thank you, gentlemen, for being here, for your long-term help to this Commission. You've all helped us throughout the years that we've been in operation, and we appreciate it.

In many ways, this appears to be a debate that we had in the '80s with SEMATECH, a number of other industrial policy arguments, the question of the rise of Japan, et cetera. You talked about the "lost decade," and now people don't think that many of the concerns that we had about Japan were well-founded.

Now we're being told that we are overreacting to the rise of China, that we should not be as concerned about their development path.

Three or four years ago, the Department of Commerce with NIST and others in government highlighted that we had three sunrise industries that we should be looking at the future. We should not be worried as much about the broad-scale industries like steel, autos, et cetera. Those had become worldwide industries, but our bright stars were biotech, optoelectronics, and nanotech.

I think we've now seen that China either through the pillar industry programs or other scientific investments has chosen those industries as the bright stars on their horizon as well.

What should we look to here in the U.S. to make sure that we're going to have a high and rising standard of living? And is the current framework for analysis and regulation of our relationship with China and others, the WTO, et cetera; is it sufficient to meet the current pressures?

Why don't we go down the line?

MR. WOLFF: The United States has done a phenomenal job of innovating, and one challenge that we are confronted with in an era in globalization, where things can be done anyplace, is whether the jobs that are associated with innovation actually take place here.

And clearly they are not, to the extent that one would like, and part of the problem is that the playing field is somewhat skewed, imbalanced. It's not just because of specific subsidies to a particular industry; it is because of a series of our policies and others' policies that create advantages to going offshore or going elsewhere, producing elsewhere.

Sometimes going offshore is justified by just being close to one's end market, and you're expected to participate, and there is some of what Clyde said of being seen to be a good corporate citizen and more responsive perhaps in a more autocratic setting than elsewhere.

But if the taxation rates on business are different from the United States, and we have much higher rates than anyplace else abroad pretty much, and the effective tax rate is even more dramatically different. That said, we are not going to get into a negotiation where we say to others you must raise your tax rates.

It's like the old value-added tax argument from 1947 through the '60s, where if the United States wanted to change its tax system, we were welcome to do so. Others were not going to change their tax systems.

So we have, I think, several things we have to work on. One is make the United States a very attractive place to do business. I noted in my testimony that it's sort of shocking that of our Ph.D. candidates in this country studying in U.S. universities in engineering, over half of them are from Chinese institutions meaning that chances are they go back to China.

We will push them back to China under our immigration laws, which is just an act of insanity. Those that didn't want to return, we will tell them you have to return. We ought to make this country a beacon for innovative, talented people, and we're doing the absolute reverse, which is just crazy.

So our own policies in education and immigration, taxation, have to be looked to, as well as levels of funding of federal R&D, basic R&D, and some of that is being looked to in the stimulus package and in the President's Budget.

The other thing we have to do is pay close attention to what China is doing and what others are doing. What is objectionable may not be WTO inconsistent, but may still be objectionable, and we have to use whatever leverage we can to get a change in policy that is not harmful to U.S. interests. Part of the leverage is making an intellectual case that some things are bad for China's own development of its economy. That won't cut much with respect to autos or biotech or other areas in which emphasis is being placed now so we have to find other leverage.

One last thing I'd say is that the imbalance has finally been discovered, as Clyde has noted, as being a problem for this country. Others have financed our investments and our housing bubble and the like, and our consumer credit, but the imbalance is actually made out of goods and services when it's a current account imbalance, and that has an effect on the shape of our economy.

And the difference between--there may be a few others--but the difference between Clyde Prestowitz and Tim Geithner is that Tim Geithner is worried about the macro imbalance, whereas, we have to be worried about the effects on individual industries, and as a government we're not.

COMMISSIONER WESSEL: Can the other witnesses respond quickly?

HEARING COCHAIR MULLOY: Go ahead. Sure.

DR. HALEY: Okay. Well, I think there are two things. Number one, I think it's absolutely insane that the United States give up on industries so quickly. If you just consider, for instance, the going back to the era when automobiles and steel were supposedly no longer valid concerns for the U.S., if you look at Silicon Valley, an economic study was conducted, and the economic profile of Silicon Valley, which is supposed to be the great champion of U.S. jobs, was the economic profile of a third-world country with a very small group of super-rich, a somewhat larger but still small group of upper middle income people, and then a huge mass of individuals who simply could not afford to live in that area based upon the income they received.

So I think one of the things is we have to quit giving up on our industries. It would help our industry tremendously, for instance, if the most advanced production facilities for automobiles were actually in the United States, but GM's most advanced production facility happens to be in Shanghai instead of in Detroit. So that's one of the things.

I think U.S. policy has to emphasize the importance of technology, the importance especially of process technology, which if you look at innovation, process technology generates a much greater return on investment both to the company and to society than does product innovation.

So we have to emphasize the retention of innovation for the United States both in new sunshine industries and in our old traditional Rust Belt industries.

The other thing is we have to promote innovation, period. There have to be tax benefits to innovation. It's been shown that they're extremely effective in creating innovation within industry, and there has to be--I don't know how legal it would be a penalty from moving technology and innovation offshore.

MR. PRESTOWITZ: The old world is looking at biotech, nanotech, advanced electronics, telecommunications. We just completed a survey of leading competitive countries, and whether it's Singapore or Israel or China or Japan, all of them have identified explicitly and have created programs to achieve leadership in those

industries because for the obvious reason that they're all considered to be industries of the future with potential high productivity.

Right now, all of the incentives for an American-based company are pretty much to leave or, to put it a different way, the incentives are that if you're an American-based company or if you're any based company, you would like to have a close relationship with MIT, Stanford, Caltech, and some of the major U.S. university centers because those are still the places where the leading-edge R&D is being done, and they are not adequately but significantly supported by U.S. government. That's where a lot of U.S. government R&D money goes.

So you want to have a relationship there, and you want to have your students there, and, as Alan pointed out, China has been very successful in getting their students there, and then you also want to have the ability to--typically these things require a lot of capital. So you want to go someplace where you can get free capital, and most countries who are focusing on these industries have at the national level, not at the provincial level--they may have it there, too--but at a national level, they have a system of tax incentives, capital grants, labor training, infrastructure provision, and so forth, that effectively reduce the cost of capital for an entrepreneur or a global investor.

Thirdly, particularly in the case of China, where you have a very large population, already a large market, in some industries the largest market in the world, and potentially in most industries the largest market in the world, so would have access to that market, and as a global company, then you respond to the pressures, the incentives, that the people who control that market put before you, and typically, those are to attract you into that market.

But the key underlying element, as you know so well, Mike Wessel, is that, on the one hand, in a Singapore, in an Israel, in a China, in a Japan, you have a national leadership, both political leadership, economic leadership, business leadership, academic leadership, which believes that what a country makes matters. They believe that having these capabilities is important to their long-term welfare.

We don't have that in the U.S. And so we need, in my view, we need to have a different mind-set, and having a different mind-set, we then need to think about these incentives.

There are a lot of American incentives, tax incentives, that actually make it advantageous to invest outside the U.S., so at a minimum, as President Obama has suggested, we ought to change those kinds of tax incentives.

I also think that we need to begin to think a little bit about this

education element. On the one hand, it's right now the case that a very large percentage of Ph.D. candidates at leading American universities are non-Americans. In the past, they tended to come here and stay here. Increasingly, they are going back.

And so, on the one hand, we probably should think about incentives to keep them here. Some people have suggested giving anyone who graduates with a Ph.D. from a leading U.S. university a green card with their Ph.D. certificate.

But I think there's also something else we need to think about, and that is, not the only reason, but one reason why our universities are so full of non-American students is because the non-Americans pay the full cost. It's advantageous to the university financially to have non-Americans. But if the non-Americans increasingly are going to go back, then that suggests that we're going to have to staff our R&D centers and our corporate management centers of the future with Americans or with more Americans.

But then that means we need to train more Americans, and so somehow we need to wrestle with the question of how do we get more Americans into these universities and what are the incentives there for all of the players?

So I think those are a couple of good points.

COMMISSIONER WESSEL: Thank you.

HEARING COCHAIR SLANE: Commissioner Reinsch.

COMMISSIONER REINSCH: Given our population growth, maybe we need to address the question of how we get more Americans, period, because I'm not sure you can address your problem without focusing on that.

But in any event, as always, you guys have very interesting comments and I think we all appreciate them. The good questions have already been asked so I'm going to ask inferior questions and ask you just to put up with me.

What I hear you saying, I think, is with respect to what we should do about this, you're suggesting things that fall into two large categories. One is we attack their game through WTO rules, through negotiation, through other tools that we have or might be able to conceive, or, alternatively, we play their game through creating the same kinds of incentives at least, perhaps not barriers, but tax incentives, innovation subsidies, or things like that, that we've just got finished criticizing them for. Okay. I guess the question is can we do both of those things at the same time with a straight face and get away with it? That might be the best strategy. And/or is one of those two large bags more important than the other?

Alan, do you want to begin?

MR. WOLFF: I think it really has to be a combination of creating a series of incentives that promote new industries, and actions against trade and investment distortions created by China's policies. We pretend that we haven't done it here, that is intervened in our economy, when, in fact, we've done it throughout our history. This history goes back to agriculture. And we have to do more of the same.

Secretary Chu, Secretary of Energy, yesterday testified that National Labs have in the last year made enormous strides in biofuels, in breaking down cellulose, in creating artificial gasoline and diesel, all enormously important. All these sorts of things have come out of our National Labs in the past. They have to in the future. And the benefits of innovation do tend to at least pause in this country before they go abroad.

I think that there have to be other supportive policies that keep the benefits of innovation here. How targeted those incentives will be depends on national priorities. Can we do some of these things and with a straight face attack foreign practices? I think we will try to make our policies less distortive and put more on the basic research side rather than on commercialization.

There are also lines that should not be crossed. If the U.S. government mandated discriminatory product standards and provided that a exporter to this market, if it wanted to have encryption in its products sent into the United States of any kind--there is encryption in everything that's Wi-Fi and wireless communication, if it were required to only have American technology, that would be a major barrier.

I don't think we are going to do that. And we have to resist the Chinese doing it, because they will cause enormous disruptions to our industries. I think we're headed for major conflicts with China, and we have not seen anything yet.

COMMISSIONER REINSCH: Do either of the others want to comment?

DR. HALEY: Well, first of all, I guess I do think one way to look at it was the way the question was phrased. However, the other way to look at it would be that we would argue for the ideal and at the same time until that ideal comes about, comes into existence, defend our national interests, which is what, after all, the government is supposed to do.

I don't think it's an issue of being in any way hypocritical about things. But if someone is pointing a gun towards between your eyes, then you'd like to have one to point back. And it should be a negotiating ploy. It should be a negotiating stance on our part that until that ideal comes about, we will make, follow the same practices

as other countries.

COMMISSIONER REINSCH: Well, I would never accuse anybody of hypocrisy. Clyde.

MR. PRESTOWITZ: I'd look at in kind of three baskets. Let me preface my comment by saying that I think we really need to try to remove the--what's the right word--the pejorative or the moralistic element from this discussion.

For a long time we've been talking free trade versus protection and that free trade is the good guys and the protectionists are bad guys, and they don't do it our way. I think we're all in a global economy. Everybody has interests, and we make certain agreements, as in the WTO, and it's, I think, perfectly acceptable that if countries sign up for WTO rules, then they should play by WTO rules.

I expect other countries to file complaints against us, as the Mexicans have just done in the case of NAFTA, when we're violating the rules. And I don't think we should have any hesitation about insisting that other countries play by the WTO rules if they're not.

But I think that a major part of this discussion, a problem in this discussion is that the WTO is in many respects largely irrelevant. The kinds of things that we're dealing with are not covered by the WTO. Investment incentives are not covered by the WTO. Currencies are not covered by the WTO. But that's the whole game or most of the game.

And so let's play by WTO when we're in the WTO realm, but when we're not in the WTO realm, then we have to look at other issues.

So, let's look at the question of currencies and financial incentives. There are some vague IMF agreements that have not been enforced, but we've been among those who have been unenforcers.

But in the case of the currencies and investment incentives, you're in a realm in which there's a great deal of room for discussion and negotiation, and you're in a realm in which the behavior of all the players really has a huge impact.

Again, coming back to this crisis that we're in, we're in this crisis because we have not adequately dealt with the currency and the financial investment incentive issues. And it seems to me the crisis should give us a great incentive to deal with them, and in doing so, there's really kind of no guideline about how you deal with them.

I think that this is an area where international discussion is very important because I think some countries are engaging in policies that are destructive to them as well as to the system without necessarily realizing it.

And then, finally, I think that there is a category where there is an acceptable, even laudable, area for government activity. Support of research and development, support of technical education, these are

things that I think are unobjectionable. I don't think we should be somehow criticizing China because they're supporting technological development in particular areas.

I think here the question is what are we doing? And I think that an important step in getting towards a more relevant discussion is to recognize that much of the debate until now has been based on a really simplistic economic model. It has been based on a model that posits free, perfectly competitive markets, a model that posits no economies of scale, a model that posits fixed exchange rates.

The model that we base our discussion on is not the model that we live on, and if we begin to have this discussion in the context of recognizing that imperfect competition, rapid technological change, creates an entirely different economic structure and dynamic requiring, therefore, a much more nuanced and sophisticated set of policy measures, I think that we would be far ahead.

COMMISSIONER REINSCH: Thank you.

If we have a second round, put me down. I've got another question.

HEARING COCHAIR SLANE: Commissioner Videnieks.

COMMISSIONER VIDENIEKS: Good morning, gentlemen.

My question is basically about tax incentives. Mr. Wolff, you mentioned that the effective rates of taxation are something like 13 or 14 percent in PRC and 40 something in the U.S. corporate income tax rates.

It's my understanding the question really should go to the taxable base. The corporate returns I've seen usually show minimal income. So it wouldn't matter much what the rate would be if the income is minimal. R&D is deductible as a business expense and is not taxed as far as particular corporations are concerned.

So my question is: do we know what the taxable base is for a typical Chinese corporation? Because it's my understanding--I've been out of the game for awhile--that ours, that actually the income, the corporate income, is not very high typically on a U.S. corporate income tax return. That is the question for all the panelists, as you wish.

MR. WOLFF: The figure I cited was a World Bank figure that was across-the-board and not by sector, and it was about a two-to-one ratio, just the base rate, and that was the effective rate. 30 in the U.S. to 15 percent. Of course, it differs markedly by industry, differs by company.

However, in China, there are a series of incentives added to that. There are in the U.S., too, but in China they are far more targeted so that you locate in an industrial park, science and technology park, and

in China the first five years, there investor pays zero tax, which is a far better rate than either the aforementioned rates, and then a half-tax going forward except if the investment is in certain high-tech areas in which the rate never exceeds 15 percent.

So if there is an industrial policy that chooses particular kinds of activity, this will, in fact, lower the corporate tax rate dramatically.

We're going to have an interesting debate in the Congress this year. President Obama said the United States ought not to confer an incentive for firms to go abroad. He said that one cannot explain to the American people why that takes place. And an American company CEO's response would be "if Ireland has a 12 percent tax and the United States has a 30 some odd percent tax, why is it unfair for me to take advantage of that lower tax?"

I think that what one can see how debate is to be shaped – centered on what taxation does to the competitiveness of U.S. corporations. There is a divergence between those who are seeking to maximize economic activity in the United States and those who are trying to maximize the competitiveness of individual companies.

COMMISSIONER VIDENIEKS: But my question basically was if R&D gets a free ride in a U.S. corporate income tax return, which is obviously not as good as getting a five-year holiday from taxation. But any comment on that?

DR. HALEY: Well, one thing that I would emphasize about R&D, maybe it does get a free ride on the tax, corporate tax rate, but it also creates the greatest return on investment of any corporate activity.

The problem with R&D is that it not only creates the greatest tax return on investment, and this is both to the company and to society, it also is the most inconsistent return on investment.

For instance, while over the long term it has a very good return investment for the corporation, in 60 percent of years research has shown that it actually loses money for the corporation.

Now when China is subsidizing and doing this research for their companies, they're taking away that uncertainty out of their balance sheet and their profitability. What the U.S. needs to do in order to counter that absolute cash transfer basically on R&D is to find some way to reduce that uncertainty for corporate management so they feel freer to make the investments on a long-term consistent basis.

And the key is reducing that uncertainty, and if that--because of the greater return on investment to society, which R&D generates, I think it's a legitimate cause, a legitimate factor for the government to consider providing extra benefits for R&D.

COMMISSIONER VIDENIEKS: Thank you, sir.

MR. PRESTOWITZ: Well, I don't really disagree with Alan or Dr. Haley. I was just sitting here thinking as you were making your comment about Tim Geithner has just announced his plan for removing toxic assets, and there's a huge government subsidy element there, and I'm thinking if we subsidize R&D the way we subsidize finance in this country, we might be better off.

MR. WOLFF: Can I add just one quickly?

HEARING COCHAIR SLANE: Sure.

MR. WOLFF: R&D is deductible. There is not a 100 percent credit so there is some degree of tax, and the credit that we have is incremental and it's not permanent. So a company cannot plan on having it. It is renewed every two years because that is what Congress wishes to do. So there are limits to the benefit for R&D—but it is not that it's completely tax free.

COMMISSIONER VIDENIEKS: Well, it's deductible as a cost of doing business.

MR. WOLFF: True.

COMMISSIONER VIDENIEKS: Whether it's contracted out or done in-house.

MR. WOLFF: Yes.

COMMISSIONER VIDENIEKS: And the effective tax rate is based upon income shown, the net income shown finally after costs, so I don't quite understand your point.

MR. WOLFF: Well, it's not tax free. It is a deduction, not a credit. It's not 100 percent credit.

COMMISSIONER VIDENIEKS: Thank you.

HEARING COCHAIR SLANE: Commissioner Mulloy.

HEARING COCHAIR MULLOY: Thank you, Mr. Chairman.

Dr. Haley, I think you said that GM has their more advanced R&D in Shanghai. Somebody made that statement. Was it you?

DR. HALEY: Its most advanced production facility. However, they are making a major investment into an R&D lab in China today. It's over \$5 billion they'll be putting into it.

HEARING COCHAIR MULLOY: My questions are going to be built around my own observation. When I went to China for the first time in 1981, they didn't have essentially an automobile industry. There were very few cars around. People were on bicycles, and then you go back now, and they're probably making more cars there than we're going to be making here. So it's an enormous change in just 28 years.

When I look at the WTO agreement with China, my understanding is that if an American company ships a car to China, and we agreed to this, they face a 25 percent tariff on that item going into

China. But when China ships a car here, if they did, and I think they will, they face a 2.5 percent tariff.

So how do you as policymakers think something like that got into a trade agreement and what was driving that?

And then I have a second part: The President in his recent statement to the Congress said 'we are committed to the goal of a retooled, reimagined auto industry that can compete and win. Millions of jobs depend on it. The nation that invented the automobile cannot walk away from it.'

That may be a goal. Do you think our present policies are going to enable us to accomplish that goal? So I ask, first, how do you think that kind of thing got in a trade agreement? Secondly, can we achieve the goal the President set going on the road we're going?

MR. WOLFF: I don't know what the tariff is into China on autos, but my assumption is that U.S. trade negotiating strategy is driven to a very large extent by the private sector. If someone from a U.S. business comes in and says we can really sell whatever it might be that we still make in this country. We'll come up with an example sooner or later. But let's say we could really sell that item, then the U.S. trade negotiator will probably make that a priority. On the other hand, if the American car companies say, well, our model has always been to manufacture abroad rather than to export, so that would not be a U.S. negotiating priority. I know that when I was in government and negotiating, certainly Ford wasn't in favor of us getting the tariff down in Europe, thank you very much; it wanted the tariff as high as possible because it was already manufacturing in Europe. It wanted to keep the Japanese out.

And there is the case of Motorola. When we tried to get zero tariffs on semiconductors, we'd come into a trade minister's office to get tariffs eliminated,, and there would be the Motorola people following us to say keep the tariff up, don't go to a zero tariff, because we are already invested here.

So there is a divergence of views between the government, again, and the private sector. My strong suspicion is --without knowing--that if there is a tariff in China that's substantial on autos, and it wasn't a U.S. negotiating priority, then it was shaped, the U.S. policy was shaped or strategy was shaped by the U.S. car companies themselves.

HEARING COCHAIR MULLOY: Let's take that one across. Dr. Haley.

DR. HALEY: I think the problem is that when China was being looked at for entry to the WTO, the U.S. policy goal itself was getting it into the WTO. Because of that, U.S. positions really gave away too much in order to get it into the WTO.

I think another issue is that American negotiators over historically have just been rotten. If you go back into history, the value added tax is, you can refund or rebate the value added tax, but you cannot rebate the income tax on products exported. We don't have a value added tax. We gave that away to the entire world.

And so I think our negotiators have quite frequently just been out-negotiated. Our policy goals have sometimes been wrong. If China wanted into the WTO, that should have been their job to get themselves qualified, not our job to get them accepted.

And for Mr. Wolff, our paperclip industry is presently under very serious attack by Chinese. We still make paperclips.

HEARING COCHAIR MULLOY: Clyde.

MR. PRESTOWITZ: I'm sure that Dr. Haley meant to except two former U.S. trade negotiators from the rotten category. Alan sounds like the voice of experience on this, and I think what he says resonates with me, and I think, Dr. Haley, also it's true that in the case of China getting into the WTO, but in many cases, the U.S. negotiating priority has been more a geopolitical priority than an economic priority.

In the post-war period, post-World War II period, the U.S. has frequently made trade concessions in order to achieve some broader geopolitical objective.

Let me add one, one third thought here, and that is that the concepts of most favored nation and national treatment, on which all of the negotiation of the past 50 years or more has been based, are old-fashioned concepts. They, again, made for a much more simple age. They sound fair and square, but they're kind of inherently unequal.

So, for example, in the case of the tariff you're talking about, we agreed to give China most favored nation treatment. So we have a two-and-a-half percent tariff for the most favored nations so China gets that automatically, and they agreed to give us MFN, and they have a 25 percent tariff for everybody, and so they're treating us the way they treat everybody else. And so what are you complaining about?

And national treatment is kind of the same thing. We agree to give our trading partners, to treat the economic actors of our trading partners who are operating in this country the way we treat--

HEARING COCHAIR MULLOY: Domestic.

MR. PRESTOWITZ: --our economic actors, which means they can go to court, get an injunction against the U.S. government, have political action committees, lobby the Congress, and so forth.

And our trading partners agree to give us, to treat our economic actors the same way they treat their own, but frequently the way they treat their own is to throw them in jail if they disagree with the government. But, we're being treated the same way. So what are you

complaining about?

HEARING COCHAIR MULLOY: Very helpful.

MR. WOLFF: Can I just ask to add something, just to defend trade negotiators for a moment? I represented and still do represent the semiconductor industry in the U.S. In the accession of China, there were half a dozen things we wanted, all of which the U.S. government got.

We wanted to get zero tariffs on entry into China and we still produce most of the chips in the United States. Most of the value is still in the United States. We wanted antidumping that was on a nonmarket economy basis, and that was gotten in the agreement. Protection of intellectual property, we got as much as one could get in that particular area.

One thing we really did add was that state-owned enterprises would purchase on a commercial basis, something that is being ignored now in government procurement talk with China, but the fact is that this was a major, major get by the United States and Europe from China. So trade negotiations are not all negatives in terms of results.

But the degree of priority put on some of these things by the negotiators really depends upon private sector coming in and say we can really sell some stuff from the U.S. if you only get that concession.

HEARING COCHAIR MULLOY: Thank you.

MR. PRESTOWITZ: Pat, I'd like to just add a word in defense of trade negotiators as well. I'd like the record to show that as a young Foreign Service officer working at the American Embassy in the Hague in 1967 when the VAT, the European VAT, was being introduced, I wrote a cable to the State Department predicting that this was going to be a trade problem for the United States.

HEARING COCHAIR MULLOY: Thank you, Clyde. Thank you, panel, and if we have time, we'll come back.

HEARING COCHAIR SLANE: One of the things that I find is that U.S. multinational corporations doing business in China resist or even undermine policies that we're trying to introduce here to correct the situation.

And my question is do you feel that many U.S. multinational corporations doing business in China, their days are numbered?

MR. WOLFF: I think they are under threat, in fact. I defer to Dr. Haley with respect to autos, but my sense is that when we see a wave of autos coming from China, they are not going to bear American brands--there's not going to be GM or -- Chrysler is gone now from China, but it's not going to be Ford or GM cars that are coming into this country from China in large numbers. It will be Chinese-owned

automobiles.

I think there are a whole series of policies that are very, very damaging potentially to U.S. high-tech companies in particular, but those who have invested thinking China are going to face some very, very serious problems.

We look at the intellectual property issue as consisting of the fact that there are not enough trained judges, that there is not enforcement in every part of China. That it is part of the problem. It is not all of the problem. There is a hijacking of intellectual property regulation for other policy purposes that is going to prove very damaging to American companies as well as to Europeans and Japanese companies.

For these 16 large projects listed in the Ministry of Science and Technology Plan, the Chinese government says give preference to--it's more than give preference--buy products that have indigenous innovation, meaning Chinese patents. That means potentially that American companies producing in China who own patents that are registered in China may not be able to supply those large projects. These projects represent what is going to be a lot of procurement in China. So I think our companies are at risk.

HEARING COCHAIR SLANE: Dr. Haley.

DR. HALEY: I think that U.S. companies, and European companies, and Japanese companies--operating in China are always at risk. The Chinese government doesn't really recognize the rights of private enterprise. It's not just incidentally the U.S. and Japanese and European companies at risk; it's also China's private companies at risk.

The emphasis will always be on building their state-owned enterprises, on creating technology that is owned and controlled by the Chinese government, either through its research labs or through its state-owned enterprises. And that they view the acquisition of foreign technology as probably the primary focus of their business activities, and so U.S. companies will be at risk; they have been at risk; they have been heavily, heavily hurt.

If you just look at Qualcomm's history in China, and what Chinese policy and regulatory decisions did to its stock value over, say, the past ten years, it's amazing that any company would want to actually get into China and give the government that kind of hold and authority over them.

MR. PRESTOWITZ: I'd make two points. One is when we say "our companies," I think that the managers of many of our companies don't think of themselves as American companies. I think they think of themselves as global companies, and I think that to a very significant extent, many of what we call "our companies" have become

Chinese companies. That is to say they are very much under, more under the influence of Chinese policy than they are under the influence of American policy.

Having said that, just before Christmas, I was in Hong Kong. I had dinner with an old Chinese friend of mine, and he made an interesting comment. He said, Clyde, we now have all the foreign dogs in a kennel, and we're going to beat the--expletive deleted--out of them.

HEARING COCHAIR SLANE: Thank you.

Larry.

VICE CHAIRMAN WORTZEL: Yes.

HEARING COCHAIR SLANE: We're going to go around for the second round. Commissioner Wortzel.

VICE CHAIRMAN WORTZEL: My first question really deals with taxation; I think you've all mentioned the benefits of taxation policy and have offered measures to attract or retain industry.

Dr. Haley actually spoke of restrictive measures. So if U.S. multinationals have different interests than the United States government, is it reasonable to limit the ability of U.S. companies to diversify that research and manufacturing as a national interest?

And second, Congressman Michaud's letter, and Commissioner Mulloy read the opening paragraph--I'm going to read the final paragraph of that letter and ask you to comment on it.

He, Michaud, is talking about a letter that he organized by 54 colleagues, signed by 54 colleagues, and he says:

We urged President Obama to halt negotiations recently launched by former President Bush to establish a new U.S.-China bilateral investment treaty. While many in Congress have echoed President Obama's call for ending existing loopholes that promote off-shoring, bilateral investment treaties--and I'll add "inherently"--provide new protections to assist U.S. firms' relocation of investment and jobs offshore.

So would you share that recommendation to President Obama that there should not be any further work on a bilateral investment treaty?

MR. WOLFF: The model bilateral investment treaty is one that we negotiated with Rwanda. China is not a small African country. It's not a small country at all. The U.S. issues and problems are very different with China than they are with any other country, any other trading partner.

I am in favor of having a bilateral negotiation with China, and it may be that a bilateral investment treaty is the way to go, but it has to be reformulated to cover the issues that you people at this

Commission, the commissioners, look at and hear about on a regular basis.

It has to address America's real concerns, which the standard bilateral investment treaty really does not.

DR. HALEY: Insofar as the negotiations are concerned, I don't think there's anything wrong with negotiating. I think the important thing would be what agreement comes out of it. I think also there's a possibility that quite frequently U.S. negotiators feel this pressure to actually come to an agreement, whereas the Chinese don't.

And so hold the negotiations and if nothing comes of it, it's just fine. There's no worry about that. There's no real need to come to an agreement that isn't satisfactory to the U.S.

Insofar as the first part of the question, dealing with the issue of companies being global or perceiving themselves in global, and the reasonableness of trying to change that perception and behavior insofar as their investment policies go, I think the key point here is that the U.S. government is not a global government; it is a U.S. government.

And its policies with respect to its corporations should be policies which seek to improve the position of U.S. society in general through its corporations.

And the second point and a really important issue that too many people forget in policy discussions is that it's not just the global corporations. Job creation in the United States is primarily through small and medium-size enterprises, and their interests have been ignored hugely, without any doubt. Their interests have been largely ignored.

And policy should start taking that into consideration. Policymakers should start taking into consideration that it's the small and medium-size enterprises that create jobs in the United States, and that their interests should come to the forefront, not the global companies necessarily, but the small and medium-size enterprises.

MR. PRESTOWITZ: Yes, with regard to global companies, I don't think you can constrain global companies and tell them you have to do X, Y and Z in the U.S., but I think we ought to maybe reorient ourselves a little bit.

If Sony wanted to move its R&D center to the United States, I'd love it. Rather than thinking in terms of we have to keep these, quote, "American companies" here, I think we should be thinking in terms of we need to be doing what Singapore and China and others do, and that is thinking about how do we get these guys to invest here?

How do we bring the R&D here? This is a very attractive place to do business, the United States. It has a lot of pluses. But does the

President of the United States or the Secretary of Commerce ever pick up or the Secretary of Treasury ever pick up the phone and talk to a CEO and say, what are your investment plans? What are you guys thinking?

How are you thinking about expanding over the next 20 years? Gee, it would be nice if you could do that in the U.S. And that dialogue doesn't take place in the United States. It takes place in every other major country except possibly the UK.

As far as bilateral investment treaty is concerned, it depends on what you negotiate. And I think it's true, that we have had in the past kind of a negotiate for the sake of negotiating tendency, and also again a thing to consider is that when we get into a negotiation with a country like China, it almost automatically is not just an economic negotiation; it has geopolitical overtones. If the negotiation fails, does this hurt our relations with China?

So I think we need to before entering negotiations think carefully about the whole context of the negotiation, but the main thing really is you can negotiate a good deal or a bad deal, but a lot of it depends on where you're starting from.

And, it comes back to this fundamental question of what are the premises of the American international economic policy? I would argue that the premises for a long time have been at odds with the reality of the world.

HEARING COCHAIR SLANE: Commissioner Wessel.

COMMISSIONER WESSEL: Thank you, gentlemen, and you've given a lot of food for thought.

Let me question, George, your comment about the negotiators as well for a different reason, because I think our negotiators have done what they've been told to do, and the fact is that the priorities of our government are misplaced.

When the NAFTA negotiations were contemplated back in the late '80s, early '90s, Mexico conducted 99 sector surveys--alcoholic beverages, autos, agriculture, machine tools, up and down the line--with their private sector, with both their companies and the unions, and said where are our strengths, where are our weaknesses, what can we export, where do we have gaps here, and what are the challenges? We did none of that here.

The comment was made earlier --I think it was you, George--that the goal was getting China in the WTO, not necessarily sub-goals. There were some with aggressive industries backed up by Congress that achieved gains on whether it was Section 421 or some of the semiconductor issues.

But we seem to have a real disconnect here in terms of what our

national priorities are. The group that was referred to that Congressman Michaud has been working with, who wrote a letter--he heads up the House Trade Working Group; there's a counterpart in the Senate as well--has asked for a review. Let us determine really what our priorities should be before we continue on the path we're on.

As you look at China, what are our priorities right now? Where are the major impediments to our having a better situation in trade? Roughly 25, as I recall, percent of China's exports come to the U.S. I think four or five percent of the U.S. exports go to China. That changes, of course, on a monthly basis but not by much.

So we have substantial leverage. China needs us a lot more than we need them in terms of economic success.

If you were able to look at this afresh, what today would you set as our priorities in terms of going into China, and can we in the context of our current WTO and other commitments try and rebalance the equation?

DR. HALEY: First of all, one of the problems I think we have with China is that to a great extent their agreements don't mean very much. They can turn around and order their corporations to follow specific policies.

If you look at what's going on today, SASAC in China is increasing its influence and power on a daily basis. Last year, they forced the consolidation of 20 logistics and storage companies in China into a government-owned entity.

COMMISSIONER WESSEL: Let me stop you there if I can because you raise an important point about the success and the enforcement, but both Alan and Clyde were involved in the semiconductor agreements, as I recall, with Japan in the 1980s, where we, in fact, had market success orientation built into the agreement, meaning that we analyzed the markets and we said our expectations are in these areas.

If the Chinese waltz on almost every deal, and then we have to go through a lengthy process to determine whether, in fact, they're actually breaking the law, it's hard to get not only transparency and get the facts, but our own multinationals are often unwilling to participate for fear of retribution in the Chinese market.

Should we have success orientation built into our agreements, that we expect certain success, and if not our government is going to look at that on a regular basis and then use that as indicator of whether the agreement is working or not?

DR. HALEY: Yes.

COMMISSIONER WESSEL: Alan? Clyde?

MR. WOLFF: Again, the U.S. government is heavily dependent

on the private sector for input in setting negotiating objectives -- maybe not in as organized way as Mexico was with respect to its negotiating priorities, but it does try to be responsive to what the private sector brings in as problems.

My fault with the U.S. government is that it doesn't have a sufficient intelligence-gathering and analysis apparatus that's devoted to this sort of thing.

I think that the WTO disciplines to the extent they exist actually have worked well where they do exist. Where there was a discriminatory value added tax rebate on semiconductors, the U.S. challenged it under the WTO rules, and the Chinese withdrew the rebate because the U.S. government brought a WTO case.

There was an antidumping case with respect to paper products the Chinese brought. The case had no basis, and the U.S. said "we will take you to the WTO," and over the weekend after USTR conveyed that message, the Chinese government canceled the case against the American companies.

So where there are disciplines, the Chinese have, at least in the early period, the first few years of WTO membership, sought to live up to those disciplines.

Our problem is the kind of economy we're dealing with, as was the case with Japan earlier and is the case in different ways with China, is just different than the underlying assumptions of the WTO, as Clyde was saying.

The disciplines on standards and the disciplines on subsidies are two areas in which the WTO rules are very weak. With respect to the China's Anti-monopoly law, there are no international rules. There are no international disciplines on competition policy. That will prove problematic.

And on the major issue of currency, I don't have an answer, but I have a strong feeling the Chinese are not going to allow the RMB to appreciate very much in the near term for obvious domestic reasons, and some form of international pressure is going to have to be brought to bear, as in the Plaza Accord sort of situation in '85, to bring about some degree of change.

I wouldn't abandon the U.S. dollar's role as a reserve currency any too quickly because actually we have a fair amount of debt out there that we want to continue to service that debt and have a continual inflow of capital.

U.S. policymakers have had difficulty in the past dealing with less formal kinds of market restrictions, distortions. The Koreans had "Buy Korean" policies that kept us out for years and plus standards, a number of other measures and policies.

The Japanese had similar policies. The Chinese are moving in that direction or have moved in that direction, and we don't have a way of countering them yet. We have to develop those.

COMMISSIONER WESSEL: Thank you.

MR. PRESTOWITZ: Yes. I think we should have, if we go into a negotiation that's supposed to be a market opening negotiation, one, we ought to be doing some kind of market analysis. We ought to have some idea of the competitiveness of our industry and therefore based on that some expectation of what this industry could do in an open market.

And I think that the problem, as Alan said, is that when you're dealing with an export-led, a country that has an export-led growth strategy, it's like playing baseball. Two teams are playing different games. One team is playing football and one team is playing baseball, and so it's very hard for them to play together.

We have in the past been in denial and we have told ourselves that they're playing our game or they pretty soon will play our game, and the WTO rules are kind of oriented towards our game.

I think we need to recognize when we're dealing with this kind of an economy, it's not the same game. We should have some expectations, and I think that we should not hesitate to, if those expectations are not, do not appear to be on their way to some kind of realization, then I think we ought not to hesitate to take those matters to the WTO and use the nullification and impairment clauses or whatever in order to kind of provide some discipline on that.

But, I think, look, there's a much, much bigger game afoot here, and that is that in the current crisis, which was largely caused by the global imbalances, the export-led game is not going to work in the future as it has in the past. It's not going to be possible, and so as we look to the future, any resolution of this crisis is going to have to result in a smaller U.S. deficit and a smaller Asian surplus, meaning that the U.S. is going to have to somehow either export more and import less or produce more domestically what it consumes or some combination.

Asia is going to have to consume more of what it produces, export relatively less, consume relatively more, and that kind of overriding imperative suggests that we need to be having very serious discussions with China, but not just with China. This is not just a China thing. There are even a number of non-Asian countries that have chronic surpluses, Germany being one of them.

And there needs to be a fundamental discussion about the inadequacies of the trade rules and the currency rules that have led us to this mess and how to get out of it, and inevitably that's going to

result in--it has to result in serious thinking about how do we attract more investment here? How do we produce more stuff?

As I said earlier, right now the greener we get, the bigger our trade deficit gets. Well, that can't be, and so I think that's where we have to go.

COMMISSIONER WESSEL: I agree that's where we have to go. I don't necessarily have your confidence that policies are going to change to get us there. But thank you.

MR. PRESTOWITZ: But, Mike, I agree with Alan, the Chinese are not going to allow the renminbi to appreciate. And so if you accept that's the case--let's put it this way. As they currently stand, the Chinese in my view are not going to allow the renminbi to appreciate.

But if there is no renminbi appreciation, then you can't break this pattern. But if you don't break this pattern, we all go down the tubes, and so somehow this pattern has to get broken. And it's going to require, I think, getting ourselves out of--so much of this discussion is about fighting the last war.

So much of this discussion is about things that happened in the 1930s, in the 1940s, and not about the world that we live in. We've just got to get ourselves out of that mind-set and into the real world.

HEARING COCHAIR SLANE: My question is can we effectively develop an industrial policy without modifying or withdrawing from the WTO? Mr. Wolff?

MR. WOLFF: There are many gradations of industrial policy. One part of industrial policy would be our tax system. We talked about earlier our education, immigration policies and the things that are fostering basic R&D in this country, which really every other country wants to emulate and most of them are doing so. So we certainly can do a number of things that can make our country more competitive as a place to locate productive activity.

Then there are more targeted programs, and the WTO rules are really not that restrictive in regulating support of industries. That may be a deficiency from the point of view of offense (going after other's measures in the WTO), but it may be a strength in terms of defense. For example, if we want to say we are going to be energy independent, and we're going to subsidize biofuels to a very large extent, that is not going to be likely to be something that would be WTO inconsistent, or at least it would be WTO defensible.

So there are many things that we could do to promote American industry that would not cause us to even consider for a moment having to withdraw from the WTO.

DR. HALEY: I think another thing we can do is actually look at

some other countries and how they've had success. Very similar in economic philosophy, for instance, is Australia. In Australia, industries and companies within industries are able to form what they call precompetitive cooperative agreements where they can work together for the development of high-risk projects, technologies that they wouldn't be able to do on their own as individual companies.

That in the United States today would be illegal. So I think we could change our policies and our laws just a little bit to promote specific behaviors that would benefit us. I don't necessarily think that would be industrial policy, but there's a whole host of little tweaks to our own laws and policies that we can undertake.

MR. PRESTOWITZ: Well, the answer is absolutely yes. We have pursued all kinds of industrial policies ourselves under the WTO. The Internet is an industrial policy, and what we do in aerospace, that's an industrial policy.

Much of what the Defense Department does is an industrial policy. What the FCC does is an industrial policy. And most of the world's countries who are members of the WTO have full-fledged industrial policies. I don't see any inconsistency.

HEARING COCHAIR SLANE: Thank you.

Commissioner Reinsch.

COMMISSIONER REINSCH: Thank you.

Clyde's right. This country has a long and honorable history of industrial policy. It's become a bad word in the last 20 years, and we keep fighting the same battle over and over and over again. I suspect for the next few years our side will win, but I also suspect it's not going to be permanent. It keeps coming back.

Let me ask a question about tax policy because we have been circling on that for some time. I think Alan made a very good point that while there clearly are tax subsidies that are among other things WTO illegal, some of which we've successfully countered, the basic fact that our corporate rate is 36 percent, and somebody else's is ten, does not necessarily mean that they're subsidizing when as a matter of national policy that's what they've decided to do.

The question that I'd like you to speak to directly is whether the United States needs to make a larger change in its approach to taxation. We're one of a handful of countries in the world that taxes on the basis of worldwide income which, in turn, then forces us to do a whole bunch of things for equity reasons, like the foreign tax credit and deferral, in order to avoid double taxation and other problems. Those corrective actions then become targets for amendments in order to achieve other policy interests.

Would we be better off if we went to a territorial system of

taxation like the Europeans do as well as most of the rest of the world and also as part of that instituted a VAT and a VAT rebate?

Anybody want to go first?

MR. WOLFF: Clearly, I think going to a value added tax, a national sales tax, would be beneficial to productive activity in this country. We subsidize, through the payment on our exports of taxes abroad when our goods enter a foreign market, their society and their social costs, and they're relieved of those on their exports. Their products coming into this country are relieved of their social costs and don't bear ours. So there's always been a disadvantage.

And the reason we did that was not necessarily--probably no one read Clyde's cable is one of the problems. But another is that we were used to border adjustments for state taxes: If there was an export from a state, it does not bear sales tax in the neighboring state and vice versa.

So to those people in 1947, at the time it seemed natural, to adopt that system.

I would convene a panel of corporations. I'd take Clyde's point that you'd have Sony and Siemens and IBM and all global companies, and you'd say what would make you locate more of your productive activity in the United States? And I'd test some propositions. They might have to have their tax directors with them.

But I don't know that that debate will actually take place because we'll have an "end deferral and let's not end it" debate. We won't have really a full-fledged debate as to what are the range of tax incentives and disincentives. How does the tax system play on location of productivity including R&D? Where does it go? Why does it go there?

Actually, there are answers to the questions. The issue is will the questions be asked? So I don't know fully the answer, but I know that our tax rates are higher, that they are disadvantageous, and that productive activity is moving out of this country. We have other factors that tend to move it back in, like our universities. People want to be close to them. That advantage may not last forever.

COMMISSIONER REINSCH: I think the full debate comes around every four or five years like clockwork. I think you're right, this will not be the year for it, but it will happen again sooner or later.

Do either of the other two want to comment? Or I've got another question.

MR. PRESTOWITZ: Well, I'm with you. I think we ought to have a value added tax. I think we ought to have territorial taxing rather than global taxing. I think we ought to conform here to the

global practice.

COMMISSIONER REINSCH: Alan, just let me just ask you a final thing, just to comment on one of Clyde's points. Do you think MFN and national treatment are dead or should be?

MR. WOLFF: They should not be. I would not retreat from our current trading system. I would try to make it work to our advantage, and there are enough exceptions to MFN that really have to be counted in the process. I don't like the proliferation of regional agreements, and when there is a pan-Asian agreement that will be very, very destructive from the viewpoint I think of U.S. economic activity.

COMMISSIONER REINSCH: Pan-Asian agreement that excludes us or one that includes us?

MR. WOLFF: That excludes us.

COMMISSIONER REINSCH: Okay.

MR. WOLFF: Actually there are lots of officials in Tokyo and in Beijing who think exclusive regional Asian agreement would be very good. I think it would be very bad from our perspective and a very serious threat. So we have to work to counter it.

And national treatment works to our advantage and is essential to the rules-based system, I would not abandon it, would enforce it.

COMMISSIONER REINSCH: Thank you.

HEARING COCHAIR SLANE: Commissioner Blumenthal.

MR. PRESTOWITZ: I wasn't suggesting abandoning it. I was just suggesting that it's not good enough.

COMMISSIONER BLUMENTHAL: Thank you all very much.

I don't agree that we, Mr. Prestowitz, in the examples you gave, that those were examples of industrial policy, like the Internet. We were trying to solve very discrete national security problems, packet switching and distributed communications, that had spinoffs afterwards, and it was the ingenuity of our entrepreneurs afterwards to figure out how to commercialize those. But that was the realm of defense national security; that was not, in my mind, an industrial policy.

The other point I would make is, sure, we can say the Chinese won't devalue their RMB, but we're also in a state where we're about to be borrowing a lot more for years to come. So we're incentivizing each other to do the exact same thing that we've been doing for the last few years by our own policies as well as by their own policies. There's no incentive as long as we keep borrowing at this pace and speed.

I just wonder about industrial policy, the Chinese have a lot of plans, and we've all written about them, but is industrial policy even working in China? Is there a national champion that is even close to

competing?

I believe Mr. Wolff, mentioned, and I think he's absolutely correct, that in the semiconductor industry, most of the value is kept in the United States. There is no one even close to competing with our top companies, Apple and Intel, and that had very little to do with industrial policy unless you call certain taxation policies and entrepreneurial environment, and so forth, an industrial policy.

I'd just call that an economic policy. But the question is, "are national champion policies in China working?" They talk about national champions. They talk about companies that are going to be brand names and competitive with the Apples and Dells and Intel's of the world, but is there anything on the horizon that will even be competitive?

It's one thing to have plans; it's another thing to actually see competitors in the highest value industries actually coming down the pike.

MR. WOLFF: I'd say that you make an excellent point. We have not seen many Chinese national champions yet. I think, Huawei is one, and there are a few other Chinese companies that are internationally competitive, but you do not have to be successful in creating a competitive national champion to do a great deal of damage to other countries' companies.

In the DRAM fight that Clyde and I were involved in different aspects of the Japanese caused enormous damage to American producers without necessarily ending up with a dominant share, and it wasn't a good policy for anyone.

The Koreans came along and they were very good at making DRAMS, and so were the Taiwanese, but in the meantime these industrial policies did a lot of damage to our companies. So the fact that they didn't create the world's dominant DRAM producer did not in that instance mean that they had not in any event caused us damage.

COMMISSIONER BLUMENTHAL: I take your point. I think it's a good one, but that's a different set of analysis than saying the response to China's industrial policy or Japan's industrial policy is to have one of our own. It should be getting people to abandon the pursuit of damaging industrial policies.

Even in the case of Japan and Korea, both of which are looked at as the models of industrial policy. You have fairly stagnant economies that are in worse shape than our own. They're so dependent on their national champions that you can't spur small business or entrepreneurship there either.

I just don't buy the premise that industrial policy has worked in any one of these countries or would particularly work here, and again

it's one thing--we'll wait and see with China, but, the idea that Huawei is going to very soon catch up to our leading telecom in terms of the value they create is, I think, is farfetched.

MR. WOLFF: But if you look at, again, going back to Japan for a moment, Honda was not a creation of the Japanese government, and it was not, it was not a company MITI wanted to see succeed, and it did anyway.

COMMISSIONER BLUMENTHAL: Right.

MR. WOLFF: But it benefitted from standards policies that prevented access to the Japanese market. Having a protected home market was an advantage. Nissan and Toyota benefitted a great deal from protected home market. So a country can have an industrial policy that you could say is misguided to some degree, but which created very strong competitors.

And with respect to our reaction, if you were looking for a market-oriented result, the United States forced Japanese investment to come to this country because we put trade restrictions into effect. So the United States intervened as well in response to Japan's interventions.

In thinking about industrial policy affecting autos, there is another example. The Canadians obtained investment from our car companies, plants created north of the border, by insisting on a degree of local content. It was not in a formal U.S.-Canada agreement, it was side letters to the 1965 Auto Agreement that forced investment to go north of the border. This was not because American car companies necessarily wanted to invest in Canada.

So industrial policy does create employment. The policy may be misguided, but it also shapes our economy when others engage in industrial policy, and we at least need to know what's going on and counter it to some degree.

COMMISSIONER BLUMENTHAL: Thank you. I'm out of time so thanks.

HEARING COCHAIR SLANE: All three of you have been enormously helpful, and we really want to thank you for taking the time to come before us.

We'll stand adjourned for ten minutes.

[Whereupon, a short recess was taken.]

PANEL II: CHINA'S USE OF INCENTIVES TO ATTRACT INVESTMENT INTO ITS PILLAR AND STRATEGIC INDUSTRIES

HEARING COCHAIR MULLOY: We're going to now start our second panel, and we have asked this panel to focus on "China's Use of

Incentives to Attract Investment into its Pillar and Strategic Industries."

But also are there things within our own corporate structure that causes them to be attracted to the incentives to move production, R&D, other things, into China?

We're very fortunate to have with us today three panelists who will offer very good ideas on what is happening to us and what we should be trying to do to cope with it.

Dr. Ralph Gomory is a research professor with the Stern School of Business at New York University. He's a member of the National Academy of Science, the National Academy of Engineering, and he's elected to the Councils of those societies.

He had business experience with IBM and he worked as President and now the President Emeritus of the Alfred P. Sloan Foundation.

I've had the privilege of working closely with Dr. Gomory on some of these issues over the last few years.

Terry Stewart is the Managing Director of the law firm Stewart and Stewart. Mr. Stewart has been of great assistance to this Commission in helping us understand issues through the years. His practice focuses on a variety of international trade matters. But he's also an adjunct professor of law at that premier law school Georgetown University.

Finally, we have Richard McCormack, who is the Editor and Publisher of Manufacturing & Technology News. That is a publication which he created in 1994. It's read by executives of industry, government, and academia on five continents.

He makes that publication available to us at the Commission, and it always has great information that helps us think about the issues that are facing our nation.

So we had the first panel, and that was, to those of us who are interested in these issues, like Caruso, and the story is that Al Jolson had to appear after Caruso, and when he stood up, he said "You ain't heard nothing yet." So that's the way I look on this panel. This is our Jolson panel, and I think they're going to make us think we haven't heard anything yet.

Dr. Gomory, if you'll begin.

**STATEMENT OF DR. RALPH E. GOMORY, RESEARCH
PROFESSOR, NYU STERN SCHOOL OF BUSINESS AND
PRESIDENT EMERITUS, ALFRED P. SLOAN FOUNDATION
NEW YORK, NEW YORK**

DR. GOMORY: Thank you very much, Commissioner Mulloy.

It's a great pleasure for me to be here. This is my, I think, second appearance before this group, and especially to be here with Patrick Mulloy with whom I have worked and continue to work over a period of many years.

So let me start abruptly--all right--with the following statement: We must realize that in the modern globalizing world the interests of many of our global corporations have diverged from the interests of the nation.

In particular, China is wisely exploiting the fact that the capabilities of today's global corporations are available to the bidder who offers the highest profit.

By the way, my voice is a little hoarse. If you can't hear me, give me a signal. Okay.

As part of the economic development of China, China has made it profitable for American companies to develop production facilities in China, and more recently, to expand R&D as well. The result is to create in China, and as part of the Chinese GDP, facilities and jobs involving the most current methodology.

And often the output of these facilities goes to the U.S. market, and there with the effect of subsidies, low labor costs, and up-to-date methodology, they can often outcompete U.S. firms who are actually working and creating value in the United States.

Why does this matter? It matters because it is corporations and other businesses that enable people to participate in the production of the goods and services that are consumed in the modern world. And it is corporations and businesses that enable people to earn a share of the value they produce to take home and to support themselves and their families.

Today, most of the goods we consume cannot be made at home or by individuals. Whether it's cars or telephone service, they are complex. They require large organizations to create them, and this is different from the past. To live, most people today must be part of an organization that makes or distributes the complex goods and services that people use today, and being part of such an organization is what people must do to earn a living and support themselves and their families.

Therefore, having productive organizations that enable people to contribute high value is what makes a prosperous nation. But globalization, on the other hand, has made it possible for U.S. corporations to pursue their profits by moving their great capabilities abroad, but in creating their profits in this way, they are creating productive jobs abroad instead of fulfilling that absolutely vital function in the U.S.

In response to this, we need to consider a U.S. national economic strategy that includes incentives for companies to have or create high value-added jobs in the United States, and if we want high value-added jobs, let us reward our companies for producing such jobs whether they do that through R&D or advanced technology or by just plain American ingenuity applied in any setting whatsoever.

As an example of this, the corporate tax rate could be scaled by the value that is added per full-time employee by the workers of corporations operating in the United States. This would be a tax aimed at results. That is to say high value-added jobs, not at means of getting there. It would be very American. Anyone whose company, large or small, has high value-added per person would benefit, and those who are unproductive would see their profits heavily taxed.

It could be made revenue neutral, and it would be an incentive to find new and better ways to do things in every industry, not in a chosen few, and in every business.

But there is one other effect from the globalizing world that we must deal with in addition to this: the effect of the mercantilist policies of other nations.

China, in particular, is loaning us the money to buy their underpriced goods with all the destructive effects that go with that approach, and this has been a major contributor to the imbalance of trade we now have.

With the aid of China and of other countries, but China first, we are, in effect, living beyond our means. We are importing more value than we export and we are consuming more value than we create. This is not a sustainable path for this or for any nation.

On the other hand, if trade is balanced, the value of goods imported is matched to the value of goods exported from the country, and those exported goods and services are provided by corporations that produce in the U.S.

Balanced trade is therefore necessary if we are to control our own economic destiny and it is attainable, as a proposal put forward by Warren Buffett, I think, clearly shows.

Let me summarize. We need to change our system to better align the goals of corporations and the aspirations of the people of our country. In addition, in a globalizing world where nations pursue their own interests with mercantilist policies, we must balance trade or we will not control our own destiny.

There is not one but rather many ways to move in these directions, but we must start by realizing the fundamental nature of the problem we face, and if we do this, we will find not one but many ways to make progress.

Thank you all very much.
[The statement follows:]

**Prepared Statement of Dr. Ralph E. Gomory, Research Professor,
NYU Stern School of Business and President Emeritus, Alfred P.
Sloan Foundation
New York, New York**

Mr. Chairman and members of the Committee:

[The views expressed here are solely my own and do not present the views of any of these organizations]

Thank you for the opportunity to take part in this hearing. The subjects that we are to discuss today are the ones in which I have been involved in one way or another for much of my working life. For almost 20 years I was the head of the research effort of a major international corporation (IBM), and had the opportunity to see at first hand the transformation of an Asian nation (Japan) from being relatively undeveloped technologically and economically to having a major worldwide impact in computers, semiconductors, electronics and automobiles. For the next 18 years I was the head of a major foundation (Alfred P. Sloan Foundation), deeply interested in science, technology, and economics. In addition, through most of my working life I have been an individual researcher in the areas of applied mathematics and economics. Today I am a Research Professor at New York University's Stern School of Business.

While the transformation of Japan in the 1970's and 1980's shows the possibility of rapid economic development in a nation that was relatively undeveloped, what we are seeing in China - the situation with which we are concerned today - is markedly different from the Japanese model. The Japanese government successfully fostered economic and technological growth with government-sponsored efforts to develop Japanese technology and Japanese companies within Japan, often testing these companies in the restricted Japanese market and then, when they deemed these companies competitive, helped them on a path to worldwide markets. During this time, U.S. corporations often struggled against significant obstacles to have major facilities in Japan or to gain Japanese market share.

The Chinese government on the other hand, has chosen a different path. To develop the industries it deems important for China, it will sometimes subsidize wholly Chinese companies. It will also sometimes also subsidize American- or partly American-owned companies. In this way, China can make it profitable for these companies to develop production facilities in China and, more recently, to expand R&D as well. The result is to create in China, and as part of the Chinese GDP, facilities that access and practice the most current methodology and R&D. Often the output of these facilities goes to the U.S. market. There, with the effect of subsidy, low labor costs, or up-to-date methodology - or all three - they can often outcompete U.S. firms actually working in the United States.

The result is that U.S. companies are contributing to the development of China and simultaneously contributing to the loss of jobs and destruction of industries in the United States. Nevertheless, they are doing these things in the pursuit of the widely accepted corporate goal of maximizing profits.

We must therefore realize that in the modern globalizing world, the interests of many of our global

corporations and the interests of the nation have diverged.

To put these developments into perspective a bit of history helps.

A Historical View

For a very long time most of the work of the world was done on farms or in small shops. An individual could learn the printing trade or shoe making and graduate to his own shop; a family could run a farm. In both cases an individual or very small groups of people could grow crops or make shoes that could be sold to others and thus have the money to supply what was not made at home.

But today the goods we consume cannot be made at home; they are complex and require large organizations to create them. You cannot manufacture a car in your garage; it takes a large-scale organization to do it. The food you eat is not produced by a family on a nearby farm, but is made by large organizations on highly mechanized farms with machinery produced by other large organizations. The food itself then travels on highly organized transportation networks to get to huge outlets, where nearby you can pick up a refrigerator made by another large organization or a television set that no individual or small group could ever build.

The same is true of services: there is no way to build your own telephone service. And even medicine, one of the last strongholds of the individual practitioner, is rapidly agglomerating into large-scale enterprises.

A person must now be part of an organization that makes or distributes the complex goods and services that people buy today. Being part of an organization is what people must do to earn a living and support themselves and their families. *The fundamental social role of corporations and other businesses is to enable people to participate in the production of the goods and services that are consumed in the modern world; this is what enables people to earn a share of the value produced for themselves and their families.*

The Divergence of the Profit Motive and the Fundamental Role

As I mentioned above, globalization has now made it possible for U.S. global corporations to pursue their profits by building capabilities abroad. *Instead of investing alongside U.S. workers and using their investment and R&D to increase their productivity, corporations today can produce goods and services abroad using low-cost labor, and import those goods and services into the United States.* But in creating their profits this way, they are building up the GDP of other countries while breaking their once-tight links with America's own GDP.

Economists will sometimes argue that this development of capabilities abroad is good for the U.S. economy as a whole. For one thing, we get cheaper goods. That is certainly true, but it is also true that if we lose our superior capabilities in many areas and are less competitive, we have less to trade for those goods, so that eventually the cheaper goods become expensive in real terms. I do not intend to repeat today the arguments that are spelled out in the book on global trade and its consequences that I co-authored with Professor Will Baumol.

I would like to point out, however, that the view that the industrial development in your trading partner can be harmful to your total GDP is not new. There is a long history of well-known economists making that observation, most recently Paul Samuelson. [See References 1-6] What Professor Baumol and I have added to that long history in our book *Global Trade and Conflicting National Interests* is the realization the benefits of your trading partner's economic development occur in the early stages of its development, and as your partner becomes more fully industrialized and is no longer confined to low value-added industries, further development is harmful to your GDP.

This result, which we derive rigorously from the most standard economic models, corresponds to the intuitive notion that we do well when we lose low-wage jobs and not well when we start losing high-wage or high-tech jobs. We are losing high-wage and high tech jobs today; this conforms to the notion that we have reached the point of conflict between corporate and country goals.

Aligning Country and Company

As we have seen above, China has a national strategy aimed at the rapid increase of its GDP. As part of that strategy the country aligns corporate goals with national goals. China has made it profitable for foreign (often U.S.) corporations to create high value-added jobs in China. They do this by offering tax and other incentives that make it *profitable* for corporations to locate high value-added jobs in China. They are exploiting the fact that the capabilities of today's global corporations are available to the bidder who offers the highest profit.

We need to consider a U.S. national economic strategy that includes incentives for companies to have high value-added jobs in the United States. If we want high value-added jobs, let us reward our companies for producing such jobs - whether they do that through R&D and advanced technology, or by just plain American ingenuity applied in any setting whatsoever.

The Asian countries have done this often by individual deals with individual companies. We have neither the tradition nor the knowledge nor the inclination in the U.S. government to do that. An approach that is better suited to what the United States can do would be to use the corporate income tax. We have already used the corporate income tax to spur R&D, so why not apply it to directly reward what we are aiming at - high value-added jobs.

For example, the corporate tax rate could be scaled by the value that is added per full-time employee, by the workers of corporations operating in the United States. A company with high value-add per U.S. employee would get a low rate, a company with low value-add per U.S. employee would get a high rate. This tax could be made revenue-neutral by having a high tax rate for unproductive companies balance a low (or even negative) tax rate for productive companies. Depending on the rates, it could be as strong or as weak an incentive as desired. This is quite doable, as value-add is measurable. Indeed, it is measured today in Europe as the basis for the value-added tax.

This would be a tax aimed at results not means. It would not be for big companies particularly or for small. It would not be for high-tech or low tech. It would be very American, anyone whose company, large or small, has high value add per person would benefit; those who are unproductive would see their profits heavily taxed. It would be an incentive to find new and better ways to do things in every industry.

Critics of this or any change may say that our national economic strategy is, in fact, to leave markets alone and take whatever those markets produce. They may also suggest that this is the best possible economic strategy. But "free market" is not a single, simple concept. Do we mean free markets with or without anti-trust laws? With or without child-labor laws? Do we want financial markets with virtually no supervision? Different restrictions and policies will produce different results all coming from "free markets"; as will different tax policies or special loans for special industries, and so on and so on. After the recent debacles perhaps it is time to think seriously about what kind of free markets we really want.

Controlling our own Destiny – the Need for Balanced Trade

If we were alone in the world, we could adopt whatever internal policies we wanted, for example the tax mentioned above to encourage productivity, and companies who wanted to produce in the U.S. would have no choice but to conform. But we are not alone in this globalizing world. And today many companies have found it advantageous to move production and R&D abroad. Driven by foreign subsidies and underpriced currencies so many have done this that we have a huge and unsustainable balance of payments deficit.

China in particular is loaning us the money to buy their underpriced goods with all the destructive effects that go with that. This had been major contributor to the imbalance of trade which is not a sustainable path for this or any nation. We are in effect living beyond our means, importing more value than we export, consuming more value than we create. Warren Buffett in a Fortune article [Reference 11] accurately compared us to a rich family living beyond its means by steadily selling off pieces of the family estate.

If we change our tax structure to reward those who create value here in the United States there would also be nothing to prevent U.S. companies from leaving the country, and continuing to send in goods and services from abroad, thus continuing the imbalance of trade and further weakening the productive capabilities of the country.

On the other hand, if trade is balanced, the value of goods imported is matched to the value of goods exported from the country; those exported goods and services are provided by corporations that produce in the U.S. and comply with the U.S. standard of what a corporation should be. *Balanced trade is therefore necessary if we are to control our own economic destiny*

It is worth mentioning that balanced trade is one of the standard conditions of an economic equilibrium, although it gets less press than another condition “comparative advantage” With balanced trade, trade can get sorted out. Companies that are in the U.S. and conform to its policies balancing by their exports whatever is imported. But if we do nothing to rebalance trade we are at the mercy of the mercantilist policies of foreign countries whose policies can flood us with their goods, create increasing indebtedness, and destroy our industries.

That is why balancing trade is essential for controlling our own economic destiny.

Balancing Trade

There is of course a long list of approaches to balancing trade, ranging from jawboning to tariffs. I do not attempt to list them here. But I do want to single out one simple approach advanced and advocated by Warren Buffet, however, could really make a difference. It is well described in his 2003 article in *Fortune* [Reference 11]. This approach, in contrast to import quotas or tariffs aimed at imports from particular countries, creates a free market in import certificates. It would balance trade and would give us control over own economic destiny.

Since the import certificate approach is a major departure from the past it should be introduced gradually. But we should take this approach seriously. In fact, a bill based on the Buffet approach was introduced in the Senate in a past Congress by Senators Dorgan and Feingold. This approach has also been the subject of a careful study by the Economic Policy Institute that ended by endorsing this approach.

Conclusion

We need to change our system and better align the goals of corporations and the aspirations of the people of our country. This is not an idle dream; it has happened before. The growth we had in America in the decades after WWII and before 1970 was both rapid and well distributed. Americans of almost every stripe benefited.

To improve our situation today we must realign the interests of global corporations with those of the country. Just the realization that the goals of our country and of major corporations are no longer

aligned is an important first step. That realization has consequences of its own, for example it should affect the way that Congress should listen to the advice it gets from global corporations.

However if we are clear on the necessity of aligning country and company we will find ways to do it. We have given a few examples of changes that could push in that direction. If we look in that direction we will find more and better ways to do this.

In addition, in a globalizing world where nations pursue their own interests with mercantilist policies, we must balance trade if we are to control our own destiny. Fortunately, there is at least one way to do that: the Buffet proposal.

We might well ask: can we change the fundamental motivations of our corporations, whether through taxation or other means? Can this be done? In this connection it is interesting to hear the remarks of two recent G.E. CEO's.

On the subject of government incentives, the present-day G.E. CEO, Jeffrey Immelt, recently stated [See Interview in Reference 10].

If the U.S. government "...wants to fix the trade deficit, it's got to be pushed...GE wants to be an exporter. We want to be a good citizen. Do we want to make a lot of money? Sure we do. But I think at the end of the day we've got to have a tax system or a set of incentives that promote what the government wants to do."

His predecessor, Jack Welch, the G.E. chief executive who ushered in the reign of shareholder value maximization a quarter-century ago, told the Financial Times in March [Reference 12] that "shareholder value is the dumbest idea in the world."

Both are starting to sound a little bit like their distinguished G.E. predecessor Reginald Jones who argued in the 1970's that corporate leaders must balance shareholder concerns against the interests of employees, American industry, and the nation, a view that was endorsed by the Business Roundtable in 1981

Perhaps the time has come to move in that direction.

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HEARING COCHAIR MULLOY: Thank you.
Mr. Stewart.

**STATEMENT OF MR. TERENCE P. STEWART, ESQ.
STEWART AND STEWART, WASHINGTON, DC**

MR. STEWART: Thank you.

It's a great pleasure to be here, and I appreciate being invited. You have in front of you both a paper and a summary of the paper, and I will try to limit my remarks to the topic of what the effects have been of the incentives that have been provided in China. All countries obviously provide incentives for people to invest in their country.

There are a combination of factors in China that have permitted rapid foreign investment, not the least of which is the large population and a rapidly growing economy, which has attracted a lot of foreign investment for the natural purpose of trying to provide goods and services to that economy.

You've heard over the years from many companies and many industries that there are also government pressures that are designed to see that people who are supplying the market supply the market from within, i.e., that there was investment that comes in.

There also has been a lot of testimony here in prior hearings about the fact that formally or informally there are requirements to export. If you look at Annex 1 in my paper, what you will find is the import statistics and export statistics of the Chinese government broken down by type of export or import entities so that you can see

what state-owned enterprises versus foreign enterprises do.

I also included that particular exhibit in one of the handouts that you should have in front of you. If you look at the front page of the handout, what you will see is that state-owned enterprises are about 18 percent of China's exports. Now, depending on the sector, it will go significantly higher or significantly lower, but for the overall economy, 18 percent.

The main driver of exports out of China has been foreign-invested enterprises which account for roughly 38 percent of a total exports in 2008 of more than \$545 billion. They are also the largest source of imports into China, 429.

So when one looks at the trade issues and one looks at the trade imbalance, the significant part of the trade imbalance flows from the private sector, whether the foreign-invested entities or whether the Chinese entities, as opposed to the state-owned enterprises.

That doesn't mean the state-owned enterprises don't affect the overall economic conditions and the perception of cost of doing business in China, but it does mean that attracting foreign investment has been successful in China in terms of driving their export machine.

One then needs to look at what has that meant in the United States? If you look at Annex 2, what you will see is for these strategic industries and pillar industries--I think it's a 14-year review of trade data--China exports to the U.S., U.S. exports to China, and the trade balance--and what you will find in almost everyone of the sectors is a rapidly deteriorating trade balance, which means that in those sectors, where they have had a policy of promoting greater internal growth in China and promoting exports, in fact, they have been successful, sometimes very successful, other times, somewhat successful.

Commissioner Blumenthal referenced semiconductors. Semiconductors is an area where to date they have not been terribly successful and is one of the few areas where there continues to be a large net trade.

You heard earlier in the first panel about some of the structural issues, and when you look at what is it that the United States can do to address the challenges of major trading partners that we face such as with China, there certainly are things that we can do domestically.

You had discussions of the tax system and the fact that under existing WTO rules, we penalize ourselves by the nature of our tax system. When it started off, the discrimination against the U.S. was minor, in the range of about two percent for a few countries.

Today, it runs up as high as 25 percent. It is probably one of the largest single disadvantages we impose on ourselves and that we accept the system imposing on us differentiation in tax systems.

HEARING COCHAIR MULLOY: That's the VAT system you're talking about?

MR. STEWART: That's the indirect tax system which most countries do through a value added tax; that's correct.

You also have the issue that was discussed earlier with regard to the currency. Currency is an important issue on which there are IMF rules and there are WTO rules, neither sets of those rules have great teeth, and certainly it has been a long time since the United State used its trade remedies to go after what were perceived to be misaligned currencies.

If you go back to the 1950s, 1930s, you would, in fact, find that historically the United States dealt with misaligned currencies under our countervailing duty law. We haven't done that in 50 or 70 years, and there are questions under the current WTO as to whether or not that would be valid, but it is an important issue that has to be resolved in ways that are multilaterally acceptable, not only to us, but to our trading partners because it is not only China with whom we have major currency misalignment.

The concept that you would have tariffs that are bound and currencies that can move 20, 30, 50 percent with no consequence and no rights amongst parties who face those kinds of swings in currencies leads to the exacerbation of the problems that we face.

So with that, I will stop and let Mr. McCormack pick it up.

[The statement follows:]

**Prepared Statement of Mr. Terence P. Stewart, Esq.
Stewart and Stewart, Washington, DC**

**Hearing Before the U.S.-China Economic and Security Review Commission on
China's Industrial Policy and its Impact on U.S. Companies, Workers and the
American Economy**

Testimony of Terence P. Stewart, Esq.

March 24, 2009

INTRODUCTION

Members of the Commission, thank you for the opportunity to appear today. My name is Terence Stewart. I am managing partner of Stewart and Stewart, an international trade law firm that has helped U.S. companies and workers compete in the international marketplace for the last 50 years.

In my testimony today, I will discuss how China has used a variety of tools to grow and

transform its economy and to achieve its national security objectives. In areas where China is a net importer and where deficits now prevail, China's leaders clearly aim to reverse the situation and achieve trade dominance in these sectors.

China's local, state, and national governments use a variety of direct subsidies to domestic industries, subsidies and other incentives to attract foreign investors, as well as major state investment of research and development in sectors where it aims to be more competitive.

China has singled out for promotion and development a number of "strategic industries" such as those that involve national security, large and important infrastructures, important mineral resources, important public utilities and public services, and key enterprises in the pillar industries, such as high-technology.

Clearly, these policies have worked for China, as is evidenced by its extraordinary economic growth and its transformation from dependence on imports to the predominant exporter to the world. Data on state-owned enterprises shows strong growth in exports over the last two years in areas such as communications equipment, consumer electronic, and steel.

Among the sectors that have benefitted from these governmental interventions in the market is information technology, steel, manufacturing equipment, tires, and paper.

At the same time, China's policies have contributed to an ever-widening trade gap with the United States. The U.S goods deficit with China was \$266.3 billion in 2008 and China accounts for roughly 12 percent of total U.S. trade and one-third of the total U.S. goods trade deficit with the world. China's policies have also raised serious questions in the United States and other countries about whether these policies have distorted trade and led to job losses and economic dislocation.

PERVASIVE NATURE OF GOVERNMENT SUBSIDIES IN CHINA'S ECONOMY

It is well established that the Chinese government at all levels - central, provincial, and local - has long provided a wide range of subsidies to state-owned and state-invested enterprises and, as well, to foreign-invested enterprises to attract investment and obtain technology transfer.

Academics, business groups such as the American Chamber of Commerce in China, government agencies such the Office of the U.S. Trade Representative, the World Trade Organization, and the Commission itself have noted the prevalence of these policies in China. The Commission's 2007 annual report cited low cost loans, asset injections, subsidized inputs, tax breaks, energy subsidies, land subsidies, and purchasing SOE products as some of the subsidies provided by the Chinese national, state, and local governments.

To date, China's disclosure of its subsidies appears to have been limited. China has submitted only one subsidies notification to the WTO (covering subsidies in existence from 2001 through 2004), and that was not submitted until April 7, 2006, four years after accession. Moreover, the United States, the European Communities, and other countries pointed out that China failed to list numerous subsidies provided at the provincial and local level in that notice.

The United States has brought two WTO actions against Chinese subsidies. One matter was resolved in January 2008, when China agreed to eliminate certain prohibited export and import substitution subsidies that benefitted a wide range of industries in China. The second case was initiated in December 2008 and concerns certain measures offering grants, loans and other incentives to enterprises in China.

Since October 2006, U.S. industries, including paper, steel, tires, textiles, and chemicals, have alleged injury from Chinese subsidies and petitioned for relief in the form of countervailing duties. To date, Commerce has completed 10 countervailing duty investigations concerning China, with three other investigations currently pending.

CHINA'S INDUSTRIAL POLICIES FAVOR SELECTED INDUSTRIES AND STATE-OWNED ENTERPRISES, WITH THE GOAL OF PROMOTING NATIONAL AND GLOBAL CHAMPIONS

That the Chinese government grants domestic subsidies in a variety of forms to SOEs and to foreign-invested enterprises (FIEs) is not in itself surprising or remarkable. What is notable, however, about China's use of subsidies and other incentives is the scale of its subsidy and incentive measures and China's efforts to direct these measures to targeted recipients and industries through the implementation of central government policies.

One goal of China's industrial policy is to favor and promote certain state-owned enterprises into national and global "champions." In the 2008 trade policy review of China, the WTO Secretariat described the shift in China's industrial policy toward favored sectors and SOEs as follows.

"Direct intervention in the economy remains the main approach of industrial policy. Nonetheless, there has been a shift towards the use of various other policy tools to channel resources into certain activities that the Government believes are important for China's continued growth and development. In addition to tariffs and other border tax measures, tax incentives, and subsidies, these tools include 'guided' credit, various 'catalogues' identifying sectors eligible for incentives, as well as restricted or prohibited activities, various forms of 'guidance' including section-specific 'industrial development policies' (e.g. for steel, automobiles, and cement), and price controls."

CHINA'S ELEVENTH FIVE-YEAR PLAN AND RELATED GUIDELINES TARGET CERTAIN DESIGNATED STRATEGIC AND PILLAR INDUSTRIES FOR DEVELOPMENT AND PROMOTION

SOE Restructuring

In 2006, China issued its Eleventh Five-Year Plan for the period 2006-2010. The Plan provided a general outlook for economic growth that aims to “further strengthen China’s industrial sectors and foster the growth of a more highly-developed, knowledge-based economy.” China’s Plan “proposed to accelerate the transformation of the economy from being ‘resource dependent’ to ‘innovation driven.’”

China implements its industrial policy through its control of SOEs, particularly through direct control of the largest and most dominant SOEs by the State-owned Asset Supervision and Administration Commission (SASAC), which is responsible for managing government assets and reform of central-level non-financial SOEs. As noted by the WTO Secretariat, SOEs under SASAC management “accounted for 40% of total SOE assets in 2006, and earned 60% of total profits.” USTR has noted that it is “evident that the Chinese government {is} intent on heavily intervening in the commercial decisions of state-owned enterprises, including decisions related to their strategies, management and investments.”

Specific guidance regarding SOEs was provided in December 2006 by the National Development and Reform Commission (NDRC) when it issued a guiding opinion on state-owned assets restructuring. The opinion states that SASAC’s state-owned assets should concentrate on “important industries and key areas” (*i.e.*, strategic industries). The opinion then explained that the “important industry and key areas” shall “mainly include industries that involve national security, large and important infrastructures, important mineral resources, important public utilities and public services, and key enterprises in the pillar industries and high-tech industries.” The opinion calls for the administrative agencies to promulgate catalogues and to lay down specifics as to which sectors shall be subject to absolute control or relative control by SOEs. “Absolute” and “relative” control are not defined; but it is generally understood that absolute control means control by majority ownership; and relative control means another controlling position short of majority ownership.

On December 18, 2006, Li Rongrong, Chairman of the NDRC, delivered a speech in which he clarified the guiding opinion. Chairman Li stated that the Government should maintain absolute control over SOEs involved in “important industries and key areas” in the interest of China’s security and economic livelihood. These “important industries and key areas” include seven industries: defense, electric power and grid, petroleum and petrochemical, telecommunications, coal, civil aviation, and shipping. Li said that NDRC’s policy was to increase the overall state-owned assets in these industries, to

optimize their structure, and to develop some of the key enterprises into world top tier enterprises.

For SASAC-controlled SOEs in the sectors of defense, petroleum, natural gas and some other important natural resources exploration, electric power and grid, and basic telecommunication infrastructure, the Government would maintain sole ownership or absolute control. For their subsidiaries, and for SASAC-controlled SOEs in civil aviation and the shipping industry, the Government will maintain majority ownership. For downstream petrochemical products distribution and retail and for telecommunication valued-added services, the SASAC will seek private and foreign investment to diversify ownership structure.

Li further stated that, in addition to the seven strategic industries, the Government would maintain a strong control position (*i.e.*, 30%-50% equity ownership) for key enterprises in the basic and pillar industries, which include equipment manufacturing, auto, information technology (IT), construction, iron and steel, non-ferrous metals, chemicals, and surveying and design. For these pillar industries, SASAC will reduce its share of state-owned assets, but will increase its economic influence and guiding role. Specifically, SASAC-controlled SOEs are directed to become key enterprises and play a leading role in the equipment manufacturing, auto, IT, construction, steel, and non-ferrous metal industries. It has been estimated that 40-50 of the SOEs controlled by SASAC are in the strategic industry category and account for 75 percent of SASAC's total assets and up to 79 percent of SASAC's total profits.

USTR has repeatedly expressed concerns about China's increasing use of industrial policies to promote SOE dominance in selected industry sectors and create national champions. For instance, USTR's 2008 compliance report noted that U.S. companies had pointed to an array of Chinese policies "promoting and protecting 'pillar industries.'"

Investment Guidelines

China furthers its industrial policy goal of creating national champions by controls on investment. As noted by the WTO Secretariat, China's Eleventh Five-Year Plan "proposed to accelerate the transformation of the economy from being 'resource dependent' to 'innovation driven.'" The scope of China's reinvestment plans was evident in the Secretariat's description, which covered more than 20 industries, including 539 encouraged categories, 190 restricted categories, and 300 prohibited categories (which are to be eliminated gradually or within a specific time frame).

With respect to foreign investment, in November 2006, China issued a policy titled Guideline for Utilizing Foreign Investment for the 11th Five-year Period (2006-2010) which signaled that China intended to continue its policy of attracting foreign investment. The key themes of that guideline include establishing a unitary regulatory system for

both foreign and domestic companies and attracting foreign investment that helps with upgrading technology-intensive industries.

The Provisions on Guiding Foreign Investment Direction set out the basic regulations concerning foreign direct investment (FDI) in China. In general, they classify foreign investment projects into four categories: encouraged, permitted, restricted, and prohibited. The current Catalogue for the Guidance of Foreign Investment Industries entered into force on December 1, 2007. The Catalogue lists industries that are encouraged, restricted, and prohibited; if a project is not within these categories, it is permitted. The FDI Catalogue provides guidance on foreign investment in China's designated "strategic" and "pillar" industries.

USTR has expressed concerns about China's investment policies that signal that SOEs "should absolutely control, or at least maintain a 'strong controlling position' over broad swaths of its industry – in sectors such as equipment manufacturing, automobiles, iron and steel."

Another investment-related concern raised by USTR and U.S. companies is China's new anti-monopoly law which took effect in August 2008. While the new law is an improvement on China's previous competition law, the U.S. government and companies have questioned whether the new law will be applied to favor domestic companies and restrict investment by foreign companies. In a recent instance that may raise concern about China's application of the anti-monopoly law to restrict foreign investment, China rejected the \$2.4 billion bid of Coca-Cola to acquire China's largest juice maker, China Huiyuan Juice Group.

SELECTED EXAMPLES OF CHINA'S INDUSTRIAL POLICIES THAT FAVOR DESIGNATED INDUSTRIES: STEEL AND AUTOS

Steel

The substantial extent of government subsidies to the Chinese steel industry has been well documented in a number of research studies. For example, one study found that a wide range of subsidies benefited the Chinese steel industry, including cash grants, land grants, transfers of ownership interest on terms inconsistent with commercial considerations, conversion of debt to equity in steel companies, debt forgiveness and inaction regarding non-performing loans, preferential loans and directed credit, tax incentives, targeted infrastructure development, manipulation of raw material prices, and manipulation of the value of the Chinese RMB.

According to the Commission, the result of such substantial government intervention has been "a dramatic increase in steel output in China, so far exceeding even China's skyrocketing domestic steel consumption that huge overcapacity has resulted." In its

2007 annual report, the Commission succinctly summarized the effects of China's steel policy –a huge increase in steel production capacity to become the world's largest steel producer and transformation from a net steel importer to a net steel exporter.

In addition to subsidies, China's steel policy protects the Chinese steel industry through restrictions on foreign investment. Article 23 of China's Steel and Iron Industry Development Policy (issued in July 2005) provides that foreign investors may not hold a controlling share in a Chinese steel company. Moreover, China's steel policy requires foreign investors to transfer proprietary technology. In addition to subsidies, USTR summarized a number of other aspects of China's steel policy that favor domestic companies and concluded, "China's steel policy is also striking because of the extent to which it attempts to dictate industry outcomes and involve the government in making decisions that should be made by the marketplace. It prescribes the number and size of steel producers in China, where they will be located, the types of products that will and will not be produced, and the technology that will be used."

Autos

China designated the auto industry as a pillar industry targeted for development. The Commission noted in its 2006 annual report that China views the promotion of the auto industry as a “fundamental step in achieving the technologically advanced industrial base it seeks to develop.” Under China’s Industrial Policy for the Automobile Industry, there is a “50% foreign-ownership restriction in vehicle manufacturing, including completely built up units, automobiles for special use, agricultural transport vehicles, and motorcycles.” As noted by the Secretariat, “When establishing a foreign-invested automotive manufacturing joint venture, the place of origin of technology must be registered with the competent authorities (e.g., the provincial departments of the MOFCOM or the NDRC).”

The effect of China’s auto policies has been a dramatic increase in production capacity and expanded exports. “China’s auto production is on a fast roll. China’s auto output has nearly quintupled since 2001, and China is expected to become the world’s largest producer in 2009. Half the world’s auto industry expansion has recently occurred in China. China achieved a surplus in auto parts in 2005. That surplus grew 83 percent in 2007 and has been increasing at an even faster rate in 2008,” according to the Commission in its 2008 annual report.

CHINA TRADE DATA DEMONSTRATES THAT CHINA’S INDUSTRIAL POLICIES OF SUBSIDIES AND INVESTMENT CONTROLS HAVE RESULTED IN EXPANDED EXPORTS IN MANY INDUSTRY SECTORS

In addition to steel and autos, there are a variety of instances where China’s industrial support policies have effectively targeted sectors in which China has experienced a trade deficit and either sharply curtailed that deficit or turned the deficit into a surplus over time. Through strategic investments and support to these industries, China has been able to stem or even reverse areas of weakness in their trade balance.

For example, in the steel industry, China consistently ran trade deficits with the rest of the world each year from 1995 through 2004. After years of government support, China was able to reverse this deficit, and it ran a surplus in its steel trade for the first time in 2005. That surplus has increased each year since, reaching nearly \$67 billion in 2008.

In the auto industry, while China still runs an overall trade deficit, it is remarkable that the deficit has not grown sharply in light of China’s surging domestic demand for automobiles and the challenges of overcapacity and dampened demand faced by the automotive industry in the rest of the world. Over the past five years, while China’s auto imports have doubled in value, their exports have nearly quadrupled.

INCENTIVES FOR FOREIGN INVESTMENT IN CHINA

Income Tax

Since the beginning of China's reform and opening up, the government has relied heavily on preferential income tax treatment to attract foreign investors. Before the current enterprises income tax became effective on January 1, 2008, China had in place a dualist system for corporate income tax, applying a special income tax law to foreign invested enterprises (FIEs). The FIE income tax law allowed favourable tax treatment for FIEs. Most well known is the so-called "two free, three half" policy, which exempted manufacturing FIEs from paying income tax for the first two years starting from the year when the company registered a profit, and allowed a 50% tax reduction for the subsequent three years. Other incentive tax policies included allowing FIEs to deduct their R&D expenses from their taxable income and allowing an income tax credit for purchasing domestic equipment. Under China's new Enterprise Income Tax Law (effective January 1, 2008), China unified its income tax system, applying the same rate of 25% to all enterprises, including FIEs, except for enterprises subject to a five-year "grandfathering" period. However, tax incentives for enterprises engaged in high-tech and new technology activities continue to be subject to a preferential tax rate of 15%.

Value-Added Tax (VAT)

In general, China applies a 17 percent VAT for selling goods or providing taxable services. VAT preferential treatment is another incentive tool, mostly used to reduce costs for technology renovation for FIEs, thus encouraging them to adopt advanced technology in their local operation. For example, China had allowed a VAT exemption to FIEs when they purchased equipment either locally or from overseas. This policy, however, was abolished in December 2008 when China introduced its new VAT code.

In more general terms, the fact that China has a system that relies on indirect taxes, such as the VAT, is itself an incentive to foreign investment due to the disparate treatment accorded direct and indirect taxes in world trade. Under GATT/WTO rules, indirect taxes, such as VAT and excise taxes, are adjustable at the border, while direct taxes, such as income taxes, are not. These rules allow countries that have indirect tax systems to (1) impose indirect taxes, such as the VAT, on incoming imports, and (2) provide a rebate of the tax on outgoing exports. However, the same treatment is not accorded to countries, such as the United States, that rely primarily on direct tax systems. In other words, under the GATT/WTO rules, indirect taxes are adjustable at the border, direct taxes are not. China is one of the 153 countries that imposes a VAT and allows rebates of VAT on exports. Based on 2007 data, the VAT disadvantage to U.S. producers and exporters as a result of China's use and application of VAT is estimated to have been as high as \$52

billion. Given the disparate treatment of indirect and direct taxes under current trade rules, China's VAT gap may be viewed as a \$52 billion incentive for U.S. producers to move to China.

China also uses VAT export rebates as a tool to adjust and control trade flows. China imposes a standard VAT rate of 17 percent on goods domestically produced or imported and grants VAT rebates upon export, but the rate of the rebate is generally less than the VAT rates actually paid. Periodically, China adjusts the rate of the VAT rebate applied to particular products in order to, *inter alia*, "meet industrial development goals, and control exports of certain products," as well as to "rein in out-of-control expansion of production capacity in particular sectors."

General Policy Shift

In general, the Chinese government has reduced some of its broadly applicable preferential policies in recent years, and has been trying to create a unitary system for both domestic and foreign-invested companies. In addition to adopting a unitary tax system, the State Council in 2006 established a national minimum price for land used for industrial purposes that applies equally to domestic and foreign companies. On the other hand, in order to expedite procedures, the Central Government has delegated foreign investment approval authority to provincial governments for projects below RMB100 million. It appears that the Chinese government has determined that, given the fast growth of China's domestic market, access to the domestic market itself will provide a sufficient incentive for foreign investors. In this respect, it is notable that China has often required that foreign companies, as a condition for access to the Chinese market, provide technology transfer to Chinese producers.

Misaligned Currency

China's undervalued currency effectively acts as an incentive for foreign companies to invest in China because the cost of foreign investment and establishing operations in China is cheaper for the foreign company than it would be if the Chinese currency operated under market forces.

Local Preferential Policies

Although the Central Government has been reducing preferential policies, local governments are still providing incentives to foreign investment. For example, the Ningbo Municipality Authority in 2005 awarded government assistance to large foreign-invested projects. Projects with foreign investment over US\$5 million are entitled to a cash award ranging from RMB 30,000 to RMB 120,000, depending on the size of the investment.

CHINA'S 2009 STIMULUS PACKAGE INCLUDES PREFERENCES FOR FAVORED STATE-OWNED ENTERPRISES AND DESIGNATED INDUSTRIES

To combat the worldwide economic slowdown, on November 9, 2008, China announced a RMB 4 trillion (US\$585bn) economic stimulus plan for the next two years (2009-2010). The size of the stimulus plan is equivalent to 14 percent of China's GDP. The Chinese Government hopes that the stimulus plan will enable China to maintain an annual growth rate of 8 percent over the 2009-2010 period. Economic growth for the fourth quarter of 2008 was 6.8 percent and the growth estimate for 2009 was 7.2 percent without the stimulus package. It is not clear how much of the stimulus comprises spending not previously planned, but it has been estimated that new spending is roughly equivalent to 5-7 percent of GDP. A total of RMB 1.18 trillion will be supplied by the Central Government in FY 2009 and 2010, and it is estimated that this will drive up China's fiscal deficit to 3 percent of GDP in 2009.

The stimulus package appears to have increased investment in China. The National Statistics Bureau released statistics on March 11, 2009 that showed that, for the first two months of 2009, total investment increased by 30 percent (after adjustment for inflation). Bank loans for the first two months of 2009 was RMB 2.6 trillion. In comparison, total bank loans for 2008 were RMB 4.9 trillion. MOFCOM data, however, show that, comparing January 2008 and January 2009, foreign direct investment (FDI) declined by US\$7.5 billion (32.67 percent).

Policies for Industries Covered by the Stimulus Package

Prior to the NPC’s annual plenary session in March 2009, the State Council decided, in general, that ten major industries would be covered in the stimulus package and laid out the general policies to be followed when funneling funds to these industries. The ten major industries include steel, auto, textile and apparel, equipment manufacturing, ship manufacturing, electronics and information technology, light industry, petrochemical, non-ferrous metals and logistics. The broad measures to be used to assist these industries include: (1) reducing tax burdens; (2) allowing more access to financial resources; (3) providing RMB100 billion and other financial support to promote R&D; and (4) facilitating industrial structure adjustments and upgrading, as well as encouraging merger and restructuring to create large companies.

With respect to concerns that the new stimulus plan would add too much new capacity to the specified industries, Vice Chairman Zhang explained that the package funds would not be used for investment in the processing industry and duplicative projects. Instead, the focus would be on promoting social welfare, or “three-rural” projects. Investments will flow primarily to infrastructure projects, ecosystem and environment protection, energy saving and emission reduction projects, and be used to cover costs for structural adjustment, technology renovation, and modification of economic development patterns.

| Industry | Policies |
|---------------------|--|
| Auto industry | Implement the new energy strategy, commercialize electric cars and key components, allocate central fiscal funds to support energy saving cars and cars using new energy in middle to large cities; subsidize consumption; encourage early retirement of old cars; reduce consumption tax for cars to 5% |
| Steel industry | Control the total output, retire old technologies, merger and restructuring, support technology renovation, optimize geographical allocation |
| Textile and apparel | Increase export VAT rebate from 14% to 15% |
| Ship making | Stabilize demand, control new capacity development, push forward structure adjustment, improve the overall competitiveness of large ship makers, speed up renovation, develop high value added ship manufacturing capacity, develop marine engineering equipments manufacturing capacity |

| Industry | Policies |
|--|---|
| Equipment manufacturing | Promote domestic manufacturing capacity for key technical equipments, encourage structural adjustment; support merger among the key equipment manufacturing companies to create a large enterprise group with the capacity to engage in international operation and financing capabilities; accelerate and improve products standards setting; and foster the development of a modern manufacturing service industry for the sector |
| Electronics and information technology | Optimize industrial structure, ensure the stable development of the key enterprises in the industry, develop self innovation capacity, achieve break-through in key technologies, enhance software development capacity, foster the creation of economic driving engine in the telecommunication equipments, information service and technology sector |
| Light industry | Expand consumption and supply, improve trade facilitation, and maintain overseas market shares |
| Petrochemical | Upgrade the industry and establish a national refined oil strategic reserve system |
| Non-ferrous metals | Stabilize and expand domestic and overseas markets; support exports of deep processed, high value-added, and high-technology products; support technology renovation; encourage enterprises restructuring; improve raw material supply security; develop recycling capacity; develop national reserve systems for some of the non-ferrous metals; and adjust VAT rebate structure |
| Logistics | Promote commercialized and specialized logistics services; promote merger and restructuring to create large and globally competitive logistics companies; promote logistics services in energy, mineral, auto, agricultural products, medical device industries; and promote international logistics and tariff bond logistics capacities |

Source: Chinanews; available at <http://www.chinanews.com.cn/cj/gncj/news/2009/02-25/1578916.shtml>.

HEARING COCHAIR MULLOY: Thank you, Mr. Stewart.
Mr. McCormack.

**STATEMENT OF MR. RICHARD A. MCCORMACK
EDITOR & PUBLISHER, MANUFACTURING & TECHNOLOGY
NEWS
ANNANDALE, VIRGINIA**

MR. McCORMACK: Thanks.

As a journalist, your Commission is one of the few places that these issues are aired, discussed, and--

COMMISSIONER BLUMENTHAL: Is that good or bad?

MR. McCORMACK: No, that's rare, and so it's very important. My job is a journalist. And my job is to give voice to people, and sometimes not to have a voice is more important than anything else I do, just provide an avenue for other people to express themselves.

When Ralph says the interests of corporations have diverged from the interests of America, that is profoundly important, and it could be just repeated over and over, and I think people intuitively know that, but it's just so important that he just said that to you.

I'm going to date myself. I started as a journalist in Washington, D.C., on Friday, February 12, 1983. There was a huge snowstorm that day. I was on the staff of the Energy Daily, and the Energy Daily didn't produce that day; we missed a day.

But on that day, there was a ship, coal collier that went down off the coast of Virginia. Some of you might remember it. It was the Marine Electric. And on Monday, I came into the office, and my editor said, "Hey, Richard, find out where that coal was going, who owned that ship."

It was pre-Internet. So I found out who the owner of the company was and I got him on the phone, and I started asking him questions about the coal, and he said, "You know, god-damn it, the coal is at the bottom of the ocean along with 31 people," and on that phone call he cried.

As a journalist--there are other journalists in this room--when you hear a grown man cry, that stops you in your tracks, and it's an important thing as a journalist to experience.

Now, flash-forward 25 years. Two years ago, I'm interviewing the president of the largest family-owned furniture company in New England. Just shut his doors, laid off 200 people. I'm on the phone with him. He said these are all people my parents have worked with, my father, my grandfather worked with them. I went to elementary school with these people. I just laid them all off because the Chinese are making the same exact cane chair that I'm making in Maine for \$15, and it costs me \$110 to make it here. All these people are now

gone. Our town is destroyed. And he did the same thing. He cried.

I don't know if you've ever been around a grown man who cries, but let me tell you, it has an effect on you. And our country for the last eight years has totally ignored these people. We heard Dr. Haley mention the small- and medium-size enterprises. They have no voice. They've had very little voice in all this.

They've been drowned out by lobbyists and the big multinational companies with their trade lawyers and economists everywhere talking about the benefits of free trade and globalization. Well, I deal with the people who, at least I try to, who are having to confront this every day. And they've been marginalized. We've marginalized them in our country. That's those people who are going to lose their jobs--we'll give them trade adjustment assistance.

That's the cost of our having a global society; that's a cost of really cheap goods at Wal-Mart. And there is this rationalization that's gone on. And as somebody who has covered this, I've covered that rationalization and I've covered the guys who are losing their jobs, the women who are losing their jobs, the towns that are completely decimated, the depression that exists in our country. It is real as real can be. All you have to do is drive through Michigan; it's a depression.

Most of us live in Washington, and in 2002, we had the sniper shooting around here. I live in northern Virginia in Annandale right close to Falls Church, and the sniper shot seven or eight people in Bethesda, and I'm thinking, oh, that's Bethesda, that's over there, I think I'm okay, I'm over here in Virginia.

A couple of days go by, and he shoots somebody down in Manassas on Route 28 and 66 at the Sunoco station. That's kind of close. Then he's down in Fredericksburg and he shot somebody. Then he shot the woman who worked for the FBI at the Falls Church Home Depot. That's where I shop.

So we've had eight years of saying who cares about Detroit, who cares about Cleveland, who cares about the Rust Belt, who cares? Well, it's not over there anymore. It was Cleveland. It was Detroit. But now what happens in Detroit is going to affect what happens in Vegas, in Tampa, and Phoenix, and the contagion has spread. It's not over there in Bethesda anymore. It's not just up in the Rust Belt. It's everywhere.

We've seen an utter economic calamity caused by this, and you guys have been in the absolute forefront of it, talking about it. We've been writing about it. We've been pressing it. We've been saying--Ernie Preeg from the Manufacturers Alliance is in the room--warning us that this could be calamitous.

The National Academy of Sciences wrote a study, "The Gathering Storm." Well, the storm has arrived. Now we need to do something, and so we have time to talk about what that is. But for me, and I'm sure for all of you, it's been a frustration trying to get these stories told, trying to get the word out.

One last point--I subscribe to a service called Government Policy Newswire, and everyday there's a journalist who provides this data service of all the press releases, all the reports, everything that comes out regarding Washington government, all the government agencies, all the congressional offices, all the trade associations.

These issues are hardly discussed. They're just hardly discussed. I read through it every day trying to pull things out. What's the impact of China on various industries? How are we approaching economic policy? What's the debate over industrial policy? How about long-term R&D?

So, at some point, all these issues are going to be elevated because we're going to have to deal with them, and it's going to happen soon. We've still not dealt with them, I don't think. The stimulus package, the whole bank bailout, that's just a palliative. It's not addressing the real structural issues that Clyde Prestowitz and Alan Wolff and Dr. Haley were talking about in the last panel.

So I commend you for doing that. It's rare and it's very important. Thanks.

[The statement follows:]

**Prepared Statement of Mr. Richard A. McCormack
Editor and Publisher, Manufacturing & Technology News
Annandale, Virginia**

Thank you very much for inviting me to testify. This commission is one of the most important information resources I use as a journalist.

Virtually all of the domestic manufacturing and technology executives and workers I cover understand the reason the United States is in its current economic predicament, and why it will take a long time for the country to recover. Few of them were "taken by surprise" by the country's economic travails.

They understand that the United States government has effectively ignored the essential role manufacturing plays in the economy. It has done so at its peril. Its senior leadership has been distracted over the past 20 years and has barely acknowledged that the country is facing an unprecedented competitive challenge posed by dozens of countries, but particularly by China. Until it addresses the underlying cause of the financial sector's collapse, which is the massive imbalance in trade, the glum economic mood of the country will not change. There are too many millions of Americans who intuitively know -- because they shop -- that the country no longer produces what it consumes. America's wealth is no longer in America. The American industrial sector knows very well that until the government puts in place policies that

encourage U.S.-based production of a new generation of consumer and industrial products, there can only be an anemic economic recovery.

I have been covering science, technology, industry and government in Washington, D.C., for the past 26 years. I was the founding editor of New Technology Week in 1987 at the height of Japan's challenge to U.S. technology dominance. I covered the deliberate and in many ways successful U.S. response to that challenge. Ronald Reagan was an economic nationalist (a reluctant one). He and many of his political appointees in the Defense and Commerce Departments -- as well as a number of members of Congress -- understood that in order for the United States to win the Cold War with the Soviet Union it could not lose the Economic War with Japan. Reagan invested heavily in digital technologies, the fruits of which propelled the country through the 1990s. After a great deal of debate, Reagan also adopted trade policies that defended American workers and important "strategic" industries including automotive, machine tools and semiconductors. It is the reason he remains a hero in America's heartland among "Reagan Democrats."

The primary "issue" that I have been covering as a journalist for the past eight years is this: How is the United States dealing with the rise of China?

With the meltdown of the U.S. economy, that question has now been answered.

Two weeks ago as I was just preparing my written testimony for this hearing I went to the Google search engine and typed in "China's strategic industries."

The first listing -- the prized position, the place on Google where companies pay money to appear -- was this hearing.

That tells you something very important.

It means that the United States-China Commission is about the only government organization analyzing the most important issue facing the United States of America.

So let me tell you my approach in preparing for my testimony here today. I went on a U.S. government goose hunt. Searching through Web sites. Calling offices. Talking to more than a dozen people in the Washington, D.C., technology and industrial policy community -- some I have known for years and others they recommended. Collectively, these people have hundreds of years of experience working in Congress, government agencies such as Commerce, DOD, the State Department, and the International Trade Commission. They have worked in the White House, the Office of the United States Trade Representative and throughout the Washington, D.C., technology, trade and manufacturing communities.

First I wanted to see if I could locate places within the government that identify any or all of China's "strategic" industries. I sought to find some meaningful analysis of what these industries are; the companies that constitute them; China's policies to promote them; and whether or not the U.S. federal government has any type of mechanism to alert American companies of overt Chinese challenges to their industries or their specific enterprises.

I will describe later some of what I found, but aside from an occasional report, there is very little.

Also, I should say that as a journalist covering these issues from Washington, D.C., I am not an expert on what China considers to be its "pillar" industries. However, I have been chronicling in great detail China's impact on American industries, the American economy and American workers. China's unrelenting drive to develop robust manufacturing and research and technology capabilities with the help of foreign

companies has had a profoundly detrimental impact on dozens of U.S. industries, ranging from consumer electronics, printed circuit boards, semiconductors, telecommunications equipment, batteries, computer components, materials, automotive parts, consumer goods, furniture, textiles and apparel. The list is comprehensive and entails virtually every industrial sector in the United States. Americans impacted adversely by China's industrial, trade and currency policies have testified many times before your commission. You have heard their stories. You have given them voice.

In doing research for this hearing I also wanted to verify what I have long known to be the case: that the United States government not only has little knowledge of what is going on in China (save for the USCC), but also has little comprehension of the repercussions for American industry, employers and, most important, for American workers and taxpayers. There is no mechanism to systematically track China's thrust into "strategic industries." Nor is there a robust mechanism in place to defend the interests of American companies and workers who must compete with entirely unfair Chinese trading. Finally, there is still no strategy to be found anywhere in the government to counter China's and other foreign nations' successful displacement of American industries.

What I found, instead, was a government that held in contempt Americans concerned about massive trade imbalances and the loss of American industry and jobs. A speech by the recently departed Under Secretary of Commerce for International Trade, Christopher Padilla, given on November 13, 2008, provides an indication of the government's attitude toward those who express concern about preserving the wealth-creation engine of the United States. Padilla describes people opposed to the U.S. government's free trade policies as being "pessimistic populists," a pejorative euphemism for "protectionist." Such "pessimistic populists," says the man who was in charge of the Commerce Department's trade functions, "fear the world, and blame its products, its people and its investors for our economic anxieties. [They] cannot be appeased."

In his speech, Padilla did not mention the trade deficit or the loss of four million manufacturing jobs over the course of the previous eight years. Like virtually all adherents to "free trade," Padilla staked out the moral high ground: "I stand on the other side of this debate, with those who embrace the enduring optimism of economic openness." As hundreds of executives in the domestic manufacturing community have told me (with remorse) over the past eight years, it is impossible to have a reasoned discussion with people holding such "religious" convictions. (Padilla's speech "Reflections and Projections: A Trade Transition Memo for the New Administration," before the Washington International Trade Association, is located at http://trade.gov/press/speeches/padilla_111308.asp.)

Padilla and others like him have mis-labeled many concerned Americans as being "protectionists" or "pessimistic populists." Many of the manufacturing executives who hire Americans to make products are fully aware of the benefits of trade. They just want the U.S. government to put in place industrial and trade policies that favor American interests over those of foreign governments, foreign companies, U.S. multinationals that have moved production offshore, shipping companies, retailers that buy from cheap factories overseas, Wall Street wizards who pressure companies to fire American workers and shift production offshore so they can make additional pennies per share, and all of the economists, lawyers and lobbyists successfully representing these people in Washington, D.C.

All of these well-funded interests have won the economic debate -- they claim that cheap prices and offshore outsourcing are good for Americans -- but the United States has lost the underpinnings of its economy.

In the 1990s, the story that I covered was the rebirth of American industry. A big part of the story was the popular business technique of studying the “best practices” of the world’s best companies, and adopting them.

What has become abundantly clear in the past decade is that the United States federal government does not study the best practices of foreign nations’ increasingly successful economic, technology and industrial development programs.

In every case, what was told to me by people I spoke with in preparation for my testimony here confirmed what I have know as a journalist in Washington covering competitiveness for 22 years: the United States government has largely disassembled the mechanisms by which it was monitoring foreign technology development and economic threats to America’s most important industrial sectors. With little knowledge of what is happening overseas, particularly in China, the United States does not have the ability to formulate any type of effective response. It does an ad-hoc job of defending American companies and their workers confronting those threats. It does not even assure that the benefits of the massive investments it is making in research are accruing to American taxpayers who fund the research.

The result of such negligence is now readily apparent to tens of millions of Americans. The U.S. economy is in ruins. Yet the “free trade” forces are in hyper-mode, pouncing on any type of pro-American policy that smacks of “fair trade.” They are ready to blame the “pessimistic populists” for a massive fall-off of international trade similar to what (arguably) occurred after the Smoot-Hawley tariff bill of 1930. Yet a massive decline in international trade is occurring without there having been implemented any substantive protectionist measures in the United States for decades.

The United States government has allowed -- indeed encouraged -- the loss of its most important “strategic industries,” one after another. The evidence resides within the story told by the trade figures released every month by the Census Bureau. These figures are about the only real indicator the government keeps of the health of specific industrial sectors.

There are, however, pockets of people in government and Congress concerned about these issues. I have worked with them for years. They are passionate about protecting the interests of America over the interests of foreign countries and multinational companies that are benefiting from foreign trade, labor, environmental and government practices that would be illegal in the United States. For the most part, this small cadre of Patriots work for institutions that are enervated after decades of neglect and budget cuts.

They have expressed to me on countless occasions that the U.S. government is structured for a different era driven by an outdated mindset that the country has the most productive workers, the best technology, and a system of unfettered free trade that will benefit the majority of Americans. For the hundreds of thousands of manufacturing workers who are losing their jobs in “low-tech” industries targeted by cheap foreign imports, there is the Trade Adjustment Assistance Program to help them retrain for new opportunities. Unfortunately, the entire country is now on a massive “Trade Adjustment Assistance.”

The U.S. governments’ effort aimed at tracking Chinese industry was described to me as being a case of “benign neglect.” There is a lack of awareness within government of China’s capabilities and even less appreciation of China’s momentum in advanced technology development, commercialization and production. “The problem is getting bigger and the capability to track it is being diminished,” said one government technology veteran. “Who is studying their capability?” asks an industrial scientist managing a government R&D agency. “That is a big blank. We’re competing globally but we don’t know what we’re competing against.” Said another: “We’re not even in the game. There is an insidious process going on.”

Here is some of what I found:

International Trade Administration

If there is one place in the government that would be monitoring U.S. and foreign strategic industries, it would be the ITA. This is home of the “Manufacturing Czar,” who resides in the division’s Manufacturing & Services Bureau. There are a few nuggets on the ITA Web site, but there really is not much about China. Two reports produced in March 2008 under the “automotive” link (“The Road Ahead for the U.S. Auto Market,” and “Automotive Parts Industry Annual Assessment”) paint a grim picture of the U.S. auto industry. In the auto parts report, the ITA Manufacturing division notes that the Detroit 3 have been “advocating that U.S.-based suppliers move production to lower cost countries or risk losing future contracts.” There is no analysis of why they are doing so, nor of how many auto suppliers have moved. The report does not describe what other countries are doing to entice them. There is nothing about what the U.S might do to counter such an economically destabilizing trend. Both reports provide little insight into the activities of Chinese and Indian parts and auto producers. The “Road Ahead” report notes that “globalization and foreign competition continue to impact the U.S. economy particularly the automotive industry.” Both reports provide little by way of dealing with the pending collapse of the American automobile industry.

STAT-USA “State of the Nation”

STAT-USA is an online subscription service run by the Commerce Department that says it is the “Federal Government’s best resource for monitoring the U.S. economy.” Frankly, such a claim is specious and the Web site is not worth the \$200 annual subscription fee for anyone involved in the industrial technology community. There are links to statements made by Fed Chairman Ben Bernanke and daily releases on Treasury yield curves, commercial paper and bond rates. It posts the economic releases from most government agencies, such as monthly trade statistics, import price indexes, employment, GDP and earnings. Most of these are available for free on those agencies’ Web sites. There is nothing on the site from the State Department’s commercial or scientific attaches or any of the intelligence agencies describing overseas industrial developments, nor anything of substance describing the true condition of various U.S. industries.

The DOD’s Office of Industrial Policy

This office has repeatedly and clearly stated for years that the U.S. defense industrial base is robust and that the Pentagon is not vulnerable to supply disruptions caused by a reliance on foreign producers of essential defense technologies. “The Department of Defense is not aware of any foreign vulnerabilities within its supply chains,” it states in its latest “Foreign Sources of Supply” report published in September 2008. It notes that the last time it assessed the military supply chain was in 2003.

The office states that that the Department’s industrial policy is geared toward working with foreign suppliers. “The Department incorporates foreign items and components into many important systems, and in some cases the Department may be dependent upon foreign supplies for these items,” it says. “However, this does not mean the Department suffers from a foreign vulnerability. Foreign dependence usually does not equate to foreign vulnerability. The Department is not vulnerable if it is dependent on reliable foreign suppliers, just as it is not vulnerable when it is dependent on reliable domestic suppliers. Foreign vulnerability would occur only if the Department was dependent upon suppliers from a single or small group of countries that had the capability and political will to halt shipments to DOD in time of need, and when such delivery denial would cause direct and unacceptable impact to operations. In short, for there to be foreign vulnerability, DOD must be dependent upon the foreign source (no alternative sources available or that could rapidly become available), and there must be a significant, credible, and unacceptable risk of supply disruption due to political intervention by the host country or countries.”

The DOD Office of Industrial Policy's Web site is worth viewing. There are current reports on various industries (such as the recent "Assessment of Industry Investment in U.S. Domestic Production of Strategic Materials," January, 2009), <http://www.acq.osd.mil/ip/>.

DOD's "Annual Report To Congress on the Military Power of the People's Republic of China 2008," is located at <http://www.defenselink.mil/pubs/china.html>.

The United States Trade Representative publishes an annual "Report to Congress on China's WTO Compliance." This is good. http://www.ustr.gov/assets/Document_Library/Reports_Publications/2008/asset_upload_file192_15258.pdf.

The International Trade Commission published an excellent report, "China: Description of Selected Government Practices and Policies Affecting Decision Making in the Economy," in December 2007. This is by far the best government study found about China's industrial policy intentions: <http://www.usitc.gov/publications/pub3978.pdf>.

Director of National Intelligence:

Over the past month, Dennis Blair, the director of National Intelligence, has briefed both the House and Senate on the "Annual Threat Assessment of the Intelligence Community." In his first sentence to both the Senate Armed Services Committee on March 10 and the House Permanent Select Committee on Intelligence on February 25, Blair said that the "primary near-term security concern of the United States is the global economic crisis and its geopolitical implications." He told the Senate hearing that "time is probably our greatest threat. The longer it takes for the recovery to begin, the greater the likelihood of serious damage to U.S. strategic interests. Roughly a quarter of the countries in the world have already experienced low-level instability such as government changes because of the current slowdown."

Most of Blair's 45-page testimony is devoted to terrorist extremists. At the February 25 hearing before the House of Representatives, he did not field a single question on China or on the "economic crisis and its geopolitical implications." Members instead focused on the prison at Guantanamo Bay, cyber terrorism, and the situation in Afghanistan, Pakistan and Iraq.

Blair's March 10, 2009, testimony to the Senate Armed Services Committee is located at http://www.dni.gov/testimonies/20090310_testimony.pdf.

A transcript of Blair's hearing before the House Permanent Select committee on Intelligence is located at http://www.dni.gov/testimonies/20090225_transcript.pdf.

"Global Trends 2025, A Transformed World," from the National Intelligence Council, states that among its "relative certainties" is the emergence of a "global multi-polar system" with the rise of China and India. By 2025 "a single 'international community' composed of nation-states will no longer exist. Power will be more dispersed with the newer players bringing new rules of the game while risks will increase that the traditional Western alliances will weaken. Rather than emulating Western models of political and economic development, more countries may be attracted to China's alternative development model." The 99-page report is located at

http://www.dni.gov/nic/PDF_2025/2025_Global_Trends_Final_Report.pdf.

World Technology Evaluation Center (<http://www.wtec.org/>)

The World Technology Evaluation Center is a private organization hired by government agencies to analyze foreign technology development. In the course of my research for this hearing, I spoke with its president, Duane Shelton.

"The little bit of scholarship that I do is pointing with alarm to China in science and technology," he explains. "I have been trying to get this in front of some members of Congress who might be aroused to do

something about this, but I have had very little luck. They are up to their necks in alligators right now and long-range problems like this take a back seat.”

Shelton’s views were typical among those involved in international science and technology issues. He says the United States does not monitor the development of strategic and potentially “disruptive” technology taking place in China. He recently read that virtually all of the key ingredients used in American antibiotics are now produced in China. “I am currently writing about President Truman setting a goal of maintaining leadership in science because of his experience in World War II,” Shelton says. It was important for the United States to continue inventing new technologies in the absence of war, which had just produced such things as the atomic bomb, radar and penicillin. So Truman created the National Science Foundation. “And now we found out that all of our penicillin is made in China, which is a potential adversary of ours,” says Shelton. “This is shocking.”

Having conducted dozens of foreign technology capability studies over the past 20 years, Shelton says the United States is no longer the world leader in many important areas. His organization just finished a study on catalysts, a valuable and widely used technology, and found that there is little technical capability left in the United States, much of it having shifted to China. “I think this is very alarming,” he says. “But I have to tell you that as I try to convince other people, it doesn’t seem to get through to them.”

In the late 1980s and early 1990s, there was concern over these issues. The government created the Critical Technologies Institute operated out of the White House Office of Science and Technology Policy. It was busy putting together “critical technology” lists and contemplating policies needed to encourage their development in the United States. “But over the years as more and more technologies were lost and the manufacturing capacity went abroad and there were multiple sources of supply, our government just gave up: ‘there is a free marketplace and we will always buy things in the market so don’t worry about it,’ ” says Shelton.

Today, China is investing huge sums in new technology, production capabilities and science and engineering education. “Everything has changed overnight,” says Shelton. “A lot of people went to China five years ago and they saw peasants pushing wheel barrels. But if you haven’t been there in the last year, you are out of date.”

Panel II: Discussion, Questions and Answers

HEARING COCHAIR MULLOY: Thank you, Mr. McCormack.

And we'll have now the questioning by the commissioners. Each commissioner will get five minutes. Commissioner Reinsch.

COMMISSIONER REINSCH: Thank you, and I appreciate your courtesy, Mr. Chairman. Unfortunately, I'm going to have to leave, and I'll be back later, but I appreciate your letting me go first.

Dr. Gomory, I have a couple of questions for you. I want to pursue a couple of the remedies that you've proposed and ask you to flesh them out a bit.

On the corporate tax rate suggestion, that it essentially be a differential rate based on company value added, can you say a little bit, first, about how you would determine the value added in that

context? And second, what do you think the impact of that would be on the total number of jobs in particular?

It seems to me that your high value added companies are creating important jobs and jobs we want; they're not necessarily creating large numbers of jobs.

DR. GOMORY: Yes. Let me just take it in pieces. How would you measure value added? I'd just point out that value added is known to be very measurable because that's what they measure in Europe. They have a value added tax, and it's a straightforward thing. It's revenue minus all the inputs to your company that you buy from the outside of it.

So there's no question that value added is measurable because it's being measured now in Europe and every country. So it's a measurable thing.

Now your question about jobs. Very, very similar to the question that always is raised when we find a way to automate something. When you want to make something, people do lose jobs. But they create also higher value added jobs. This would be an incentive to do that.

In Westchester County where I live, there are a lot of very low paid people making stone walls by hand. With this tax, there would be an incentive for other companies--those jobs would still exist. It's just the companies they represent would not be very profitable. The wages would still be paid, but the profitability would be there, but it would be taxed highly. High tax on the low productive per-person thing.

It's an incentive for people to invent another way to make stone walls, and I can tell you there are other ways. Higher investment, more robotics, things of that sort. And they would enter into that field, and they would be low taxed.

So that is a way to drive innovation in our country and create higher value to replace lower value jobs. We were a rich country compared to the world because we dug ditches with machines, not shovels. If we were trying to create jobs, we could dig ditches with spoons. That's not the game. The game is to use backhoes. That's the game that this would be pushing.

COMMISSIONER REINSCH: How would your proposal affect the automobile industry?

DR. GOMORY: Well, the automobile industry is a very productive industry. It would get a low tax. It's very productive per person, yes.

COMMISSIONER REINSCH: Even though they have large numbers of employees overseas, you'd--

DR. GOMORY: No, you only look at their domestic activities.

COMMISSIONER REINSCH: Not their U.S. employment relative to their foreign employment?

DR. GOMORY: Excuse me?

DR. GOMORY: Not at all. The only issue is, are these folks providing a lot of output per capita in the U.S.? That would be the only measure.

COMMISSIONER REINSCH: Okay. Let me ask you about the trade balancing proposal.

DR. GOMORY: Yes.

COMMISSIONER REINSCH: The Warren Buffett proposal.

DR. GOMORY: Yes.

COMMISSIONER REINSCH: Do you think that's consistent with our multilateral obligations?

DR. GOMORY: You mean like is it consistent with WTO and things of that sort?

COMMISSIONER REINSCH: Yes. And other bilateral and multilateral obligations.

DR. GOMORY: I've discussed that with lawyers, and there is dissent among them. So I think it's, I believe there's a WTO provision that allows a country that has a consistent trade deficit to do this sort of thing. We are such a country. That's probably where it would come out, yes.

COMMISSIONER REINSCH: Terry, are you one of the lawyers that thinks it's WTO compliant?

MR. STEWART: I think the issue is could you structure something that would be WTO compliant, and if you went off of that particular provision, then perhaps you could.

COMMISSIONER REINSCH: I'm not sure what that means.

MR. STEWART: This is the opportunity to impose a duty across the board where you're running a large balance of trade deficit. It's what the U.S. did back in--

COMMISSIONER REINSCH: No, I'm trying to figure out what you would do that is different from what Mr. Buffett proposed that would make it okay?

MR. STEWART: I haven't read his proposal in a long time. So my recollection of his proposal was that you would impose a duty based upon the level of deficit that you were running to try to get to a balance. Is that correct or--

DR. GOMORY: No.

MR. STEWART: No.

DR. GOMORY: That's not quite right. It was really a market-driven thing, but it would have ended up with the effect that Mr. Stewart is describing. Yes. But I've spent time talking to people

about this. They think you can do it. Yes.

COMMISSIONER REINSCH: I'm out of time.

HEARING COCHAIR MULLOY: Yes. If I could just supplement that. The Alfred P. Sloan Foundation did make a grant to EPI, the Levy Institute, and some others to flesh out that proposal, Bill, including looking at how you can make it WTO consistent, and my understanding that study will be out within a month or so, and we'll make that available to all the commissioners.

COMMISSIONER REINSCH: Good.

HEARING COCHAIR MULLOY: Mr. Wessel.

COMMISSIONER WESSEL: Thank you, gentlemen.

I'd like to follow up in part on Bill's line of questioning --these are great informative charts. My hope is that they'll be in our hearing record and we can post them on our Web site so that we can have peer review and share them broadly--

HEARING COCHAIR MULLOY: I'm told by staff that we can do that.

COMMISSIONER WESSEL: That's great. Let me, Dr. Gomory, if I could, follow up for a moment, and you and I have talked in the past. I think we share many of the same goals. We've talked about corporate governance and some of the great work that Sloan has funded in the past, not only what Pat just referred to, but on corporate governance, on counting of intangibles, how one values the work product and the investments we've done here in the U.S., in training, retraining, and the skills that our workers have, et cetera.

At the same time, I have some concerns about the differential tax approach because, and I believe it was during the NAFTA negotiations again where the ITC did an evaluation of how workers would be affected, which has been a proxy for many other trade debates, and they said 70 plus percent of the American people would be disadvantaged as they were lower skilled because they had less than a college degree.

They said that high-skilled, high college-educated people would be the beneficiaries, and those who did not have that level would not be, and clearly we have to do something about our education level, et cetera.

But if you use a value-added model as you're suggesting, a General Motors could increase its value addition, if you will, assuming it can maintain prices, by importing more foreign auto parts because on a credit invoice method or on a VAT deduction method, you do it at the value it's been increased at each stage of production.

As you pointed out, you subtract out the inputs into the system. And I think that in some ways unless we are able to disaggregate this

and go at it much more carefully, the system you're suggesting may actually disadvantage lower-skilled workers. Not all of them are going to be able to move up and stop using the shovels and using the backhoes. We'd love all of them to, but that's not the way that the system works.

So I think again the goals that you're suggesting are very laudable.

In addition, the Buffett approach, I believe, allows for gamesmanship, and, I've been arguing for my entire adult life policy-wise that we need to do something about our trade deficit. However, the Buffett approach, if you're talking about the certificate-based approach where exporters earn certificates, for those with monopoly, monopsony or other substantial power in our markets, they would keep these certificates of the market and therefore limit the ability of their competitors to be able to gain access.

So all I'm suggesting is I think there are no simplistic solutions--we need to find a way of debating all of this.

The question is for so long we have viewed China, Japan and others as being unfair in terms of their trade approaches. Maybe we need to become more like them. How would you change U.S. policies? That the Chinese, the Japanese, the Europeans, what are they doing that we should, in fact, adopt rather than simply continue to ask them to dismantle their policies?

DR. GOMORY: Well, you've got a lot of questions there.

COMMISSIONER WESSEL: That's true. And I got all my questions in under five minutes.

DR. GOMORY: So let me try my best to answer them. First of all, on the question of disadvantaging lower skilled workers--I think there has been far too much emphasis placed on this educational attainment. When we became the greatest economic power in the world, which was in the 1920s-- it wasn't because our workers were better educated. It was because our companies provided them a setting in which they could contribute, notably a production line.

So we keep pointing to the education of our individuals. We should be pointing at the ability of our companies to make them productive. I think we're underestimating the human capabilities and pushing it on the educational system.

With respect to gaming, the Buffett thing, we'd have to talk about that in great detail, and we should fix it. But the merit of it is, is that it looks at the result. All the proposals are about we'll do this and we'll do that, and maybe that will balance the trade better. This looks directly at the balance.

And so with these certificates, we're going to have balance.

Then, people can start to play games with the certificates, but I think it's a good direction and deserves serious consideration. All these other things get talked about, but this thing, which depends on the end result, doesn't, and it needs it.

COMMISSIONER WESSEL: Comments by the others on what you think we should do differently?

DR. GOMORY: I think we should do different two things. We should adopt some version of the tax I described, and we should adopt some version of the Buffett proposal, but, in addition, in the first panel and in many discussions in which I have participated, we're always telling the other country to do this and do that. In my opinion, they aren't going to. They're going to pursue their national interest.

I think we should pursue our national interest and put first things we can control, not things we can try and persuade others to do.

MR. STEWART: I gave two areas where it seems to me you have important opportunities from the U.S. government point of view. I also think when you take a look, there is a strategic shift in the way multinationals are behaving.

Historically, U.S. multinationals in particular, but also European multinationals, had a model of supplying from a regional base, and China is, at least in some cases, threatening that basic model, and one needs to take a look, I think, at what is driving companies to change their model.

I believe that the answer that will come back, it is the distortions that are created by the wide range of issues that have been looked at that make China appear to be the only place that one can have a global shipping strategy from, even though take China out of the mold and they wouldn't do that anywhere else in the world.

MR. McCORMACK: There has been a theme today: how do we become more like them? Or adopt their strategies? And I think, first, we don't really have a governmental apparatus that really studies, does the analysis of what those are, and Clyde was talking about it this morning. We heard him say that it would be great to get Intel and IBM and others to discuss why their investment is going where it is. And until you know that, it's very hard, I think, to counter it.

Second, Commissioner Reinsch asked this morning what is our strategy? Should we attack them with trade rules and the like--or should we play their game even though we think it's illegal?

Having covered science and technology, industry and government since I started New Technology Week in 1987, I think there's an American way to do this, too, and it's been successful. We created the National Science Foundation after World War II. We created DARPA.

We put a lot of money into science and technology. The Internet was

not industrial policy per se, but it was generally the result of a tremendous investment in research and technology.

I started New Technology Week in 1978 at the height of the Japanese competitive threat, and I got to know people like Bob Galvin at Motorola and John Young at Hewlett-Packard and Bob Noyce at Intel. We had real champions come, and they thought the way you deal with this Japanese threat, at least one of them, and a very important one at that, was by investing heavily in science and technology.

We saw the creation of SEMATECH. The National Center for Manufacturing Sciences was created. You'll hear from OIDA, the National Electronics Manufacturing Initiative was created.

There was a tremendous sense that for the United States, the only way it could win the Cold War was we couldn't out-produce the Soviet Union, but we could make sure that we were dominant technologically. And for some reason in the last eight years, that's just been off the table.

During that era when we had these incredible champions, and maybe it's for the reasons that Ralph talks about, the divergence of corporate interests and national interests but we don't have them anymore. But in terms of covering the Reagan era there was policy debate about industrial policy and how to deal with Japan, but the country had Alan and Clyde. I don't know if those people exist now. I just don't know.

Maybe they do. Maybe they're somewhere at USTR, and we'll know about them in 20 years, but they were pretty well-known back then. And so I don't see that now. And I think after Ronald Reagan did what he did, he became a hero among Reagan Democrats because he was an economic nationalist. He was a reluctant one, but by 1987, I was covering him closely, and he was as old as my grandmother, and everything had kind of run amok in many respects, but in science and technology, it's good to have things run amok.

It's good to have trial and error. It's good to pick winners and losers because when you pick a loser, you're going to learn a lot from it. That's the whole idea behind the trial and error method. So we have our way. It's proven to work. We know it works. And in all this, the rules dealing with China, trying to force them to float their currency, man, that's tough, that's tough.

But there are some things that aren't. I think one of them is just an absolute commitment to science, technology, innovation, commercialization. We have the models here. Everybody else has studied them. We have the Advanced Technology Program. We have DARPA. We have these mechanisms already in place to utilize, and that's at least one that's within our control.

HEARING COCHAIR MULLOY: Commissioner Wortzel.

VICE CHAIRMAN WORTZEL: I have a longer question for Dr. Gomory that, if we get around to a second round, I'll give him a few minutes to talk about. Mr. Stewart, two of your tables really attracted my attention, and I want to focus on them. China's imports by state-owned enterprises and China's exports by state-owned enterprises. And I want to turn our attention to national security for a minute.

If you look at the number five import by China's state-owned enterprises, in your table, today 74 percent of the imports by state-owned enterprises are aircraft, powered aircraft, spacecraft and launch vehicles--powered aircraft, spacecraft, and launch vehicles.

And then number 47 is turbojets, turbo-propellers and other gas turbines. China has been historically horrible at those things, and--although they've improved--they imported 68 percent today--in 2006; only 50 percent today.

If you look at China's exports in that area, those things aren't listed in the top 50 exports. They're not there. So you have a country that is manufacturing maneuverable satellites to potentially impact American spacecraft. You have a country that's doing a great job on anti-satellite weapons. It's got new ranges of missiles, and it's doing all that with foreign help.

It can't make an effective jet turbine engine for a tank or for an aircraft or for a submarine, or a turbo engine for a submarine, and it's importing all that.

It seems to me that one of the policy levers we need to think about is how to make sure that they don't do a lot better and that they don't begin exporting that stuff that they get to be a world-class producer?

And so I would invite all of you to talk about mechanisms to make sure that in those two areas, the United States is able to maintain its competitive edge and protect its national security when you have the Second Artillery of China threatening to use these missiles to sink American ships.

MR. STEWART: Part of the challenge, it seems to me, commissioner, that we have in an area like civil aircraft, what the statistics show is what their industrial policy is, namely, that civil aircraft is a state-dominated area.

The challenge is with so few major civil aircraft producers, you already have commitments to produce in China certain pieces of the big commercial aircraft as the price for a state-owned enterprise being willing to continue to buy from American sources I suppose.

So the challenges, having transferred a certain amount of the

technology and a certain amount of the manufacturing, we're not yet seeing it in finished aircraft, but obviously one of their ambitions is to be an internationally competitive aircraft producer, and with a good part of global demand for aircraft projected to be in China over the next ten, 15 years, there certainly is an incentive for them to get there.

Hard to see how you back away from them having that opportunity other than putting a restriction on companies like Boeing from being able to transfer that technology which is already being transferred. So I don't have a good answer for you as to what you can do.

VICE CHAIRMAN WORTZEL: Any other comments?

DR. GOMORY: No.

MR. McCORMACK: Good luck. I went to Japan in 1987, and I toured around Japan with the Akio Morita, and we met with the Keidanren, and also we also went to Mitsubishi Heavy Industries, and they were pursuing all these technologies, and they said we targeted your industry. We targeted your American aerospace industry. Look out.

I've learned a lot from Toyota. I wrote a book about Toyota. Toyota doesn't mind giving away its, quote, "secrets" because it's trying to stay in front of everybody else, and I think for us to survive, to prosper, I think that's pretty much what our strategy should be--we can't stop technology from leaking or stop people from getting it.

When the Soviet Union put up their space shuttle, it looked exactly like our space shuttle. I've just seen pictures on the Internet recently of China's B-1 bomber. It looks exactly like ours, so you just have to stay ahead. You have to stay ahead. Otherwise you're history; you're toast.

There just has to be such a profoundly important and robust commitment to science and technology in our country, and there hasn't been.

The National Science Foundation's budget is \$5 billion or \$6 billion for research. That's our trade deficit in three days. The DoD budget is \$600 billion, \$700 billion. NSF's is \$6 billion. It's noise. When I was dealing with the DARPA guys who are in charge of technology, Steve Squires back developing advanced computational techniques to create the petaflop computer--he always said that's "noise."

So we have to do something other than noise to make sure that we stay in front, ahead, vibrant, and to keep our companies healthy.

DR. GOMORY: Could I add something to your question? If you pick a particular industry, say part of this aircraft industry, I think it's a mistake to say how can we keep it? If you have balanced trade, if

you're losing this, you're going to make up for it somewhere else.

It's the threat that we're going to lose everything that is disturbing. And that's why you may lose it because they subsidize their aircraft part industry or something else. That's why balancing trade is absolutely essential because otherwise they can take one damn thing after another.

So if you don't address balanced trade, you're just going to fight one losing battle after another.

HEARING COCHAIR MULLOY: Commissioner Blumenthal.

Thank you.

COMMISSIONER BLUMENTHAL: Thank you all very much.

President Reagan as an economic nationalist--I guess we're all economic nationalists now in terms of flashing marginal tax rates and deregulating major parts of the economy. Certainly he was interested in certain technologies to compete with the Soviets, SDI, but economic nationalist I think may be pushing it.

I've read "The Gathering Storm" very carefully, and I agree with Mr. McCormack on the need for science and technology, which has been downward since the end of the Cold War.

But let me ask you all three this question, which is what made Japanese and Korean and German auto companies decide to invest heavily in the southern states of the United States?

DR. GOMORY: In what?

COMMISSIONER BLUMENTHAL: In the southern states in the United States? What policies did those states take to make themselves attractive?

MR. McCORMACK: Well, Clyde mentioned it, just asking the basic question, which is what will it take for you to invest here?

COMMISSIONER BLUMENTHAL: And what did it take?

MR. McCORMACK: I think Alabama put \$350 million down on the table, and that's been debated as to whether or not that was paid off, if it was a worthy investment? I think North Carolina has probably done--I'm not sure exactly how much--but they came to the table with BMW. I think IBM invested in New York.

COMMISSIONER BLUMENTHAL: Wasn't it labor policies and tax incentives and--

MR. McCORMACK: Partly, yes. It's all that.

COMMISSIONER BLUMENTHAL: Okay.

MR. McCORMACK: Uh-huh. I think that's one of the keys that we have to--we don't know in this country why companies are investing. One of the big stories that I covered in manufacturing in the 1990s was best practices.

Companies studied best practices and adopted them. We haven't

really done that in our country.

COMMISSIONER BLUMENTHAL: Are those investments by Mercedes and DaimlerChrysler and Hyundai and Toyota and Honda, are they good for American workers and are they good for the American economy as investments in those particular states?

MR. McCORMACK: It's a rhetorical question; right?

COMMISSIONER BLUMENTHAL: Well--

MR. McCORMACK: Yes, absolutely.

COMMISSIONER BLUMENTHAL: So we actually know how to do this? We actually know how to incentivize foreign companies to invest in our country?

MR. McCORMACK: Our states do. Yes, I would say our states do.

COMMISSIONER BLUMENTHAL: Anyone else on this issue? We actually know the answer to Mr. Prestowitz' question before?

MR. STEWART: There's no company that has a facility in America that doesn't know how to go after the states to help lower their costs by providing incentives for locating or relocating where they're located. So that's true for domestically-based companies and for subsidiaries of foreign companies.

COMMISSIONER BLUMENTHAL: But, in general, this has been good for the American economy, in your opinion?

MR. STEWART: There will be debates as to whether or not it's been good for the American economy to have that competition between the states. But certainly the states know how to go out when somebody is looking to invest in the United States to get it invested in Alabama or Michigan or California, where have you.

COMMISSIONER BLUMENTHAL: Do you think that those investments have been good for the American economy? Those investments by foreign automobile makers, in particular?

DR. GOMORY: Do I think so?

COMMISSIONER BLUMENTHAL: Yes.

DR. GOMORY: I think it's hard to know, but if I may mention some related topics. There's been a stress on understanding that sort of question, and one of the things that the Sloan Foundation did was to found in 26 industries academic centers to do that kind of study. I would suggest that you talk to our Automobile Center.

I've done that. And I've asked them this sort of question. For example, what is the foreign content in a Toyota made in North Carolina as compared to the foreign content of a Chrysler or a GM car?

And the answer is it's about the same. So what you really have done is simultaneously Detroit has started to import a good portion of its value and Toyota has created in North Carolina, for example, a place

which also imports but adds American labor and so forth, and today they're hard to distinguish between.

The net impact on the United States is partly to keep down the wage level. Okay. So that the division of value add is a little different from what it used to be. In other words, one of the attractions of those states, of course, was that their non-union labor was lower paid than union labor in Detroit, but if you look at the actual performance, they're all using about the same technology. One is not more efficient than the other. They have a somewhat different labor scale, and that's about the only difference today.

COMMISSIONER BLUMENTHAL: Do you think the Japanese and the Koreans are debating whether their companies by investing in the United States are somehow being unpatriotic, and if they are, would that be a destructive debate to have in the American economy?

DR. GOMORY: That's very hard for me to know what they're debating, but I can tell you this, I remember quite a few years back seeing a presentation by a Japanese computer manufacturer because that's what I dealt with, when I was in IBM, and they put up a list of what the company is there for. Number one on the list, and I never forgot it, was create good jobs in Japan.

That was number one. Around number seven was profit.

COMMISSIONER BLUMENTHAL: But they're creating good jobs in the United States, and if they otherwise didn't invest in the United States, then they wouldn't be creating those good jobs in the United States.

DR. GOMORY: I think if I were in Japan, I would be very concerned that if I attempted to continue to compete in the United States by shipping over completed vehicles, that I might have a problem.

COMMISSIONER BLUMENTHAL: Is my time up?

HEARING COCHAIR MULLOY: Yes.

COMMISSIONER BLUMENTHAL: Okay. Thank you.

HEARING COCHAIR MULLOY: Thank you.

Commissioner Slane.

HEARING COCHAIR SLANE: One of the impediments of solving our deficit problem is the resistance that the government receives from U.S. multinational companies. How do we change the fiduciary duty of U.S. multinationals from a stockholder to include other constituents?

DR. GOMORY: Well, I do think that one of the ways is to reward companies that do what we consider the right thing. The first thing, however, is the government has to say what it thinks is the right thing.

I sit on the board of a nameless global corporation and all we do is we move jobs out of the U.S. Now we're moving them out of Mexico. Now we're moving them out of Scotland. All we do is moving them to what we refer to as low-something companies. We do that.

Nobody makes a peep on the board including yours truly. What am I supposed to do? Say this is bad for the country? I've tried doing that. And the answer is the country is not saying that to us. The United States government is not asking this company or any other company to keep jobs in the U.S. or to keep them in Mexico or to keep them in Scotland. They don't have anything to do with that.

Number one, there is no reference point for a board of directors to have other than profit maximization as its goal. Okay.

Second, if we were to enact a tax which made corporate profitability in the U.S. high value add, then there would be a motive to consider things of that sort, like jobs in the U.S. But right now it's a vacuum. Even jawboning is not being done.

MR. McCORMACK: It's amazing.

MR. STEWART: It's an interesting question. I guess I would start from a premise similar to Dr. Gomory, in that as presently constituted, boards obviously have as their primary objective to look out for the shareholders. In many companies shareholders include the workers through retirement funds or pension programs where company stock is part of what is being held.

From a corporate law perspective, one could look at the right of what you might call minority shareholders, which would typically be the role of employees. However, I think in terms of the overall issue, vis-a-vis China and other trading partners--it comes down to the basic government policies that have been put in place.

When you take a look just at something like the discrimination we face on indirect tax versus direct tax, our inability as a nation to come up with a system that relies more heavily on indirect tax, we subject our domestic producers to as much as a 25 percent disadvantage on imports that come in and compete against them, and our exporters to a 25 percent tax over and above what they pay in the United States.

Those are major disadvantages that are policy selections by the government that ought to be addressed that are within our control that don't have anything to do with what China does or doesn't do.

There are many policy options that China pursues that either are subject to negotiation. We don't have investment obligations, and so the bilateral investment treaty approach would be an approach that could help address some of the problems our companies face in getting

a fair shake when they move to China or when they consider investing in China or when they consider not investing in China, but nonetheless face barriers that would be WTO inconsistent or that could be addressed through some other negotiation.

So I see my time is up. So I'll stop there.

MR. McCORMACK: I would say this, that Dan is right. Since the Reagan years, we've been in an era of thinking the corporate profit motive is going to save us, and our best long-term interests are going to be carried by the interest of corporations.

But I think that model has proven to be wrong. I have covered government being here for 26 years, and I think one of the frustrations that I found within our government and people who are dealing with these issues that you are talking about here is that there's only one place really in our country that has the long-term interests of our country within their purview of what they do, and that's within our government.

Because the private companies are looking to maximize profit. They are looking to move jobs overseas. And I think our government infrastructure has been enervated by this inability to, unwillingness to, allow/empower people to take risks, to look out for the long-term interests of the country, to adopt, quote, "industrial policies," or picking winners or losers, or corporate welfare, what have you.

There's that old saying in Japan that the nail that sticks up gets hammered back down. Well, it's kind of happened in our country. And we're paying the price for that. We are, everybody knows that with the Wall Street meltdown.

We need to have a much longer-term view. We need to empower people within our government to take risks, and when I mentioned during the Reagan years, there were people like Bruce Merrifield and Bob Costello and Clyde and others. They were empowered to take risks, and I think that the one thing that I would love to see occur in our country is that happening once again.

HEARING COCHAIR MULLOY: Thank you.

Commissioner Videnieks.

COMMISSIONER VIDENIEKS: Gentlemen, good afternoon. It's my understanding that U.S. R&D expenditure a part of GDP, is pushing three percent, two-and-a-half, three percent total, government and private, corporate.

But I understand the trend has been sliding a bit. Going down from the highs of a few years ago, a couple decades ago, down to what it is now. Our relative productivity apparently, employee productivity and competitiveness relative to PRC are apparently sliding also. And yet we still lead the world or are one of the leaders of the world in

R&D expenditures. Where is this money going? That's a question for all of you.

MR. McCORMACK: Nuclear bombs.

HEARING COCHAIR MULLOY: You want to start, Ralph, or we can go across the panel.

DR. GOMORY: Well, I didn't quite follow whether you were talking about--

COMMISSIONER VIDENIEKS: Has there been a shift in destination of this R&D money? The money is there, a lot of it.

DR. GOMORY: I didn't quite understand whether you were talking about government R&D or all private industry R&D or what?

COMMISSIONER VIDENIEKS: You can take them separately if you wish, corporate versus government, but I'm basically interested in aggregate amounts. The money is still big, it's out there, one of, we're top, top of the world.

DR. GOMORY: Yes.

COMMISSIONER VIDENIEKS: Competitiveness is going down. Where is this R&D money going? That's, my question and we'll have to answer it someday.

DR. GOMORY: I think the spending on R&D does not necessarily result in competitiveness. First of all, government expenditure in R&D is very different from corporate expenditure in R&D. So government expenditure--so let me just take the part I know--

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COMMISSIONER VIDENIEKS: Basic versus applied maybe?

DR. GOMORY: Basic research-- we do a lot I think compared to many countries. But basic research, which used to then result in new industries in the U.S., because we were the only people who could read the damn papers--it's a different world now.

You've got people in China and you've got people in Japan and you've got people all over Europe who are just as capable of reading the papers and translating them into action. Right. So it's very hard to win by doing basic research.

So your competitiveness, which it isn't clear exactly how that gets measured again, but let's say market share of something. Fine. Competitiveness depends on (a) being able to know the latest; and (b) translate it into product.

COMMISSIONER VIDENIEKS: Capital investment does make the highly-paid U.S. worker more competitive than a lower-paid worker with less capital back-up.

DR. GOMORY: Certainly.

COMMISSIONER VIDENIEKS: So my question is are we still investing in capital that would increase the productivity of the worker

or are we investing someplace else?

DR. GOMORY: Oh, I see. I misunderstood your question.

Yes. That would be a very interesting question to know, whether the capital per worker--that's a different number than an R&D number totally, and it would be interesting to know, and I don't have that in my arsenal.

COMMISSIONER VIDENIEKS: Sir?

MR. STEWART: I'd be happy to supply information on the private sector from the government stats after this. I don't know off the top of my head where the changes occurred. When I've looked at the issue in the past, you can typically correlate R&D expenditures and to some extent capital expenditures with industry profitability.

And so the sectors that have had high profitability, one would expect there to be high R&D, high capital expenditures. But I'm happy to do that for each of the two afterwards.

COMMISSIONER VIDENIEKS: Thank you. We'll get it. Sir?

MR. McCORMACK: In my coverage of science and technology over the years, I think I've heard a lot about the "valley of death" and this kind of the mezzanine area that is between basic and applied product research, and there's been a big debate in the last few years about our investments in science and technology. If you invest in nanotechnology, it gets applied in all products across the board.

If you're not making those products in the United States, then why are you investing in that if it's benefiting everybody else? I know people who have looked at our investments in solar power, for instance, in photovoltaics, and it's like we don't make any of them here. So that's a lot of great investment that's just benefiting others.

Nuclear power is the same. We don't have a nuclear vendor in the United States, yet we're still making tremendous levels of investment.

When I came up to the press conference here for "The Gathering Storm," the question I asked Senator Domenici and others was, okay, you're going to put all this money in science and technology and in R&D, but that's not the problem. The problem is you've got to commercialize it. You have got to create jobs. You have got to create a structure so that you've got economic development. Jobs are a big deal, and that's not been a focus.

COMMISSIONER VIDENIEKS: The reason I'm talking about the ratio, maybe R&D was the wrong approach, but the ratio of capital to labor. There must have been a shift.

MR. McCORMACK: I think there's been a massive shift, and now pendulum has swung. We're not producing in the United States. A lot of our R&D is being conducted offshore because you can hire a

scientist in India for \$5 an hour; in the United States, it's \$86 an hour.

So we have to figure out a way to get this pendulum back so it's benefiting the United States, and right now it's not. All that investment, it's questionable as to whether or not that investment is benefiting the United States. That's a serious question that needs to be addressed and I think is going to be starting to be addressed. All these issues are starting to be addressed now because we're forced into it.

DR. GOMORY: Yes.

MR. McCORMACK: So that's the good news I think.

COMMISSIONER VIDENIEKS: Thank you.

DR. GOMORY: I think it's a very good question, and I think you've illuminated, and I hope maybe our answers have, is that there are different parts. There's doing the research. There's doing the R&D. Then there's putting the investment into it so something really comes out. And you can't just talk about one part as driving it. You have to have all the pieces or you get nothing out.

MR. McCORMACK: DARPA was a good model because of the whole idea of noise; they didn't want to invest a little bit. They needed to get through that valley of death.

COMMISSIONER VIDENIEKS: But they lead the world. So it may be noise to DoD, but it may not be noise to another department. The bucks may be small depending on how you look at them.

MR. McCORMACK: Well, in preparing for this event, I started calling around to see if anybody monitors foreign technology, and I came across the World Technology Evaluation Center. They just completed a report on catalysis research and how important catalysts are in the entire industrial process. And I think in here it says that catalysis results in like \$1.3 trillion worth of GDP.

And then they looked at the United States investment, in catalysis research, and it's minuscule. It's like \$7 million, but the net benefits are an industry that's \$1.3 trillion. So for a little amount of money, you can get a big impact.

COMMISSIONER VIDENIEKS: That's with the multiplier effect, I guess, of high-tech S&T investment. Yes. Mr. Chairman, I'm done.

Thank you.

HEARING COCHAIR MULLOY: Thank you.

That was a very interesting discussion. Mr. Stewart, you were going to be able to get some information that we could put in the record?

MR. STEWART: Yes, I'll do that after the hearing.

HEARING COCHAIR MULLOY: That would be very helpful. We're going to start a second round after I have my time, and then

we'll go through. People have some second-round questions.

Here's my understanding. Alexander Hamilton when he was Treasury Secretary after we got our independence, I think the British wanted us to take manufacturers and we were to provide the raw materials, and Alexander Hamilton said no, we're going to become a manufacturing country.

And so there was essentially an industrial policy put in place to help us do that. So this isn't a new game. And my understanding is China looked out there and said, well, you know, if we provide the low-cost stuff and the Americans do the high-cost stuff, they're going to be bigger and more powerful and richer, and so let's figure out a way for us to move up. They're like Alexander Hamilton, you know. We're like Britain. And they said no, we don't like it that way, and they developed a different way of looking at it.

Now, the AFL-CIO at their March meeting in Miami issued a statement on "America Needs a Program to Maintain and Grow Good Jobs." In this statement, they say:

"It's time to realign corporate and financial interests with national interests. All stakeholder concerns, not just the narrow interests of the privileged few, must be addressed if we are to succeed as a nation."

My understanding is the corporations now are focused solely on shareholder value. My further understanding is that's a new phenomenon essentially from what was going on in this country 35 years ago. There were more stakeholder interests involved.

I also understand that the CEOs have tied their own salaries to the shareholder value. So if they increase shareholder value, they increase their own well-being. And the companies have found they can increase shareholder value by moving production and R&D out of the country and shipping back to the country, which is different than the Japanese companies do. Honda may make a car here, but they're not shipping the cars from here back to Japan.

So I see that as a different way, and our corporations are doing the other, making it there and then shipping it back. Is that from your perspective the right analysis of what is going? I ask this because we're going to be wrestling how to write a report to the Congress on these issues.

Dr. Gomory, Mr. Stewart, and Mr. McCormack.

DR. GOMORY: I do think it is the right perspective. I would only make one small inundation to your remarks, is that it isn't the corporate salary. It's the CEO's compensation, the high management compensation, which consists only in a very small way of salary although people always talk about limiting that. There are bonuses

and then there are stock options.

The bonuses depend on attaining a certain goal. Stock options depend on the share going up. But the purpose of that change which occurred in the last 25 years was precisely to tie the CEO's interest and the upper management interest to that of the shareholder, and it has been exceedingly successful in doing just that.

HEARING COCHAIR MULLOY: Mr. Stewart.

MR. STEWART: Commissioner, I would refer back to my comment that the phenomena you identified, namely, companies moving offshore and shipping back, is one of the fundamental shifts in behavior that one sees, and whether that flows from corporate governance issues is less likely in my view. I think it flows from an imbalance between overall cost structures, incentives and policies of trading partners that make it an easy decision for someone looking to maximize profitability to pick.

And that in my view is an artificial framework that has been created that we don't recognize because our system puts a primacy on, quote-unquote, "free markets" even if the market that we're dealing with is not a free market such as is a large--partly the case in China.

The other aspect that I think often not understood is that over the last 50 years a lot of corporate America has moved from family businesses. If you look at most major cities and you look at what has historically been the corporate anchor, that's a family that has deep ties to the community, and so you often find those families on the names of hospitals and high schools and other things in the community.

As those companies have been sold off from the families, you lose that connection, and then it becomes an easier matter to simply look at it as a chessboard and where do I move my pieces, and that becomes a constantly evolving game.

HEARING COCHAIR MULLOY: Thank you.

MR. McCORMACK: In terms of my coverage on these issues, your question is about the most intriguing issue I've covered in the last eight years because I didn't ever hear of it until eight years ago, until you had the domestic manufacturing group within the NAM saying our interests are different from the multinational interests.

And to cover that story, it's hard. It's a hard story to cover, and it's not been covered well, but it's absolutely the essential story of our era. This idea of corporate interests diverging from national interests is a very hard thing to put your hands around, but you have to ask the question.

If you ask that question of Caterpillar or of the companies that are outsourcing or are global, you don't get really much of a reply

other than the fact that they are doing what's in their best interests and they have to do it in order to survive.

And you ask the small guy, and he's absolutely irate and he's going out of business, and he's losing his ability to pay workers and have communities that thrive. As a journalist covering this, it's incredible to hear the passion of people who are in the small and medium-sized businesses talk about how this is a major societal change.

If the multinationals are no longer supporting Americans, then what? If you have this whole system, this infrastructure fallout, and then do Americans do? Do we all knit and grow gardens and become somehow self sufficient. Do we all go back to the pre-multinational days?

HEARING COCHAIR MULLOY: If I could, before we start the second round, I'll just finish, and I won't take a second round.

MR. McCORMACK: Yes.

HEARING COCHAIR MULLOY: The other question, you said that this is the way our system works, the companies are out pursuing the profit, and I think you said earlier that the government should have a voice telling what do you really want of your companies, and our government doesn't say anything.

MR. McCORMACK: I think it might change. I think we might see a change.

HEARING COCHAIR MULLOY: Why isn't our government saying anything? I'd like for you to go across the board and tell me that.

MR. McCORMACK: I talked to Representative Michaud and I asked him the same question, and he said we have monied interests. Basically he just came straight out and said it: Those who control the debate are the people who have the money to influence and shape the debate, and those are the organizations that represent these very large companies. He says it straight out.

HEARING COCHAIR MULLOY: Does anybody else have a comment on that one?

DR. GOMORY: I would agree, but I think we keep coming back to the fact that the corporations are making a profit and that's their whole goal, and the country needs GDP--right--and these two are not the same. And the government is doing nothing to align them, and that's why I propose the particular form of tax that I did, and in the debate, they don't have a clear vision of this problem.

They are constantly getting input from my old company, good old IBM, et cetera, et cetera, and that input is leave us alone, we're doing just fine.

HEARING COCHAIR MULLOY: Do you have anything to add? Okay. Commissioner Wessel.

Thank you.

COMMISSIONER WESSEL: Thank you.

I'm sure we could not only have a hearing on this topic for the rest of the day but probably for many, many weeks. Although we are a U.S.-China Commission, the issue of corporate governance I think does impact a lot of these issues.

I should point out that a corporation is a legal entity. It's created by government or actually the laws that allow its creation are created by government, and Commissioner Slane from Ohio has the benefit of a dramatically different corporate structure there or corporate law as it relates to the business judgment rule, where in Ohio, a director of a public corporation is allowed to take the interests of all stakeholders into account; a Delaware corporation has to address the primary of the interests of the shareholders.

So there are some ways of looking at this, but it demands a much deeper, longer-term discussion that really goes to the core of some of our laws that have been on the books since the founding of this nation, some since the '34 Securities and Exchange Act and subsequent to that.

Potentially the Research Working Group may want to discuss the question of whether we can see any differences in how companies operate based on their state of incorporation and whether there is some impact on that vis-a-vis also family-owned institutions, et cetera?

That may be a project that is too big for us to undertake but something worth discussing.

Mr. Stewart, I'd like to go back to your data for a moment, and looking at the foreign-invested enterprise issue, when PNTR was passed, the proponents heralded the ability to serve the Chinese market as one of the most important benefits of PNTR.

As I look at these numbers and the research we've done over the years, I look at these, many of the foreign-invested enterprises, potentially as industrial tourism, that they are importing parts that are largely being assembled and then re-exported rather than serving the Chinese market.

Have you looked at the underlying data here, and would you agree that what many of the multinationals that have gone over to invest in China are, in fact doing is really using China as an export platform?

MR. STEWART: I don't have good data on domestic consumption in China. Certainly what you say is true, that there are lots of imports by foreign-invested companies that are components that go into products that are either sold domestically or exported to

someplace in the world.

How big that difference is I can't tell you. You see large increases on both the exports and the imports from foreign invested, and it varies quite a bit. When you look at the IT sector, for example, you see that there's massive semiconductors that are exported to China and obviously all of the products in which semiconductors are used, there's even larger increases in exports from China of those products.

The missing element is how big is the domestic market and how much of the foreign-invested product is, in fact, being sold in the domestic market? Certainly, from anecdotal information that I would have from companies that I've talked to over the years, that will vary quite a bit.

You have companies who view their investments as, first and foremost, to serve the Chinese market and to supply certain products for export, but I'm sure that you have some, some companies who have invested to make that be the global source for Product A or Product B.

COMMISSIONER WESSEL: Do you have as a private sector practitioner access to that information? Is corporate reporting robust enough? Is it done through BPI data to Commerce? How would we, if we wanted to get further into this information and understand sourcing patterns and consumption patterns get at it?

MR. STEWART: I'm not aware of any source, and as a general matter public companies don't break China out separately. Some do, but most don't. And so I don't think you could get it from a public database.

You would need a survey done either by one of the business associations, something of that sort. Now, the U.S. Chamber in China may collect that type of information. I haven't looked at their most recent report so I don't recall off the top of my head.

COMMISSIONER WESSEL: If the ITC were asked to do a study such as that, would they through one of the questionnaires have access?

MR. STEWART: Sure. They could do that through questionnaires. You could do it through Fortune 100 and get a good idea for at least some of the very largest companies what their experience has been.

COMMISSIONER WESSEL: Okay.

HEARING COCHAIR MULLOY:
Commissioner Wortzel.

VICE CHAIRMAN WORTZEL: Dr. Gomory, I've never read Warren Buffett's 2003 Fortune article. So I just missed that.

DR. GOMORY: It's really a beauty.

VICE CHAIRMAN WORTZEL: Can you briefly explain how this

market in import certificates might work?

DR. GOMORY: Yes.

VICE CHAIRMAN WORTZEL: And then what, if you created such a market

--what regulatory mechanism would you need to prevent manipulation as people trade in certificates?

DR. GOMORY: Yes. Let me describe the second part. You're sure you want to hear this?

VICE CHAIRMAN WORTZEL: Well, keep it simple. DR. GOMORY: It's pretty straightforward because Warren Buffett is a very straight thinker. And it's just this, that every exporter, suppose he exports a million dollars' worth to any country outside the U.S gets a certificate that says a million bucks export.

Any importer, and these things are sold on the market now, who wants them, importers are not allowed to import—for example in a million dollars' worth of goods unless they've bought the certificate.

VICE CHAIRMAN WORTZEL: Okay.

DR. GOMORY: So now you have a free market of selling these certificates. Now the way this would work, at the beginning, since there's a deficiency of imports versus exports, these things would go for a high price, but as the thing equalized, it would get down to zero, and you'd have balanced trade.

Now, as far as schemes for manipulating it, it would be like manipulating any other market. You might try and corner this or corner that, and so I would say whatever regulatory mechanism one has for ordinary markets, and perhaps there's some deficiencies in them, would be applied here also.

HEARING COCHAIR MULLOY: Thank you.

Commissioner Slane.

HEARING COCHAIR SLANE: One of our responsibilities is to report to Congress recommendations on how to deal with this issue. I just have a very simple question. Would we be better off talking to the chairman of boards rather than the CEOs of these large multinational corporations or should we go directly and solicit their input from the CEOs?

DR. GOMORY: From the?

HEARING COCHAIR SLANE: CEOs or the chairmen of boards?

DR. GOMORY: In most companies today, that's the same person, yes. I don't think you'll get a divergence of views. I think that most boards of directors, and I've been on boards of directors for 25 years, and it has changed. Believe me the orientation of boards has changed, and today it's all about share value, and it wasn't when I first was around.

You're going to just get, I think, from both of them a focus on shareholder value, and I think they'll say, as a matter of fact, I have some quotes at the end of my written testimony that the government does something to change that, we're going to go straight ahead.

And they're really even suggesting the government should give them an incentive for doing something else, but the government wasn't.

The Chief Economic Advisor of the previous administration said in his annual report that off-shoring is good for the United States, and so it makes it pretty hard for anyone else to go in a different direction.

MR. McCORMACK: I think right now we're at an inflection point. People have realized, okay, we've done all this outsourcing; we've forgotten that the engine for the whole world economy is the United States. Uh-oh.

So I think we're at this point where the CEOs are reevaluating now. Where do we make our investment? How do we make sure that the U.S. market remains robust and strong enough? Because everybody thought they were decoupled. GE's chairman Jerrey Immel was on the Charlie Rose show, and said that if the U.S. economy goes soft, it's not going to matter.

But it does matter, and I think all these other economists now are beginning to re-evaluate their previous assumptions. We heard in the first panel this morning about how all this investment in China might backfire. I think there's definitely an opportunity here. It's very important right now. We're at this moment where there's a sense we have to gain control of the situation again.

I also think there's an intuitive understanding in the United States that we have to start making products again. The products that we're consuming have to start to be made in the United States so that we're creating wealth in the country. And I think that goes all the way up to the top to the CEO now.

HEARING COCHAIR SLANE: I keep reading this quote from this professor of economics at Princeton, Alan Blinder, who was the former vice chairman. And he says that we're going to lose 30 to 40 million jobs to off-shoring in the next ten years.

DR. GOMORY: Yes.

HEARING COCHAIR SLANE: That's very, very disturbing, and it flies in the face, Ralph, of what these people are saying.

DR. GOMORY: Of what?

HEARING COCHAIR SLANE: What this former government official is saying, that off-shoring is good.

DR. GOMORY: If I may be allowed to reply, and I will try and be measured and not get too--what that chap was saying is wrong. Okay. Just plain wrong. I really know that sort of economics up,

down, and sideways. Okay. I've written a book on international trade with a very, very well-known economist. And it simply isn't true.

MR. McCORMACK: But there are so many people who believe that it's true still.

DR. GOMORY: I know, but they don't read--they haven't read the economic literature.

COMMISSIONER BLUMENTHAL: What is it?

DR. GOMORY: And I cite that--

MR. McCORMACK: The Mankiw line about how outsourcing benefits the United States. We're better off.

DR. GOMORY: It's just wrong. Even if you take the simplest economic example that everybody gets taught. England specializes--England makes textiles well, but doesn't, their wine is crummy. Portugal's really good at wine. Okay. It's true that free trade improves things.

The British make all the textiles. Portugal makes all the wine. They're both better off, but they never take the next step. What happens if Portugal learns to make textiles? Have you worked that out? I've worked it out. Paul Samuelson has worked it out. The answer is the British standard of living goes down.

And most economists never make that step even in the simplest example. So the guy is wrong. He's wrong theoretically; he's wrong in practice. And it's a horrible thing.

HEARING COCHAIR SLANE: The government official is wrong?

DR. GOMORY: Yes.

HEARING COCHAIR MULLOY: Thank you.

Commissioner Blumenthal.

COMMISSIONER BLUMENTHAL: Yes. I just wanted to correct Mr. McCormack. We're in violent agreement on the need for science and technology spending. But--

MR. McCORMACK: I did say that--

COMMISSIONER BLUMENTHAL: During the Reagan era was when corporations all of a sudden misaligned with U.S. interests. It has always been thus. I'm trying to think of the great halcyon days when corporate interests were perfectly aligned with national interests. I'm going through my American business history here.

MR. McCORMACK: What's good for GM is good for America.

COMMISSIONER WESSEL: Let's not have so much corporate bashing.

COMMISSIONER BLUMENTHAL: There's always a creative tension between government and business--we had trust busters during the Reagan years and we had companies that wanted to invest in the

Soviet Union in the oil sector, and that was put down. So this is some imaginary time when corporations were aligned with national interests.

They do their bit and government does its bit to create fair markets, free markets. So let's just put that premise aside for now.

I think there will be a question here, but I think the other thing I wanted to correct you on is about science and the science policy in the United States; one of the reasons we had a major boom is because we were able to have immigration of Indian and Chinese and Taiwanese scientists, to absorb the talent better than anybody else, to keep them in Silicon Valley.

If you look at what's been going on in Silicon Valley over the American boom really in high tech is that Taiwanese and Chinese form great connections with their Silicon Valley counterparts, got capital, got technological development, and brought some of it to Taipei, brought some of it to Shanghai, but we're still keeping most of the value.

I don't think it's this ratio that is the straw man that's set up that because an Indian scientist is cheaper than he's taking somebody's job, I think is just plain wrong. I think so another element of the policy is to just keep the immigration and attractiveness of the American economy open to the best talent which is something we've been good at for so very long.

The question is, and it's kind of a leading question, but in China you have a situation where we're all sort of saying that China is doing so much right and therefore we should fear a "economic threat."

I don't know what an economic threat is actually. I know what a military threat is. That does concern me with respect to China.

But, in China, you do have an alignment, and it's a particular party and company. So its party-company interests more so than national and company interests. There's a lot of corruption because of that. There are a lot of bad loans that go out. China is, in this recession, is facing 20, 30 million job losses at a minimum.

This is also a leading question, but which economy would you rather have? The American economy or the Chinese economy, which, is throwing a lot of money into industrial policy, and hoping that they get some brand for national prestige reasons. but the Chinese economy is aligned with a party, and there are examples of that in Nazi Germany and in Italy, but it didn't work so well for them.

So the idea that this is somehow posing a long-term economic threat, again, I ask you which economy would you rather have, even in this global recession? The Chinese economy or the American economy, which part of the world would you rather be part of?

MR. McCORMACK: I'd be amazed if anybody in the United

States would say the Chinese economy.

COMMISSIONER BLUMENTHAL: Okay. Thank you.

MR. McCORMACK: Really. But you might want to ask that question in five years. That might be a different answer in five years. We have 31 million people who receive food stamps right now and 45 million or 50 who don't get health care.

COMMISSIONER BLUMENTHAL: What is the Chinese economy going to do in five years to make it more attractive? What are you seeing now in the Chinese economy that they're doing right now?

As I said in the earlier panel, we're all repeating the same exact impulses we had before. We're spending a lot and going into deficit, and they're buying our debt, and they're trying to get back to an export-led model.

What do you see in the Chinese economy right now in terms of major structural reforms that would make you say that in five years they might have a more attractive economy.

MR. McCORMACK: Well, I'm thinking about our economy. I looked back at my reporting three years ago, and we did not pressure China. We did not want to pressure China on their currency because there was a concern that Chinese financial system would collapse.

That's what the concern was. That's why we didn't approach China and try to force them to float their currency, but it was our financial system that has now collapsed. We'll find out the repercussions of that in five, ten years, I think.

COMMISSIONER BLUMENTHAL: Is China doing anything today to fix its basic structural imbalances? Its demographic problems? Its pension problems? Its over-savings? Its overreliance on the export economy? Is there any evidence to back up the claim that in five years China will have a more attractive?

I'd like some evidence that the Chinese are doing something today that will make them more attractive in five years.

DR. GOMORY: Today we're in a crisis. But let's just back up a year and ask what happened the five previous years? That's reality. That economy grew at about eight percent. That's a very good rate. That's what they were doing right.

HEARING COCHAIR MULLOY: Good. I want to thank this panel. I want to thank Dr. Gomory for coming all the way from Sun Valley, Idaho to be here today.

And, Mr. Stewart, thank you for your wonderful testimony that we'll put up on the Web site and those great statistics. Thank you, Mr. McCormack for providing us with your monthly report and for your

testimony here today. You have all made a great contribution and we appreciate it very much.

DR. GOMORY: Could I say one thing? I'm sure I'm representing the views of the three of us. We're grateful to you because you are addressing a terribly important problem that most people neglect. So we would like to thank you.

HEARING COCHAIR MULLOY: Thank you.

COMMISSIONER BLUMENTHAL: Thank you very much.

HEARING COCHAIR MULLOY: We will reconvene at 2:00 o'clock for the next panel.

[Whereupon, at 1:00 p.m., the hearing recessed, to reconvene at 2:05 p.m., this same day.]

A F T E R N O O N S E S S I O N

**PANEL III: CHINA'S TELECOMMUNICATIONS AND
INFORMATION TECHNOLOGY (IT) INDUSTRIES**

HEARING COCHAIR SLANE: This is our third panel which is going to address the development and growth in the telecommunications and information technology industries of China.

We're particularly interested in hearing about the role of the Chinese government in the market structure.

Richard Suttmeier is Professor Emeritus at the University of Oregon and a former Director of the Center for Asian and Pacific Studies. Dr. Suttmeier specializes in Chinese and Japanese politics, science, technology and international relations.

His current research includes study of China's scientific community, the role of science and technology in U.S.-China relations, and a longer-term study of Chinese approaches to the management of technology and environmental risks.

Andrew Szamosszegi is a Managing Consultant with Capital Trade Incorporated, who specializes in international economics and trade policy. He has consulted for U.S. and international clients on a wide range of topics ranging from the impact of trade liberalization and currency valuation issues to technical aspects of antidumping and countervailing duty margins.

Denis Simon is a Professor at the Penn State School of International Affairs and he focuses on international and comparative business strategy, technology innovation and global management of technology with a special reference to China and the Pacific Rim.

Dr. Simon has established deep government, business and academic relationships in China and is well-known for both his scholarly and entrepreneurial accomplishments.

Dr. Suttmeier, would you start, please?

**STATEMENT OF DR. RICHARD P. SUTTMEIER
PROFESSOR EMERITUS, UNIVERSITY OF OREGON
EUGENE, OREGON**

DR. SUTTMEIER: Yes. Thank you, Mr. Chairman, a pleasure to be here.

I come at this, as you suggested, as somebody who sort of works on science and technology policy, but has had a long-standing interest in industrial policy, in part from teaching on Japan, and having done research in Japan at an earlier stage as well.

That experience with Japan alerted me to the fact that this issue of technical standards, which Alan Wolff mentioned this morning, is, in fact, a very central question for industrial policy. When the Chinese government began to talk quite a lot about standards shortly after their accession to the WTO, I began to look into that question a little bit, and have now produced several reports dealing with Chinese approaches to technical standards.

So part of my remarks here will be drawn from these reports. A copy of the latest is submitted here for the record. And then I'll make a few additional comments on industrial policy.

I do think, as suggested this morning, that this is an international problem that we're talking about today; it's not simply a bilateral problem. When we look around the world, we find governments all trying to reach some kind of new integration of the protection of national economies and accommodating the dynamic flows of technology and investment that happen internationally. I think it's important to keep that in mind to start with.

Secondly, it's also a little bit tricky to try to nail down exactly what Chinese industrial policy is. In part, that's because China is changing so very rapidly, with the result that industrial policy of the early 1990s and mid-1990s is no longer the industrial policy of today.

Ownership is changing in China. Levels of technology are changing in China. Relations with the international economy are changing. And as a result, we see very significant movements from a country primarily concerned with absorbing foreign technology to one very much committed now to developing its own, and with that objective, a very aggressive science, technology and industry program for the current Five Year Plan and for the next 15 years.

So with that, let me just try to address very briefly the points that you put to me in your letter of invitation. One question had to do with the ways in which China's R&D programs tend to support the ICT industries. There is, no question, as my written submission points out, that ICT is a very high priority area for China, as it is for most other countries, and indeed we find it emphasized in China's national R&D programs. It has been in the 863 Program, until now focusing on so-called third generation telecommunications, and there is now in the new long-term plan, 2005 to 2020, a major commitment to fourth generation technology.

And I think it is the latter that we really should be focusing on at this point, rather than revisiting some of the problems with 3G. However, as I point out in the written statement, the 3G problems illustrate the pitfalls of industrial policy. Indeed, looking at 3G, I think one could argue that China on balance has not been all of that

successful with its industrial policy with regard to standards.

The 4G is worth noting for a couple of reasons. First, the amount of money that will be spent on it will be much, much more than anything done on 3G. More importantly, the base of participants, the stakeholders who are being created for this 4G program, is much broader. Our work suggests that when you have a broader coalition of interests, that tends to be good for the acceptance of the standard.

Most importantly, this new work, I think, will be done much more by Chinese companies as opposed to research institutes and universities. So the old problems of getting research out of institutes into the marketplace will be, I think, less of a problem.

What about Chinese overseas expansion of its telecom industry? Yes, indeed, one can see that especially I think with regard to the equipment manufacturers. Huawei and ZTE, for instance, have been very successful, I think, in expanding especially to second and third-tier markets. As I point out in the paper, we see some evidence of successful penetration of first-tier markets as well.

The service providers are somewhat less internationalized, although some of you may know that China Mobile, the biggest mobile carrier in the world did, in fact, acquire a wireless telecom company in Pakistan.

Third, with regard to the reorganization of the telecom industry you asked about, I think China is now in a shakeout phase, and this could last for some time. As some of you know, the reorganization has led to the establishment of three major service providers. Will this enhance the ability of those providers to expand internationally? I think not. I think that probably the big focus in the near term is going to be just making that reorganization work domestically.

There are obvious problems of corporate cultures which have to be integrated, and there is also the issue of the implementation of TD-SCDMA, the indigenous Chinese 3G standard, which has been assigned to China Mobile.

So where does all this leave us in terms of implications for the U.S.? I just got back from China last week, and I was thinking a little bit about how one returns from China today in comparison with the way one returned from China in 1978, the time of my first visit.

In 1978, we were still thinking about the legacy of Maoism and how it was intended to make China a revolutionary society. Yet, at that time, China was the deadest, most “unrevolutionary” place in the world. Not too much evidence of change. You arrived back in the United States and you said, wow, this is really a revolutionary society, one that's really dynamic and on track.

Today, the feeling is quite different. Today, you get the sense of

a China that is really very dynamic, very much on the move, filled with problems which I allude to in the paper. The U.S. on the other hand, seems to be asleep. We don't quite know what we're doing with regard to globalization, the nature of our economy and, with all of its resources, and we seem to be letting our scientific and technological leadership on which past dynamism rested, slip away. As a result, the impression today, I think, is quite different from what it was 30 years ago.

What I suggest in the paper is that we need the network qualities of globalization, and with that I think the key question is how do you--how does any country--capture the positive network externalities of globalization? I think the Chinese have been extraordinarily clever at this whereas we have been somewhat overwhelmed by a combination of the negative externalities and our own domestic problems.

How do we get the network to serve us? A critical part of that--I suspect my colleague, Denis Simon, will say something more about this--has to do with high-level human talent. The competition for talent is a very, very major part of this new world, and I think the U.S. has traditionally done exceptionally well as being a magnet for that talent.

For a lot of reasons--new opportunities elsewhere, our ill-conceived and implemented immigration problems--this is changing. We can go into this in Q&A if you want.

Export control questions, I think need some attention. We have this new report from the National Academy of Sciences that warrants attention, whether you agree with all the conclusions or not, but it does raise some important questions.

Foreign investment issues, I think, are going to come up. Again, it has to do with this whole question of the United States being a magnet for foreign investment. China, given its size, given its technological level, is going to be an increasingly interested party in investing in this country, but we haven't really shaken out what the national security questions really are.

The experiences thus far, as I suggest in the paper, are not so illuminating. But fundamentally, I think I'd subscribe to the points that were made this morning, about the importance of the U.S. maintaining an ecosystem for innovation. We just have to run faster. Our problems with our economy--and where we are going as a society--are not principally problems derived from China's industrial policy. In this whole question of the 1978 to 2009 comparison, you don't explain that change as a result of policy alone. Something fundamental is happening with the cultures of the two countries, their motivations, what's driving them, their visions, and so forth. We need

to become far more sensitive to these changes. In this, the question of the revitalization of U.S. science is important. And ultimately I think that comes back to questions of primary and secondary education. So the human resource dimension of our challenges, I think, is one that has to be given a lot of attention, and it doesn't get as much.

Thank you.

[The statement follows:]

**Prepared Statement of Dr. Richard P. Suttmeier
Professor Emeritus, University of Oregon
Eugene, Oregon**

**Written Statement to the US-China Economic and Security Review Commission
Hearing on China's Industrial Policy And Its Impact on US Companies, Workers
and the American Economy, March 24, 2009**

Richard P. Suttmeier
University of Oregon

The subject of today's hearing is an important one for a variety of reasons. It is important for the US as it seeks to define appropriate policies for relations with a rapidly changing China. It is important for China, as well, as it seeks to refine the policy environment for its developmental trajectory in the face of new domestic and international contingencies. It is also important for the larger international community which must both accommodate China's emergence as a major economy, and force in science and technology, while also struggling with the reconciliation of national self-interests, international processes of technological innovation, and the building of international regimes for the governance of a global knowledge economy. The issues before us are not simply those of a complex bilateral US-China relationship. They are rather symptomatic of the challenges facing many countries as they attempt to prepare domestic industries for interactions with global production and innovation networks.

Our topic is also one that is not easily understood. China's industrial policy, and it's approaches to the building of pillar or strategic industries, continue to evolve as the economy becomes more complex in terms of ownership, levels of technology, and relations with players in the international economy. And, increasingly, industrial policy engenders dissensus within China, thus making the domestic politics of industrial policy also more complex. A central question for any national industrial policy, and one which China struggles with now, is the proper role of the state in guiding industrial development. Once taken for granted, the answer to this question in China today is increasingly contested as China attempts to conform with its WTO obligations, as Chinese companies discover that their interests are no longer automatically aligned with those of the state, and as increasingly cosmopolitan government officials come to

understand that national industrial policies which do not recognize and accommodate global trends in research and innovation invite costly failures. Let me illustrate some of these points with reference to our recent work on ICT standards as a tool of industrial policy.¹

There is no doubt that the Chinese state regards the telecommunications and information technology industries (hereafter, ICT) as central to national security and economic well-being. In this, China is no different from the national governments of a number of other countries, including our own, which have used industrial and technology policies to promote these industries. In China, the recent government reorganization to create the Ministry of Industry and Information Technology (MIIT), which has as part of its Chinese name (*Gongye Xinxihu Bu*) the concept of “infomatization” (*xinxihua*), implies that advanced information technologies are intended to be diffused throughout society, including to the industrial economy and the national defense system. Not surprisingly, therefore, ICT research has been included in major state-supported national R&D projects, such as the 863 program, and in the new 15 year Medium to Long-Term Science and Technology Plan. Included in the latter, for instance, is a large project on “Next-Generation Broadband Wireless Mobile Communications Network,” focused on the development of fourth generation (4G) telecommunications technology, which is expected to receive more than 70 billion *yuan* over the course of the project.² The national R&D system has taken technical standards development as a key task, special R&D programs for standards have been initiated, and tax and procurement policies are being used to incentivize Chinese enterprises to become centers of intellectual property development and standards initiatives. In addition, direct R&D support is being offered to enterprises. In the ICT sector, for instance, Huawei and Datang reportedly have been awarded new “national laboratories,” an institutional designation that leads to preferential funding that had previously been reserved for research institutes and universities.³

Large R&D projects of this sort, however, have not always enjoyed the success which might be expected from the heavy investment of resources they have received. This is well illustrated by past work on 3G technology and, in particular, the development of the Chinese TD-SCDMA 3G standard. Although TD-SCDMA was recognized by ISO as international standard in 1999, China’s ability to incorporate the standard into

¹ Scott Kennedy, Richard P. Suttmeier, and Jun Su. *Standards, Stakeholders, and Innovation: China’s Evolving Role in the Global Knowledge Economy*. Seattle. National Bureau of Asian Research. NBR Special Report Number 15. September, 2008.

² <http://english.caijing.com.cn/2008-02-25/100049443.html>. Accessed March 20, 2009.

³ See Caijing Annual English Edition, December 2007, <http://www.caijing.com.cn/English/Cover/2008-02-20/48880.shtml> and <http://www.caijing.com.cn/English/Editorial/2008-02-20/48880.shtml>.

commercially viable innovative telecommunication systems has been a long and drawn out affair, with Chinese telecommunications companies only reluctantly accepting it.

Chinese efforts to support a distinctive Chinese 3G standard illustrates a number of problems with the development and implementation of Chinese industrial policy more generally. First, in spite of the technical contributions made by Chinese researchers, the standard also relied heavily on foreign technology.⁴ Thus, in spite of suggestions that China seeks greater technological self-reliance in its industrial policy, maintaining an openness to international technology flows will continue to be an important part of technological development going forward. As with other standards, such as the WAPI (WLAN Authentication and Privacy Infrastructure) security standard for local wireless networks, TD-SCDMA was aggressively pushed by its developers and bureaucratic allies to the point of securing government support without necessarily considering the interests of other Chinese stakeholders; in this case, important telecommunications companies who had a vested interests in commercially viable 2G legacy technologies more compatible with the other two international 3G standards (WCDMA and CDMA 2000). Thus, in keeping with classical critiques of industrial policy, predictable rent seeking behavior by special interests seeking bureaucratic sanction emerged and came into conflict with the market-based technological judgments of the Chinese service providers.

The development of operational TD-SCDMA systems has been further complicated by efforts to reorganize the telecommunications industry. The now reorganized industry involves competition among three service providers each having a license for a different 3G technology. Thus, the TD-SCDMA standard is licensed to China Mobile, the world's largest mobile operator (which absorbed China Tietong), while China Telecom has a license for a CDMA 2000 system, and China Unicom (which merged with China Netcom) is licensed to develop W-CDMA technology.

The reorganization itself raises some interesting questions about industrial policy. By licensing three separate and competing technologies, the Chinese government appears to be adopting a position of technology neutrality *vis-à-vis* Chinese and international standards, seemingly in support of the principle of market competition. On the other hand, the delays in licensing which have occurred over the past several years have been interpreted as a form of state intervention to allow time for further development of the less mature TD-SCDMA technology. In addition, the assignment of the TD-SCDMA license to China Mobile, which has a much larger mobile subscriber base (over 400 million, in contrast to Telecom's 43 million and Unicom's 125 million) could be interpreted as tilting the competition towards the stronger player as the chosen champion of the Chinese standard. On the other hand, Chinese industrial policy has often sought to

⁴ Chinese share of the patents in the standard, reportedly, was only about 7%. Yan Hui, "The 3G Standard Setting Strategy and Indigenous Innovation Policy in China: Is TD-SCDMA a Flagship," Danish Research Institute for Industrial Dynamics, DRUID Working Papers, no. 07-01, 2007.

promote competition. Thus, the less mature technology was licensed to the stronger company in order that competition be maintained. Should Telecom, and especially Unicom (which has the second-largest subscriber base), provide better quality service, based on more mature technologies, Mobile's advantage could erode. Further complicating the picture are the problems of making mergers work, as companies that have developed under competitive market conditions face the challenges of dealing with the corporate cultures of new partners whose traditions are in a planned economy.

The 3G story in China illustrates both possibilities for effective industrial policy, but also its pitfalls. Through government policy efforts China has been able to establish an international standard for next-generation mobile telephony and seems ready, finally, to establish the standard in a large commercial system. Many observers both inside and outside of China, however, would be loath to regard the 3-G story as a success, however, given the costs it has imposed on service providers, and the cost to consumers in terms of delayed rollouts of 3G service and the likelihood that the service may not employ the best available technology. A far stronger case for the TD-SCDMA program can be made if it is regarded as an expensive learning technology which will put China in a much stronger position to compete in 4G technology. For instance, for 4G, there will be more companies involved as stakeholders in the development of the technology, and more of the R&D will be performed in corporate labs, rather than in government research institutes and universities.

Chinese industrial policy will be measured, in part, by the success of its key companies abroad, and Chinese telecommunications companies are certainly beginning to make their presence known internationally. Among service providers, for instance, China Mobile in 2007 acquired Pakistan's Paktel and established CMPak, now a wholly owned subsidiary of the parent company. China's telecom equipment manufacturers, especially Huawei and ZTE, have been considerably more active in terms of international expansion. Both have become important international suppliers of telecom equipment in second and third tier markets, and are beginning to make their presence felt in first tier markets as well. For instance, Huawei reportedly has secured a contract from TeliaSonera to deploy the world's first 4G commercial network in Oslo, which should begin operations in 2010.⁵

An interesting question about this expansion is the extent to which it leads to the diffusion of Chinese technical standards abroad. The evidence is not clear. Successful companies, like Huawei and ZTE, are now investing heavily in their own R&D at home and abroad and are incorporating innovative Chinese technology in the products they sell internationally. However, market-based companies are driven primarily by solutions that work and thus are drawn to the use of established international standards where these

⁵ <http://www.chinatechnews.com/2009/01/20/8544-huawei-deploys-first-4g-commercial-network-in-norway/>. Accessed March 18, 2009.

offer the greatest functionality. Thus in the Oslo project, Huawei appears to be offering innovative fourth-generation telecommunications base stations that can handle 4G standards derived from WCDMA (WCDMA/LTE) and CDMA (CDMA/LTE), and not from TD-SCDMA. It is interesting to note, though, that in May, 2008, China sponsored a 20 day seminar on Chinese approaches to standardization for officials from African standardization bodies. In this, China seems to be proselytizing Africa in ways which are reminiscent of recent US and the EU sponsored standards workshops and seminars intended to proselytize China!

As we observe the evolution of Chinese industrial policy, especially as it relates to technical standards, we can see that it is responding to the complexities of global innovation networks and the new technologies they generate, in a way which points to active policy learning. The crude attempt in 2004 to mandate the WAPI standard for wireless devices has now given way to a far more sophisticated appreciation of the need for industrial policy to conform to market forces and the norms and processes of international institutions, including standard-setting institutions. Efforts to impose strict uniform national limitations on the participation of foreign companies in Chinese technical committees for standard-setting reportedly have given way to a somewhat more relaxed approach in which technical committees can set their own rules for foreign participants that are wholly-owned or joint venture firms that are legally registered in China.⁶ These rules, no doubt, will still be under the influence of state bureaucratic parents, but the overall policy is one that subjects techno-nationalist objectives to some of the realities of techno-globalism.

Chinese industrial policy shares with the industrial policy experiences of other East Asian countries in having both successes and failures. The successes, often achieved at great - and in some cases, arguably, unnecessary - costs have come as a part of the national “catch up” strategies that have transformed poor agricultural countries in the region into the ranks of technologically capable, middle-or wealthy country status. The ability to mobilize resources and direct them towards state selected priority sectors has been key to this catch-up strategy. But, as with its East Asian neighbors, there comes a time when the challenges of moving beyond catch-up make old policy modalities a liability. Parts of China still have a very long way to go before the catch-up phase is over, but clearly some sectors are approaching - or are at - the stage when catch-up industrial policies must give way to new approaches. China’s leaders appear to recognize this fact and have called for the creation of a China by 2020 which is an “innovative society,” and an industrial leader in new science-based industries, including ICT. Opinion is divided, both in China and abroad, as to whether these goals are achievable and as to the instruments being used to pursue them. In many ways, the trajectory of Chinese high technology development is very impressive, but we should also recognize the many

⁶ Personal communication. Beijing, March, 2009.

problems China faces to maintain that trajectory.⁷ Nevertheless, as frequent visitors to China can attest to, there is an increasingly sophisticated and cosmopolitan vibrancy to the place which would lead one to place one's bets on significant industrial and technological achievements over the coming decade.

Given this likelihood, the US must prepare itself for a far more competitive China in areas of high technology and science-based industry where we once enjoyed comfortable leads. While it will want to continue to monitor Chinese industrial policy to assess China's compliance with its WTO commitments, and engage China on a variety of bilateral trade and investment issues, the US must confront the need for its own revitalization and realize that revitalization is inseparable from our growing interdependence with China. This requires some serious rethinking of our interests *vis-à-vis* China, and a far more proactive approach to securing long-term benefits for the US from the successes of China's industrial and technological development. Chinese industrial policy need not lead us into a zero sum game, especially if we recognize that the challenges from China has less to do with Chinese industrial policy than with our failures to solve chronic problems keeping our nation from reaching its potential. A number of interrelated issues have to be faced by the US political system, the resolution of which requires far more effective bipartisan congressional leadership, and executive-legislative cooperation, than we have recently seen. These include:

1. Global Competition for Talent. Due to the relative underdevelopment of research and education conditions in China, and the superiority of those conditions in the United States, the US has long been a magnet for science and engineering talent from China. But, as a result of pro-research and education policies being pursued by the Chinese government, the advantage once possessed by the US is fading. As Chinese students seek advanced degrees in their own country, as generous research support from the Chinese government makes the salaries, equipment and facilities in China competitive with those in the US, and as economic conditions lure Chinese technical entrepreneurs to invest their energies in home markets with remarkable growth opportunities, the trans-Pacific competition for talent will intensify. One should note that this competition is not solely limited to Chinese scientists and engineers. China seeks to attract talent from around the world much as the US has long done.

2. Immigration. This competition for talent moves immigration policy to the center of the economic revitalization agenda, as illustrated, for instance, by the concerns of US high-technology companies in their efforts to recruit highly skilled Asian immigrants. Although some progress has been made in reconciling US traditions of free movement of people with the security concerns expressed in tightened post-9/11 visa policies,

⁷ See, Richard P. Suttmeier. "The Discourse on China as Science and Technology Superpower: Assessing the Arguments." Presented at the "International Symposium on China As a Science and Technology Superpower" Organized by the China Research Center Japan Science and Technology Agency Tokyo, December 9-10, 2008. Submitted for the record of this hearing.

problems remain. Chinese scientists often have been unable to get visas in time for important professional meetings (including meetings of technical committees for international standards development), for instance, and this has not only produced considerable antipathy towards the US in the Chinese technical community, but has also led US companies and professional societies to convene their activities outside of the United States. Less than welcoming immigration policy has not helped in the competition for talent. Since the success of Chinese industrial policy, especially in next-generation science-based industries, ultimately depends on the quantity and quality of technical personnel available, US visa policy should be seen as a factor affecting the success of Chinese industrial policy.

3. Export controls. There is a need to reassess whether controls over high technology exports hit the right balance between the promotion of trade in industries where the US enjoys comparative advantage and the protection of strategic technologies in the face of Chinese security challenges. Special attention should be given to “deemed exports,” or the movement of technology acquired by foreign researchers who participate in the work of American companies, universities, or government laboratories. The analysis and recommendations of “Beyond Fortress America,” the recently released report on export controls and visa policies by the National Academy of Sciences, warrant priority attention. Chinese colleagues take great pleasure in pointing out that US export controls, while limiting technological capabilities in the short run, have often forced China into either seeking technology from other suppliers (at US expense) or, forcing a recommitment through Chinese industrial policy to develop the technology itself.

4. Foreign Investment. The growing wealth and technological sophistication of Chinese companies are likely to lead to an increased interest in acquiring stakes in American high-technology firms. Interest in such investment is again symptomatic of the interrelated nature of competitiveness and China policy. The hostility toward prospective Chinese investments in American firms during the past eight years was often of questionable economic rationality and security value, and created negative feelings towards a US which has long preached to others of the virtues of free and open foreign investment policies. A China that is emerging as one of the world’s largest economies and an important player in global research and innovation is certain to seek further foreign investment opportunities in the United States, and the US needs to have a policy environment that will increase the likelihood that these investment initiatives lead to win-win outcomes, rather than lose-lose.

5. Standards and Intellectual Property. US leadership in setting technical standards and creating intellectual property continues, but there is little doubt that China seeks to challenge that leadership for economic, national security, and prestige reasons. With enhanced national science and technology capabilities, distinctive market conditions, and government policies in support of standard-setting and intellectual property development, competition over standards and IP is sure to increase. The US cannot allow its leadership

in standard-setting for cutting-edge technologies to dissipate.

A “new geography of knowledge”⁸ represented by China’s emergence as an important player in science and technology, a “new geography of finance,”⁹ represented by China’s national wealth and foreign currency reserves, along with a “new geography of pollution and resource consumption” have created a very different international reality from that which most Americans are familiar with. This new international reality requires a major recalibration of US security, economic, and environmental interests *vis-à-vis* China. Successful engagement with the consequences of Chinese industrial policy, including its growing technological capabilities, requires that the health of the eco-system for research and innovation in the US be ensured. It is necessary that the nation’s science and engineering be given high level attention and priority access to resources. Science in the White House can no longer be relegated to an ancillary position. The President’s Science Advisor needs to be given real stature and the Office of Science and Technology Policy should be strengthened, including the addition of personnel who are familiar with Chinese science and technology trends. Since the stakeholders in US science and technology relations with China extend well beyond those in the government, there is also a need for a high-level government-private sector council on US-China science and technology relations that would include representatives from industry, universities, NGOs, as well as government, to share information and coordinate activities. At present, US participation in science and technology relations with China are woefully uncoordinated, and government offices responsible for this relationship are woefully understaffed.

The US must recommit itself to the ideas of maintaining scientific and technological excellence throughout its public and private institutions and ensure that it remains a magnet for technical talent from throughout the world. This cannot be done without the revival of science as a US cultural value and the rebuilding of an effective system of science and engineering education. There is no greater long-term threat to the US ability to engage Chinese industrial policy than having a scientifically illiterate American population interact with a scientifically and mathematically sophisticated Chinese population on matters of science and technology.

HEARING COCHAIR SLANE: Thank you.
Dr. Simon.

⁸ Dieter Ernst. “A New Geography of Knowledge? Asia’s Role in Global Innovation Networks.” East-West Center Policy Studies. 2009.

⁹ I’m indebted to Dieter Ernst for suggesting this term.

**STATEMENT OF DR. DENIS FRED SIMON
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DR. SIMON: Thank you.

I also have recently returned from China, actually having made about three trips over the last several months, and one simple fact is clear to me. We might say it this way: the dragon is not asleep.

I think one is impressed quite clearly by looking at, whether the national level or the local level, that the PRC is less engaged right now in debates about bailouts and bonuses and Cabinet appointments, and much more preoccupied with figuring out how China is going to move beyond the current economic and financial crisis facing the country.

What's really interesting, I think, about the current period is that the chaos and the tumult that have come on line because of the global financial crisis for China represents a kind of ideological and philosophical watershed moment, not only in world history, but also in the 60 year history of the People's Republic.

I think for Chinese leaders in Zhongnanhai, the failure of the market economies, led by the United States, to reign in the excesses and the extremes of Wall Street and the banking industry are viewed as a reaffirmation of the Chinese proclivity for favoring more explicit state control and more overt regulation.

I also think that from the perspective of the current leadership, there has not been a vision about China's future that has not included a central role for the state as the ultimate source of guidance and control, even allowing for all of the reforms and the introduction of market mechanisms throughout the last 30 years.

I think for both historical and cultural reasons, as well as some combination of political expediency, the Chinese see this as a rather unique and advantageous moment in time, it is a strategic opportunity where China holds the philosophical high ground to reinforce its long-held position at home and abroad that unbridled capitalism and a weak state are a sure recipe for serious sociopolitical and economic problems.

It's against this backdrop that one must evaluate and assess the role and impact of industrial policy in China, especially with respect to the development of high technology capabilities. I think it's important to recognize that while we don't want to underestimate the salience of the global financial crisis as a precipitant to fostering some badly needed economic changes in China, it also is the case today that many of the challenges facing the Chinese leadership are rooted in a

range of critical structural problems that predate the onset of the crisis.

In effect, the global financial crisis exacerbated many of these structural problems and highlighted the necessity of moving beyond the so-called "factory to the world" economic model that has helped spur Chinese growth over the last three decades including driving its open policy.

As Long Yongtu--China's former negotiator for WTO—recently said speaking to a conference in Wenzhou in December that I attended-- and I'm paraphrasing here:

“While we China can easily be deterred by the difficulties brought on by the global financial crisis, the fact is that the current crisis is a cloud with a silver lining, an opportunity to take on the underlying defects and shortcomings present in our prevailing economic model and to move the country to the next phase in its economic and technological development.”

So, I think it's important to understand that China sees this as a strategic opportunity and that they have, in a real sense, this kind of moral and technological high ground.

I was asked to talk about a number of facets about the Chinese technology effort. I think one thing is clear, and Professor Suttmeier alluded to it, that with the onset of the Medium to Long-Term S&T Plan, which I'll call the MLP, Chinese leaders have recognized that even though they have been the beneficiary of the open global economy, the reality is that it is no longer safe, it is no longer wise for China to depend so extensively on external sources of technology.

And for the time being, we can see in China that those who favor the “make side” of the so-called "make versus buy decision" are in the ascendancy. This is the group of technologists seem to be in the lead versus the group of economists who have debated the other side of the argument.

I think there also is a growing apprehension in Beijing that the technology related benefits that China has been able to secure as a result of its openness to globalization may, in fact, be starting to erode. And, Chinese leaders are fearful that they will now have even more limited access to some of the core technologies that they seek to drive their innovation program and to catapult the Chinese economy to the next level.

We know that China has put in place over the years a number of strategic technology programs--the 863 Program, etc. the Torch Program, the 973 Program. All of these initiatives are reflective of a state-directed effort to catapult China ahead in its technological development.

And, all of these programs, while they've yielded some substantial results, also have generally left Chinese leaders somewhat disappointed by the pace of progress.

The Chinese R&D system continues to be beset by a range of problems and challenges, including the absence, in large part, of a culture that rewards risk taking, entrepreneurial behavior, individual initiative, and even at times creativity.

There also have been a number of criticisms launched both internally and externally about the management of these key programs and the use of government funds.

On the success side are companies like the SIASUN Automation and Robotics Company up in Shenyang, which is led by a returnee who studied robotics in Germany in the early '90s. He came back and he jump-started this company working with the Chinese Academy of Sciences and receiving money from the 863 Program.

He is an example of the entrepreneurial spirit that has succeeded in China despite countervailing trends and pushback in a number of areas.

At the same time, there also are a number of other problems that have affected programs like the 863 Program. In 2006, for example, there were two serious scandals that were uncovered that reflect the huge pressures that exist for progress among those receiving high level and often substantial government support in programs like the 863 Program.

The first case, known as the Hanxin chip case, involved a returning scientist at the prestigious Shanghai Jiaotong University. A second example involved a Chinese company named ARCA Technologies which diverted funds away from research and used those monies for real estate investments and for high salaries to pay top executives.

These two scandals because they were so public and so pronounced rocked the Chinese S&T system and raised many questions about the status of China's actual capabilities in fields such as microelectronics.

I also was asked to talk, in fact, about the PRC microelectronics effort, so let me say a few things about it because I think that despite the fact that China has placed a high priority on development of this area, it continues to suffer some serious problems.

The effort to promote the development and deepening of the semiconductor industry today stands out as an example of the mixed results of industrial policy. Today, China absorbs about a third of the worldwide market for semiconductors, reaching about \$88 billion in 2007. At the same time, however, the Chinese share of global

semiconductor production accounts for only nine percent of worldwide output.

China's IC market grew to almost 74 billion in 2007, accounting for 33-34 percent of global IC trade.

According to a recent study by PWC, however, there were no Chinese companies in the top 55 suppliers to the Chinese semiconductor market in 2007. The PWC study goes on to indicate that, quote: "Even if the largest Chinese semiconductor companies sold all of their output within China, no Chinese semiconductor company would be among the top 50 suppliers to the Chinese semiconductor market in 2007." The situation regarding ICs is even worse with the consumption/production gap reaching almost \$55 billion in 2007. This is a strong indictment of Chinese efforts heretofore to enhance their capacity to meet the growing demand for semiconductors and IC products which, in fact, continues to exceed the international growth rate by a significant margin.

So where does that leave us with China? Well, let me cite two examples where there does seem to be progress. First, the case of the Godson or what's also called the Loongson computer chip; and second, the development of China's high performance supercomputer sector.

Through the 863 Program and the Knowledge Innovation Program under the CAS, the Chinese have been able to launch their first somewhat Intel-like Pentium IV replicated chip. The Loongson chip basically is an effort by China to wean itself off of not only Intel products but also the Wintel platform for personal computers.

The chips have been designed by the Institute of Computer Technology and by the BLX IC Design Corporation, a company founded by that Institute.

The Loongson is a basic chip for computer technology, but the unique thing about it is that it's not based on the x86 instruction set, but instead uses a modified version of the MIPS instruction set. That means that basically it can use Linux but not use Windows products.

The other example I want to cite is the supercomputer effort by China, the Dawning 5000A, which is a high performance computer that rates number seven in terms of the world's fastest computing computers out there in the marketplace.

The Dawning 5000A is no match for IBM's Roadrunner which basically runs at about one quadrillion operations per second which is four times faster than the Dawning 5000A.

But very interestingly, the Dawning, which uses AMD microprocessors, costs about \$29 million in contrast to the IBM Roadrunner--which cost the U.S. Department of Energy about \$100 million. The Chinese already are seeking to bring their computer into

the global marketplace.

So where does that leave us with China and where is the PRC headed? It's clear that China remains strongly committed to further enhancing its own industrial base and indigenous technological capabilities. But, it's also clear that China is not an unstoppable technological juggernaut.

There are two large unknowns regarding China's technological potential, whether it's in ICT or in other areas. First is the software side of what I call the technology equation, and second, China's strategic intent.

With regard to the software side, questions exist about the ability of China to adapt, shift and operate with the high degree of flexibility, agility and responsiveness required for competitive success in the globalized world of the 21st century.

With respect to strategic intent, the unknowns may be even greater. It is clear that China remains frustrated with the United States in a number of key areas, particularly as Professor Suttmeier indicated, the continued imposition of U.S. export controls.

On the other hand, American and Chinese businesses, as we heard this morning, are inextricably linked together, and if trends persist, they will become even more intimately coupled.

Simply stated, at present, China's rise, perhaps rather than being a strategic threat or a zero sum game, may present, in fact, a strategic opportunity for the United States. In fact, it may represent the beginning of a new innovation paradigm. The real challenge for the United States in this regard is to better appreciate China's sensitivities and vulnerabilities, to identify and capitalize on the emerging pockets of excellence in the Chinese technology system, and to engage China as a full partner.

Deeper engagement and closer articulation with one another in science and technology affairs provides, I believe, one key mechanism for building bridges and understanding as well as building trust. In emerging fields such as new energy development and environmental management, such bridge building could become the impetus for a new paradigm of innovation and technological advance that will not only benefit the people of both countries, but also other parts of the world as well.

Thank you very much.

[The statement follows:]

**Prepared Statement of Dr. Denis Fred Simon
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Introduction

Thank you for the invitation to address this commission on the issue of China's industrial policy. Having made three trips to China over the last 6 months, let me state at the outset a simple but important fact: "the dragon is not sleeping." Chinese leaders at both the national and local level are less engaged in on-going debates about bailouts, bonuses, and cabinet appointments, and are more preoccupied with managing China's way out of the current economic and financial crisis facing their nation. They are making a concerted effort, using all the policy instruments and tools at their disposal, to re-fashion and re-shape China's development trajectory. Key cities such as Dalian are fully engaged in re-defining their economic and technology base as part of China's transition to the next stage in the country's modernization. While still somewhat "shocked" by the rapidity and comprehensiveness with which in the international financial crisis has engulfed the Chinese economy, the PRC leadership appears to be moving ahead with a high degree of self-confidence and conviction that is helping to moderate the "sense of gloom and doom" that seems to be steadily overtaking the economies of the US and the other industrialized nations. Even taking into account the fact that 2008 was a tumultuous year for China, especially in terms of the Wenchuan earthquake and the onset of a number of serious food and product safety issues, the Chinese leadership has been able to leverage the success of the 2008 Olympics to mobilize domestic resources and talent to attack the numerous economic and financial challenges facing the country.

In many respects, for China, the chaos and tumult brought on by the global financial crisis represents an important ideological and philosophical watershed moment in both world history and the 60 year history of the People's Republic of China. The "failure" of the market economies, led by the United States, to reign in the excesses and extremes of Wall Street and the banking industry, is viewed in Zhongnanhai as a reaffirmation of the Chinese proclivity for favoring more explicit state control and more overt regulation. From the perspective of the current leadership, in spite of all the adjustments and concessions made over the last 30 years of reform to allow more room for market forces and the market mechanism in the operation of the PRC economy, there always has remained an underlying commitment to the efficacy of the state as the ultimate source of control and guidance. For both important historical and cultural reasons, as well as political expediency, the role of the Chinese state has remained a necessary and ever-present feature in evolving visions of China's future. In this regard, it is quite clear that China's leaders see the current crisis as a unique, advantageous moment in time—as a strategic opportunity where China holds the philosophical high ground to reinforce its long-held position at home and abroad that unbridled capitalism and a "weak" state are a sure recipe for serious socio-political and economic problems.

It is against this backdrop that one must evaluate and assess the role and impact of industrial policy in China, especially with respect to the development of high technology capabilities in the PRC. Even though it is clear that one should not underestimate the salience of the global financial crisis as a precipitant to fostering badly needed economic change and restructuring in China, it also is the case that many of the challenges currently facing the PRC leadership with regard to the Chinese economy are rooted in a range of critical structural problems that predate the onset of the crisis. In effect, the global financial crisis exacerbated many of these structural problems and highlighted for President Hu Jintao and Premier Wen Jiabao the necessity of moving beyond the "factory to the world" economic model that helped support Chinese growth over the initial three decades of reform and the open policy--as quickly and definitively as possible. While it might be more natural as well as politically easier for the PRC leadership to play to the crowd of those Chinese workers whose jobs have been lost and whose lives have been dislocated by the progression of the financial crisis—and adopt a sort of "henny-penny, the sky is falling" motif, the fact is that Chinese officials seem to be moving in just the opposite direction; as Long Yongtu, China's former chief negotiator for WTO accession, remarked (paraphrase) to a group of business leaders in Wenzhou in December 2008, "while we [China] can be easily deterred by the difficulties brought on by global financial crisis, the fact is that the current crisis is a cloud with a silver lining—an opportunity to take on the

underlying defects and shortcomings present in [our] prevailing economic model and to move the country to the next phase in its economic and technological development.”

The External Environment

Just as policymakers and corporate executives in the US and EU read such reputable magazines and newspapers as *Business Week*, *Fortune*, *Forbes*, the *Wall Street Journal*, etc., so do their Chinese counterparts. Over the last 2-3 years, China’s leaders have become familiar with stories about the fluidity and turbulence present in the global economy, about the intensification of international competition, about the impacts—positive and negative—of globalization, about the growing concerns surrounding energy and the environment issues, and about the heightened focus on intellectual property matters. They also have become familiar with the on-going provocative characterizations of international competition as reflected in phrases such as technology wars, patent wars, talent wars, and standards wars. And, they too have come to recognize what many corporate CEOs and some government officials have come to understand about the growing centrality and strategic importance of innovation. For the PRC, innovation, and by implication, strengthened capabilities in science and technology, hold the key to addressing China’s three most pressing overall priorities: increased international competitiveness, enhanced national security, and long-term sustainability.

In January 2006, Chinese leaders put into place their new 15-Year Medium-to-Long Term S&T Plan, which laid out an innovation driven roadmap for pressing ahead with the goal of re-orienting the economy away from excessive dependence on an economic model dominated by its strong emphasis on cheap-labor driven low-end manufacturing, over reliance on fossil fuels and extensive consumption of natural resources, and an apparent insensitivity to the environmental implications of that model. The focus of the MLP is explicitly on enhancing China’s capacity for independent innovation (*zizhu chuangxin*); the goal is to ensure that more and more of the intellectual capital and know-how utilized across the Chinese economy—derives from indigenous sources rather than simply importing know-how and equipment from abroad. The Chinese emphasis on independent innovation does not mean, by any measure, a return to the self-reliance policies (*zili gengsheng*) that came into prominence during the Cultural Revolution; Chinese leaders have gone to great lengths to assure foreign observers of the Chinese S&T that China intends to remain fully engaged with the world. After all, globalization has proven to be a major windfall for China in terms of the increased access it has provided in terms of knowledge acquisition, investment, and trade opportunities. With globalization has come a massive explosion in foreign investment around the world, with China being among the top five recipients of FDI annually over the last decade. While it is not always the case, the growth in foreign investment to China has proven to be an important vehicle for technology transfer, including managerial know-how, that has helped China steadily move up the learning curve in terms of taking on more sophisticated, higher value-added production tasks and becoming more deeply integrated in the global supply chains of the world’s most technologically advanced companies.

Nonetheless, with innovation having moved to center stage in the world of international competition, Chinese leaders have determined that continued dependence on external sources of technology is simply not a smart thing to do. For the time being, the “make versus buy” debate in China between technologists and economists seems to have been won by the former.¹ There is growing apprehension in Beijing that the technology-related benefits that China has been able to secure as a result of its openness to globalization may be starting to erode as access to “key” or “core” know-how remains restricted or limited and may

¹ This does not mean that reverse-engineering, for example, has been rendered a lower priority, but rather that Chinese leaders increasingly have come to appreciate the need to generate more of their own know-how and IPR and that the best way to ensure China’s on-going ability to “plug into” evolving technological streams around the world is to ensure that the PRC has the ability to generate key pieces of the overall know-how puzzle from indigenous sources.

become even more so as controls on IPR and related technology become even tighter. In other words, the hospitable world of last two decades of the 20th century may be giving way to an international environment that is less user-friendly than before. Added to this, we must also factor in Chinese national security imperatives, which continue to be a key driver behind China's desire for strengthening its internal innovation capabilities. While China's overall perception of world trends may be true in some key respects, it is ironic insofar as three countervailing trends that seem to be underway: first, the continued growth of foreign R&D centers in China—there are over 1200+ such centers in operation and indications are that more will be setup in the future—even taking into account the porous nature of China's IPR regime; second, the apparent increased willingness of many foreign firms to share technology with China in return for access to Chinese industrial and consumer markets—these decisions seem more the result of strategic business considerations rather than arm-twisting from the Chinese side; and third, the enhanced importance of China's high-end talent pool—which now has become an attractive magnet for both domestic and foreign firms wishing to tap into “Chinese brainpower” to drive advanced manufacturing and innovation activities in China. In fact, of all China's alleged comparative advantages, it may be “talent” -- effectively deployed and efficiently utilized--that ultimately stands out as the key source of the Chinese long-term competitive edge.²

It must be recognized, however, that there really is nothing novel or new about China's stated effort and pro-active attempts to build up its domestic S&T capacity. Starting from the early 1980s, one can easily chart statements by Chinese leaders across the board that identify “catching up with the West” and “closing the prevailing technological gap” as national priorities and goals. The drive to strengthen independent innovation as articulated in the MLP must be viewed within the context of a series of state-directed, S&T plans and initiatives that China has put in place since the mid-1950s. I mention this not so much as a lesson from history, but largely to indicate that China's drive to catch up with the West is not the product of secret internal Chinese deliberations and “neibu” “hongtou wenjian” (red-headed documents); rather, the drive to close the technology gap has been a largely transparent effort situated at the nucleus of the modernization drive launched under Deng Xiaoping. The problem is that many in the US and abroad paid scant attention to Chinese ambitions, let alone China's actions and progress until recent years. Perhaps this was a product of our extensive concerns with the former Soviet Union or our preoccupation with the competitive threat from Japan in the 1980s; nonetheless, it is important to acknowledge the steadfastness with which China has carried forward its programs, policies, and initiatives to ensure that it has the requisite credentials and capabilities to sit at the table of global competition. China has built an extensive network of global S&T connections and international relationships, most clearly manifested in the plethora of bilateral government-to-government S&T agreements and student-scholar exchange programs that it has put in place, that have become a strategically important component of its industrial policy and technology strategy since the early 1980s.

The Domestic Perspective

From a domestic perspective, at the heart of China's state-driven technology initiatives have been a series of programs that have been in operation since the mid 1980s, foremost among them in the 863 Program and the Torch Plan, subsequently followed by the 973 Program almost a decade later. The 863 Program is a program under the Ministry of Science and Technology, first brought forth to Deng in March 1986 by four of China's top scientists who wanted to ensure that China could generate its own high-technology know-how. The program covers a broad range of civilian and military related technology fields; each year, applications are made for project grants and reviews are carried out to award these funds—some of which go to enterprises and others of which go to faculty members at various Chinese universities. Overseas Chinese scholars also are allowed to participate in 863 projects, and most recently, under an agreement with the EU, foreign scholars from Europe can work with their Chinese counterparts on projects funded

² See Denis Fred Simon and Cong Cao, China's Emerging Technological Edge (Cambridge U Press, 2009).

under the 863 program. Projects in the IT field, microelectronics, semiconductors and integrated circuits have been a critical focal point for 863 support over the years—along with projects covering a broad range of other fields under the umbrella of high technology, e.g. lasers and biotechnology.

The Torch Program is a complementary project to the 863 Program; the Torch Program is focused on commercialization of R&D and ensure that research results get translated into usable, commercially viable new products and services. Torch operates many of China's technology incubators, where new, emerging technologies can be harvested and brought to market by young start-up companies who need assistance securing ample capital and/or talent. It also has responsibility for managing the 50+ national science and technology industrial parks under the aegis of the State Council.

It is clear that monies allocated to projects sponsored by these and related programs have yielded some impressive results (see below); it also is clear that Chinese officials remain generally disappointed by the pace of progress. China's R&D system continues to be beset by a range of problems and challenges, including the absence, in large part, of a culture that rewards risk taking, entrepreneurial behavior, individual initiative, and even creativity. There also have been a number of criticisms launched both internally and externally about the management of these programs and the use (or abuse) of government funds. On the success side stands the example of the SIASUN Robot and Automation Company in Shenyang, which was founded by Dr. Qu Daokui, a 48 year-old senior scientist who also serves as Deputy Director of China's National Engineering Research Center on Robotics. The company, which is affiliated with the Chinese Academy of Sciences, has a 90% share of the domestic robot market, with sales of 880 million yuan in 2008. It also controls 30% of the industrial robot market in China. SIASUN's CEO Qu studied with Jiang Xinsong, who is considered to be the father of robotics in China. He spent the early 1990s studying robotics and automation overseas in Germany and returned to China in 1993. After his return, he began the process of building his reputation and creating a commercial enterprise; he became CEO in 2000. His company has received funds and support from the 863 Program as part of MoST's support for establishing an "intelligent robot industrialization base" in China. The firm also is certified as a "national robot engineering center" by MoST as well. Along with the equipment developed by SIASUN that is used in the automobile industry, its robots and automation equipment also are deployed in rail transit, the energy sector, logistics and storage, and clean room automation. The company seems positioned to continue its steady, albeit gradual, march to becoming a global player in robotics.

Unfortunately, such cases do not always appear to be the norm. Problems within 863 and similar plans, as suggested earlier, have emerged due to oversight and monitoring issues. In 2006, two serious scandals were uncovered that reflect the huge pressures that exist for progress among those receiving high-level and often substantial government support. The first case, known as the Hanxin chip scandal, involved a returnee scientist (Professor CHEN Jin) at the prestigious Shanghai Jiaotong University. Dr. Chen was found guilty of scientific fraud after he claimed to have developed an indigenous microchip (digital signal processing chip), but was later discovered to have faked his research. It is said that Chen received in excess of 114 million RMB; his work was allegedly reviewed by a team of experts during each new funding phase of his research. Initially, his research achievements and results had been applauded as a prime example of the utility of close university-industry ties, but he was later totally discredited after the fraud was uncovered. A second example involves a Chinese company named ARCA Technologies, which was viewed as a rising star within the Zhongguancun Science Park in Beijing. After receiving approximately 100 million RMB from the Chinese government for developing Arca-1 and Arca-2 CPU chips for lower end computers, ARCA was awarded another 15.38 million RMB under the 863 program to develop an Arca-3 version. Unfortunately, the monies allocated to the firm did not seem to end up in the research lab, but rather in real estate investment and high salaries to the firm's top executives. These two scandals rocked the Chinese S&T system and raised many questions about the status of China's actual domestic capabilities in the microelectronics field. It also generated a broader discussion about the line

between business and academia—a line that seems to have become blurred on many occasions as efforts were made to ensure closer links between university-based research and enterprises to foster the commercialization of technology. Prompted by the possibility that further examples of research fraud might exist in other areas, to its credit, China's MoST immediately stepped up its due diligence efforts to ensure improved compliance.

The ICT Sector

One of the constants of China's industrial policy and technology development efforts over the last ten years has been the high priority attached to the development of microelectronics, telecommunications, and information technologies.³ In the space of a few minutes, it is not possible to do justice to the full range of issues that need to be discussed when assessing China's progress in this strategic field. Few persons realize that China's efforts to develop its own indigenous computer industry date back to the 1950s, when with Soviet assistance and training, China began its march to establish a viable computer design and production capability; were it not for the damaging effects of the Cultural Revolution, China might have been one of the world's major players in the global computer industry today. At the center of China's efforts has been the desire to develop a domestic capability in semiconductors and integrated circuits as these are the building blocks for advancement in computers, telecommunications, and programmable machine tools. The effort to develop a competitive capability in advanced microelectronics reflects both the strengths and weaknesses of Chinese industrial policy and technology strategy. In the midst of some ample progress, especially since 2000, there have been many false starts and stops that have slowed down the overall momentum in this sector and have done little to diminish China's overall reliance on imports to service the country's growing demand for semiconductor products and components.

In 2006, in conjunction with the S&T MLP and program such as 863, China's State Council set forth the country's new national informatization strategy, 2006-2020. The initial phase of that strategy was reflected in the priorities and policies set forth in the 11th FYP (2006-2010). The goals for the informatization strategy include building a vibrant nationwide IT infrastructure, strengthening the country's innovation capabilities in IT, improving information security, enhancing the application of IT across the economy and public, and optimizing the structure of the IT industry. There are nine key aspects to the strategy, the bulk of which are focused on ways to promote overall informatization of the national economy and government sector. In 2008, IT spending in China grew by 9.1%, commensurate with the overall rate of economic growth; while IT spending will probably slow down somewhat in 2009, the fact is that within the country's national stimulus package of US\$586 billion, investments in railways, telecom, and education will provide opportunities for continued growth of IT.

Driving the country's IT agenda is the newly formed Ministry of Industry and Information Technology. The new ministry absorbed many of the responsibilities of the former MII (Ministry of Information Industry) in terms of the IT sphere. In addition, however, the new MIIT, will play a larger role in establishing industry standards, driving technology innovation, shaping the development of the IT infrastructure, and promoting information security. Of special importance will be three areas: 1) overall development of the software industry; 2) growth and expansion of IT services; and 3) continued development of the local semiconductor industry. In 2007, China's annual software output topped US\$84.5 billion, making it the fourth largest producer of software in the world, with an 8.7% share of the global software industry. Software exports, however, were only US\$930 million. With respect to IT services, the market value reached US\$10.9 billion in 2007—leaving China far still behind India both in terms of capacity and capability.

The effort to promote further development and deepening of the semiconductor sector stands out as an

³ Michael Pecht, China's Electronics Industry (Norwich: William Andrew Publishing, 2007)

example of the mixed results from Chinese industrial policy. Today, China absorbs about 1/3 of the worldwide market for semiconductors, reaching about US\$88 billion in 2007. At the same time, however, the Chinese share of global semiconductor production accounted for only about 9% of worldwide output. China's IC market grew to almost USD\$74 billion in 2007, accounting for 33.8% of the global IC market. Trade data from MIIT and from China's Ministry of Commerce indicate that the primary market for semiconductors in China continues to be the export market. Foreign companies are the main suppliers for meeting Chinese needs. According to a recent study by PWC, there were no Chinese companies in the top 55 suppliers to the Chinese semiconductor market in 2007.⁴ The PWC study goes on to indicate that "even if the largest Chinese semiconductor companies sold all their output within China, no Chinese semiconductor company would be among the top 50 suppliers to the Chinese semiconductor market in 2007." The situation regarding ICs is even worse—with the consumption/production gap reaching US\$54.9 billion in 2007. This is a strong indictment of Chinese efforts heretofore to enhance their capacity to meet the growing PRC demand for semiconductor and IC products—which continues to exceed the international growth rate by a significant margin.⁵

In 2000, the Chinese government issued State Council Document #18 which lays out a new strategy for developing the country's semiconductor and integrated circuit industry. Under this new plan, the PRC government has invested a total of US\$ 6.6 billion over the last five years and is expected to invest over US\$20 billion in the next five years (2009-2013) in projects in Suzhou, Wuxi, Shandong, Shanghai, Shenzhen and Dalian. Overall, it is estimated that between 2008-2020, the Chinese government will invest a total of US\$30 billion in the semiconductor and software sector. Whether these huge investments will materialize and whether they will yield desired results are major questions; nonetheless, moving ahead is considered to be a critical priority for the government. Key to this new strategy is the recognition that foreign investment can play a critical role in helping to stimulate the overall growth and expansion of the industry. Much of this foreign investment has located in and around Shanghai and the Yangtze River Delta area. One key exception, however, is the recent US\$2.5 billion investment by Intel in Dalian—which reflects Intel's intent to remain not just a major supplier to China (it was #1 in 2007), but also to help shape the evolution of the industry and to use its "insider" position to influence the direction of Chinese policies and technical standards. The plant known as Fab 68, which when approved in 2007 intended to deploy 90 nanometer technology to produce 300 mm integrated wafers, is intending to move into the 65 nanometer range once operational in 2010. It is clear that as demand for semiconductors in China has risen and as electronics and IT-related manufacturing has moved into the higher valued added segments in computing, communications and consumer products, many of the world's major semiconductor firms have decided to set up shop in China, bringing with them advanced equipment and know-how needed to support their increasingly advanced operations. China is continuing to absorb more and more of the world's semiconductor production activities, especially as demand seems likely to continue to rise across the board—but with foreign firms occupying the largest portion of the market.

Of course, China's semiconductor sector has not gone unscathed by the recent financial downturn. Experts project that the market will decline in 2009. Reverberations and bankruptcies occurring around the world are clearly making themselves felt in China. To remedy the situation, Wen Jiabao chaired a special meeting of the State Council in mid-February 2009 to address the challenges facing the electronics and information industry. Domestic producers in China are seeking more favored treatment by the government with respect to import duties on equipment, financing, and chip procurement. The premier outlined four core tasks to assist the industry get through the tough times ahead: a) improve the industrial structure of the industry; b) increase investment in technological upgrading, including the integrated circuit industry, LCD

⁴ See, PWC, "China's Impact on the Semiconductor Industry: 2008 Update," 2008.

⁵ According to PWC, since 2001, China's semiconductor market has grown at a 31.5% compounded annual growth rate, while the world market has grown at 10.6%.

technologies, and new generation mobile telephony; c) strengthen the capacity for independent innovation; and d) increased support for service outsourcing as well as the globalization of Chinese firms in R&D, manufacturing and marketing. To their credit, Chinese leaders seemed less inclined to adopt a “circle the wagons” strategy and appear to be more interested in preparing the industry for its future challenges.

Perhaps the two best examples of the early success of Chinese industrial policy in the ICT sector involve a) the development of the Godson (also called Loongson) computer chip and b) the development of the high performance super-computer. In an effort to dislodge itself from total dependence on foreign imported CPUs for computers, China has been engaged in a research initiative designed to create an indigenous computer chip. Supported by both the 863 Program and the Knowledge Innovation Program (KIP) under the Chinese Academy of Sciences, the Institute of Computing Technology (ICT) seems to have achieved its mission with the design and production of the Loongson IIE chip. The chip emulates early series Intel Pentium IV processors in performance, but cost less to produce. Also, most important, Loongson PCs use a Linux operating system, which also plays to China’s desire to wean itself off excessive dependence on the Wintel platform. The chips are manufactured in China by a French-Italian firm named ST Microelectronics in conjunction with BLX IC Design Corporation, which was founded by ICT and the Jiangsu Zhongyi Group. The chip is a much improved and enhanced version of Loongson-1 (a pure 32-bit CPU which was used for running cash registers and similar equipment). A Loongson-3 version is now in development; the new version will have four cores and an eight core version is being planned.⁶ The unique aspect of the Loongson design is that it is not based on the x86 instruction set, and instead uses a modified version of the MIPS instruction set.⁷ In July 2008, two foreign manufacturers—one in Holland and one in France—announced that they would adopt Loongson products for sale outside of China.

China’s success in building its own supercomputer reflects another example of Chinese efforts to target needed technologies and create an indigenously designed and manufactured product. The global market for high performance computing systems reached US\$11.6 billion in 2007 and is expected to reach US\$15 billion by 2011. Currently, among the world’s 500 fastest supercomputers, 15 are in China. In mid-2008, Chinese officials at the Dawning Information Industry Company announced the production of the Dawning 5000A, a Chinese-made high performance server that rivals the 7th fastest in the world for computing speed. The machine has a capability of 160 trillion computing operations per second. The Dawning 5000A remains no match for the fastest computer in the world, the Roadrunner—designed by IBM for the US Department of Energy’s Los Alamos National Laboratory—which at one quadrillion operations per second is 5.4 times faster than the Dawning 5000A. The computer is installed at the Shanghai Supercomputer Center, which specializes in computing outsourcing services for genome mapping, earthquake appraisal, weather forecasting, mining surveys, and stock exchange data analysis. Originally, the Dawning 5000A was to utilize the Loongson computer chip produced domestically, but instead a decision was made to rely on the AMD Barcelona quad-core processor. The choice of AMD was largely based on the fact that Dawning relies on a Windows-based operating system instead of Linux. The cost of the Dawning 5000A, even with imported AMD microprocessors, was about US\$29 million in contrast with the IBM Roadrunner, which cost the US Department of Energy US\$100 million. Chinese officials clearly hope domestically designed and manufactured machines will make their way into the international market; the Chinese Electronics Standards Association already has a process underway to help PRC manufacturers become suppliers of their machines to the developing world.⁸

⁶ Tom Halfhill, “Fast Forward: China’s Newest CPU,” *Maximumpc*, February 26, 2009, #5418.

⁷ According to Li Guojie, Director of ICT, these devices cannot compete head on with Intel on mainstream desktops and laptops, but rather will focus primarily on embedded applications, including set-top boxes, auto electronics, and industrial control. Use in low-end computers also is a possibility.

⁸ *South China Morning Post*, June 24, 2008, p.7.

These two examples attest to the extensive commitment made by the Chinese government to enhance its indigenous technological capabilities. While neither product is state of the art in terms of carving out a new technological frontier or leading the pack in terms of a new technology roadmap, they represent part of an important learning curve that is occurring in Chinese technology circles across many industrial sectors and technology fields. With compressed product and technology life cycles and new opportunities for cross border collaboration emerging, China is now part of a series of global knowledge networks that are helping to define the new technological frontiers of the 21st century. Unlike the hierarchical forms of one-way technology transfer that characterized international technology markets from the 1960s through the early 1990s, the process of engagement in global technology collaboration networks has become the new modality for technological learning and advance. A nation does not necessarily need to have ownership or control of state-of-the-art knowledge to enjoy the benefits of collaboration in these new knowledge networks; rather, the nature of specialization and cross-border collaboration are increasingly focused on the merging of technological complementarities that provide new channels for less advanced players to enter into these collaborative activities. As Chinese talent progresses ahead in the coming years, there is little doubt that China will become further embedded in these networks, moving from being a “taker” and lower end contributor to a high value added contributor. Developing and maintaining incentives and opportunities for China to remain engaged in these networks fully and collaboratively represents not only a technological challenge but also a political challenge in the years ahead.

Whither Industrial Policy in China?

There is little doubt that China remains strongly committed to further enhancing its own industrial base and indigenous technological capabilities. During the course of the next 5-10 years, China will continue to strengthen its domestic institutions, especially at the enterprise level, to promote an enhanced commitment to technological innovation. At the same time, global competition, transplanted to the Chinese market, will mean foreign firms will continue, willingly and actively, to bring advanced technology and equipment to China as part of their global strategic positioning. While the Chinese system may lag the US in most areas of innovative capability, the fact that it currently has become a preferred site for R&D suggests it is now strongly embedded in the global knowledge system. And, as China becomes more integrated into the fabric of global R&D activities, it will no doubt steadily seek a greater voice in negotiations about standards, markets, etc.

At the same time, however, it also is clear that China is not an unstoppable technological juggernaut that will soon dominate international product and technology markets, especially in terms of high technology. There are two large unknowns regarding China’s technological potential and the role that it will play in the global economy: 1) the “software” side of the technology equation; and 2) the issue of strategic intent. With respect to the software side of the equation, many questions remain about China’s ability to adapt, shift and operate with the high degree of flexibility, agility and responsiveness required for competitive success in the globalized world of the 21st century. For example, do Chinese policymakers and enterprise executives have the skills and comfort levels to manage in a highly fluid, fast changing environment? Do they have the ability to manage technologies across borders and cultures, especially outside of Chinese ethnic and guanxi networks? Does China have the ability to fully absorb the new cohort of Chinese returnees who are seeking to come back to the PRC to launch new research projects and businesses? And, does the leadership have the global outlook and understanding needed to compete effectively in a world where collaboration and cooperation are the new hallmarks of innovation and new knowledge creation?

In terms of the uncertainties regarding strategic intent, the unknowns may be even greater. Chinese perceptions regarding global trends and developments, especially in view of the global financial crisis, need to be better understood. It is clear that China remains frustrated with the US in a number of areas, especially with respect to bilateral S&T cooperation and the continued imposition of export controls. On the other hand, there are few global problems, if any, that can be addressed adequately without full

cooperation and participation from the Chinese side. American and Chinese business are inextricably linked together, and if trends persist, they will become even more intimately coupled. The fact is that the US and China have reached a level of interdependence that few could have predicted when Deng Xiaoping made his historic visit to the US in the late 1970s. Simply stated, at present, China's rise represents a strategic opportunity for the US, not a zero sum game or threat.⁹ The real challenge for the US, in this regard, is to better appreciate Chinese sensitivities as well as vulnerabilities, to identify and capitalize on the emerging pockets of excellence in the Chinese technology system, and to engage China as a full partner. While we may be a long way from the G-2 model being put forth by some in Beijing and other places around the world, the reality is that both countries can benefit a great deal from easing the continued political distrust that exists. Deeper engagement and closer articulation with one another in science and technology affairs provides one mechanism for building bridges and understanding as well as trust. In emerging fields such as new energy development and environmental management, such bridge building could become the impetus for a new era of more mutually beneficial "collaborative innovation" and technological advance that will not only benefit the people of both countries, but also other parts of the world as well.

HEARING COCHAIR SLANE: Thank you, Dr. Simon.
Mr. Szamosszegi.

**STATEMENT OF MR. ANDREW Z. SZAMOSSZEGI
MANAGING CONSULTANT, CAPITAL TRADE INC.,
WASHINGTON, DC**

MR. SZAMOSSZEGI: Thank you.

I just wanted to start off by saying that I'm honored to testify before the Commission on China's industrial policy and the impact on U.S. companies, workers, and the American economy.

As you know, I have co-authored an analysis of subsidies provided by the government of China to domestic and foreign firms in the so-called absolute control and heavyweight industries. And my discussion today is going to draw heavily from that report.

The subsidies report reviewed the financial statements of three firms that are relevant to today's inquiry: China Telecom Corporation; China Electronics Corporation Holding Company; and the IRICO Group Electronics Company Limited. Information about telecom equipment providers Huawei and ZTE was also reviewed, and I will reference that information as well.

Today, I hope to make six points that I address further in my written testimony:

⁹ In many respects, the strategic opportunity derives from the fact that the US-China S&T relationship has become less one-sided than before and is much less hierarchical due to the fact that the PRC has more to contribute of value and interest to the US science and engineering communities in key fields such as nanotechnology, life sciences, and new materials.

Point one: the Chinese government is a major player in the telecom and IT sectors. For example, as of December 31, 2007, state-owned enterprises and other government entities owned approximately 83 percent of China Telecom, 75 percent of China Electronics, and 75 percent of IRICO, and also 18 percent of ZTE.

So that's another way in which the Chinese government, rather than through funding, can influence research and development and technology within these firms.

Government ownership in China really means something. Typically, state-owned firms have better access to loans from the Chinese state-owned banks, better access to below-market financing, government grants and other benefits.

Under these circumstances, we should not be surprised if firms stress goals other than profit maximization in these sectors.

Point number two: The government provides these sectors with meaningful financial support. Based on our analysis of 2007 financial statements, we found the following: in 2007, China Telecom benefitted from large tax breaks for investing in Western China and for its purchase of domestic equipment.

The firm also purchased subsidiaries in Hong Kong and in the Americas from its government-owned parent at below-market prices. Together these subsidies totaled \$700 million, which is more than half of value of money raised by the firm in its 2002 initial public offerings in New York and Hong Kong.

ZTE benefitted from a number of special tax preferences related to its high-tech status, as well as a grant. These preferences amounted to \$162 million, which is 36 percent of the funds it raised in its 2004 public offering in Hong Kong. So the bottom line is that this support is pretty significant in the overall scheme of these firms that we looked at.

Point number three: China's industrial policy toward telecom services is multifaceted and extends beyond international competitiveness in the services industry.

Beijing wants to improve telecom service in the domestic market, encourage activity in the western part of the country, encourage consolidation, and support the development and adoption of home-grown technology and equipment.

While it is true that the government wants service providers to compete internationally, it is possible that pursuit of these other policy goals may get in the way of that goal.

Point number four: the impact of China's support for the telecom and IT sectors has both short and long-run dimensions in terms of the U.S. economy. The Capital Trade Study includes policy simulations

that assess the potential effect of reducing Chinese subsidies to absolute control and heavyweight industries on the Chinese and U.S. economies.

Were Chinese subsidies removed, U.S. employment, exports, domestic sales, and economic welfare would rise in the targeted sectors while China would experience lower exports and higher imports in those same sectors.

If we take into account lost U.S. investments resulting from Chinese subsidies, especially those that shifted investment from the United States to China, the losses caused by the subsidies are even higher over the long run to the U.S. economy.

Point five: any remedies to Chinese subsidies in this particular space may have to go through the WTO. Domestic trade laws can be used to attack Chinese subsidies but are limited. If you are a U.S. firm operating in a special economic zone and benefiting from Beijing's generosity, it might be very difficult for you to file a petition that puts the government of China on trial for programs similar to the ones that are putting money in your pocket.

If you are a player in China's market, and many IT and telecom equipment vendors are because China traditionally had few domestic sources for these products, then you do not want to get on the government's bad side.

Given these circumstances, the WTO may be the best venue for addressing Chinese IT and telecom subsidies because the U.S. industry is not a direct participant in the WTO investigations, and the U.S. government has the visible support of other countries.

Because of this, a WTO filing is less likely to cause blowback than a CVD petition filed by U.S. producers.

Point number six: on the telecom equipment side, the challenge may have less to do with standards and more to do with manufacturing prowess. Huawei and ZTE have a growing international presence and appear to have leadership positions in certain applications, though not in 4G.

They both try to spend about ten percent of revenues on R&D and have filed thousands of patent applications over the years. The two firms' combined revenue has gone from \$3.4 billion in 2002 to \$17.1 billion in 2007, an annual growth rate of 31 percent.

According to the U.S. Census Bureau's MA334P, the U.S. trend is heading in the opposite direction, negative six percent growth in revenue from 2001 to 2007.

So standards are extremely important and the implications to U.S. economic security of China's rapid ascent up the ladder of technological innovation are worrying though, as my colleagues here

have noted, there are certain opportunities that come with China's development.

But it is somewhat disconcerting that the government of a country that already has a massive trade surplus with the United States is spending billions of dollars so it can replace high-tech imports with domestic products, and it's likely to tilt the playing field in China against U.S. producers going forward.

But what worries me more than the standards are the negative trends on the production side of things, that we are letting a very focused country approach and potentially surpass us in manufacturing this important set of products so that standards ultimately may not matter.

Thank you.

[The statement follows:]

**Prepared Statement of Mr. Andrew Z. Szamosszegi
Managing Consultant, Capital Trade Inc., Washington, DC**

Good afternoon. My name is Andrew Szamosszegi. I am a managing consultant with Capital Trade Incorporated. I am honored to testify before the Commission on China's industrial policy and its impact on U.S. companies, workers, and the American economy.

I have recently co-authored an analysis of subsidies provided by the government of China to domestic and foreign firms in the so-called absolute control and heavyweight industries. Telecommunications is one of China's absolute control industries and is therefore considered of vital importance to the proper function of China's safety and economic well being. Information technology is considered one of China's heavyweight industries, and is also considered to be of special importance. My report therefore contains information relevant to today's hearing, and my testimony will rely heavily on information collected while preparing that study.

The Capital Trade subsidies report reviewed the financial statements of three firms relevant to today's inquiry: China Telecom Corporation Limited, China Electronics Corporation Holdings Company Limited, and IRICO Group Electronics Company Limited. Information about equipment providers Huawei and ZTE was also reviewed, and I will reference that as well. With the exception of Huawei, these quasi-public companies have SOEs with similar names. To avoid confusion, the firms I refer to as China Telecom, China Electronics, and IRICO are subsidiaries, not the 100 percent state-owned parents.

Point 1: The government is a major player in the telecom and IT sectors.

Our study suggests that the government plays a significant role in the telecom and IT industries. I just want to highlight the government's role in three areas: ownership, subsidies, and policy guidance.

In terms of ownership, the government remains a major player in this space. As of December 31, 2007, state-owned enterprises and other government entities owned approximately 83 percent of China Telecom, 75 percent of China Electronics, 75 percent of IRICO, and 18 percent of ZTE.

Government ownership in China means something. Typically, state-ownership confers access to loans

from Chinese state-owned banks, below-market financing from those banks and related companies, and access to government grants. In the case of telecom, the government has already announced that state and state-owned financial institutions will support the development, deployment, and export of domestically developed telecom technologies. The extensive ownership by the Chinese government suggests that the government will have many levers at its disposal to make firms in this space toe the line with the government's industrial policy. Under these circumstances, we should not be surprised if firms stress goals other than profit maximization.

Point 2: The government provides these sectors with meaningful financial support.

The firms we examined all received significant government aid. China Telecom is a case in point. By the end of 2007, it had 220 million fixed line subscribers and 35 million broadband subscribers, and described itself as China and the world's largest wire line telecommunications and broadband services provider. Despite this firm's preeminence in the Chinese market, it was still a major recipient of state support. In 2007, it benefitted from large tax breaks for investing in western China and for its purchases of domestic equipment. The firm also purchased subsidiaries in Hong Kong and the Americas from its government-owned parent at below market prices. In all, the government subsidy to China Telecom indicated in its annual report was nearly \$700 million in 2007.

ZTE's annual report shows it too receives subsidies. It benefits from a number of special tax preferences, such as the two full, three half program, special VAT rebates related to software procurement and high tech production, and an R&D grant. These preferences amounted to \$162 million in 2007.

China Electronics and IRICO are much smaller firms and they received subsidies of \$4 million and \$46 million respectively. What is interesting about these firms is the extent to which the government has played a role in their recent restructurings in the face of unfavorable trends. In the case of China Electronics, its state-owned parent performed a nifty reverse listing in Hong Kong by purchasing newly issued shares from an existing company on the Hong Kong Stock Exchange and effectively becoming the firm's majority owner. The firm's existing business lines were sold, leaving only the handset operations of China Electronics, a major producer of Philips branded phones. Philips has since exited the mobile handset business, leaving the brand and sales channel to China Electronics. IRICO experienced a similar misfortune as the world has moved to flat screen TVs, thereby reducing demand for IRICO's primary product, color picture tubes. The government's response was telling. IRICO's state-owned parent company built China's first LCD-TFT glass substrate production facility and then sold it to IRICO at a discount. IRICO is also the beneficiary of preferential tax rates, government grants, and preferential loans.

The subsidies received by these firms are not trivial. The value of the subsidies calculated from the China Telecom's 2007 annual report is more than half of the value of money raised by the firm in 2002 from its initial public offerings in Honk Kong and New York. For ZTE, the estimated subsidy calculated from the 2007 annual report amounts to 36 percent of the funds it raised in its 2004 public offering in Hong Kong. For IRICO, the 2007 subsidy is equivalent to 46 percent of its 2004 public offering in Hong Kong.

Point 3: China's industrial policy toward telecom services is multifaceted and extends beyond competitiveness.

The Chinese government seems to be pursuing a number of different goals. One, it wants to improve telecom service in the domestic market. Two, it wants to encourage activity in the western part of the country. Three, the government is also looking to consolidate the telecom services sector. I am not only speaking of the current tie ups pushed by the government. It is reasonable to conclude that the cash haul from the China Telecom's 2002 IPO funded the firms' domestic buying spree thereafter. Four, the

government is pushing the adoption of homegrown technology and the use of domestic equipment, and is deploying the resources of state-owned financial institutions to achieve these ends. This goal seems to be above all others. For all intents and purposes, the government is forcing the TD-SCDMA technology onto China Mobile and telling the main domestic service providers that they will be judged by their ability to develop and propagate homegrown technologies. While it is true that the government also has dreams of competition in international services, it is possible that pursuit of these other policy goals has the potential to get in the way.

Point 4: The impact of China's support for the telecom and IT sectors has both short and long-run dimensions.

The Capital Trade study includes policy simulations that assess the potential effects of reducing Chinese subsidies to absolute control and heavyweight industries on the Chinese and U.S. economies. Without getting into specific numbers, I will say the subsidies are harmful to U.S. interests in the short run. Were these subsidies removed, U.S. employment, exports, domestic sales, and economic welfare would rise in the targeted sectors, while China would experience lower exports and higher imports in these sectors.

The long run dimensions of this subsidy problem are even more troubling. U.S. data indicate that the stock of equipment in the U.S. manufacturing sector has been stagnant since the year 2000. This is no surprise in light of the massive increases in manufactured imports from China. Data also indicate that capital expenditures by the majority-owned manufacturing affiliates of U.S. multinational corporations in China have been increasing during this period, and that manufactured imports from China have been increasing as well. Combined, these two trends suggest that foreign investment in China may be replacing capital investment in the United States. To assess the potential effects of such a trend on U.S. economic performance, we ran a long-run policy simulation in which capital stock was shifted to the U.S. from China in conjunction with a removal of subsidies in China. The result was an even more significant improvement in the performance of U.S. industries at home and abroad, and a larger increase in U.S. economic welfare.

Point 5: Any remedies to subsidies in this space may have to go through the WTO.

Given the widespread use of subsidies by China, and their adverse impacts on U.S. producers, it is curious that more U.S. industries are not utilizing U.S. trade laws. Part of the answer to this puzzle may lie in the high levels of U.S. foreign direct investment in China. Because the government in China has a much larger economic footprint in China, U.S. firms with operations there may be reluctant to file CVD petitions against Beijing. Unlike antidumping cases, subsidies cases require participation from the government of China. If you are a U.S. firm operating in a special economic zone and benefitting from Beijing's generosity, it might be very difficult for you to file a petition that, in essence, puts the government of China on trial for programs that are similar to the ones putting money in your pocket. If we look at the firms filing petitions, they tend to belong to U.S. industries such as steel and paper, with limited participation in China, or from smaller, largely domestic, industries. Beijing has no leverage over them, so it is easier to file a petition if the subsidies are hurting your U.S. operations. Another factor limiting the use of domestic trade remedies is that the Chinese market is booming and a potential source of huge profits in the future. If you are a player in that market, and many IT and telecom equipment vendors are because China traditionally had few domestic sources for these products, then you do not want to get on "Red Star's" bad side.

Given these circumstances, the WTO may be the best venue for addressing Chinese subsidies. The United States usually has to take the first step, as was the case in the prior subsidies cases and in the current case against China's "famous brands" program. But once a case has been filed, other countries have participated in the process. Because the U.S. industry is not a direct participant in WTO investigations and the U.S.

government has the visible support of other countries, a WTO filing is less likely to cause “blowback” than a CVD petition filed by U.S. producers.

It is doubtful that the WTO can solve all of our problems regarding any adverse U.S. impacts of China’s state support. However, the United States has had some success with the WTO. For example, China agreed to delay implementation of its plan to increase tariffs on imported parts that were contingent on the localization level of Chinese produced vehicles. Unfortunately, China appears to have made this concession only after extracting promises from several foreign carmakers to increase local content. The last dispute settlement action against certain subsidies programs also resulted in China promising to end a variety of programs, including certain tax provisions that favored foreign investors. Many firms that are now paying corporate tax rates of 15 percent or less will see rates rise to 25 percent in stages over the next several years.

Point 6: On the telecom equipment side, the challenge has less to do with standards and more to do with manufacturing prowess.

Huawei is a major force internationally. Its revenues have increased at a compound growth rate of 33 percent from 2001 to 2007. According to an Economist Intelligence Unit report, the firm is ranked number 1 in the world in terms of commercial WiMax contracts and its shipments of 3G and 2G mobile phone networking equipment doubled during the first half of 2008. Growth has been strong internationally. In 2007, 72 percent of its growth came from increased penetration of international markets, with a growth rate of 150 percent in developed markets. Huawei has also been very successful in Latin America.

In terms of its technological prowess, Huawei’s R&D labor force is 35,000 strong and it spends 10 percent of revenues on R&D. It is one of the top applicants for UMTS 3G essential patents and among the worlds’ top 3 holders of LTE essential patents. It had filed 35,773 patent applications by December 2008.

ZTE is smaller than Huawei overall, but is no slouch. ZTE’s revenues increased 24 percent annually from 2001 to 2007, and its exports are expected to expand 30 percent in 2009 despite the weak global economy. The company actually has a higher market share in China than Huawei. ZTE also strives to spend 10 percent of its revenues on R&D. It has applied for 17,000 patents, including 1,000 3G terminal patents.

The two firms’ combined growth is impressive. They have gone from a \$3.4 billion in revenues in 2001 to \$17.1 billion in 2007. Their annual revenue growth during the period has been 31 percent. According to the Census Bureau’s MA334P, the U.S. trend is heading in the opposite direction. The U.S. growth rate from 2001 to 2007 was negative six percent, compared to positive 31 percent for Huawei and ZTE. The value of telecom equipment shipments by U.S. producers was \$61.9 billion in 2007, less than four times the revenues of Huawei and ZTE combined.

When I consider the rapid progress made by these two firms relative to U.S. firms, the U.S. consumer electronics industry comes to mind. Back when countries were racing to develop HDTV, someone, it may have been Peter Drucker, said that it did not matter who invented it, because Japan had raced so far ahead of the United States in manufacturing that whatever standard was adopted, Japanese companies would be able to make it. This was prophetic. Japan’s NHK developed and, in 1987, began broadcasting over analog HDTV. Digital HDTV, what we are all watching now, was invented in California in 1990 by a Korean-born engineer working for a firm called General Instruments. But today, when I look around the competitive landscape, I see many Americans buying digital HDTVs, but no U.S. firms producing them in large quantities. The one I know of, a niche player called Olevia, entered chapter 11 last year.

I do think standards are important, and I do worry about the implications to U.S. economic security of

China's rapid ascent up the ladder of technological innovation. I am also perturbed that the government of a country that already has a massive trade surplus with the United States is spending billions of dollars so that it can replace high tech imports with domestic products, and likely to tilt the playing field in China against U.S. producers. But what worries me more than standards are the negative trends on the production side of things -- that we are repeating the mistake of letting a country get so far ahead of us in manufacturing this important set of products that standards ultimately will not matter.

PANEL III: Discussion, Questions and Answers

HEARING COCHAIR SLANE: Commissioner Wortzel, we'll start with you.

VICE CHAIRMAN WORTZEL: Gentlemen, thank you all for being here today and for sharing your research and knowledge with us.

I have to say as a comment, Dr. Simon, that I think the "make versus buy" argument that you cite among Chinese economists is really a false argument, that most of what I've seen over the couple of decades I've been watching it has been a lot of buying, a lot of reverse engineering, and then a lot of making.

In other words, we deal with it all time here with IPR theft, which leads me into another area that Dr. Suttmeier referred to and that will affect the industries that Mr. Szamosszegi investigated. I'd like to draw you out on the balance between national security controls on exports and bringing in researchers or doing research in China, both as applies to basic research and applied research at U.S. universities, and how these deemed export rules are really affecting it?

I read the Fortress America report. I like it very much. I think Commissioner Reinsch may have some other views, but I think they did a very, very good job.

The problem is where does this balance come in when you still have a country that's trying to use a space-based satellite architecture to guide a missile warhead through space using sensors that will attack an American carrier? Not much room there for cooperation.

DR. SUTTMEIER: I think that your question about the deemed exports really goes to one of the changed circumstances that we face-- the dual-use revolution phenomenon and the fact that so much basic research does have a relatively short time frame before it actually can find its way into applications.

Just as an aside, I've been working on this project on U.S.-China science and technology cooperation looking over the past 30 years, and one of the things that I think is really manifestly clear is just how much that gap has closed or how much the acceleration has occurred. I think to implications follow. First, again, we have to run faster. But, second, we need to improve our intelligence about the Chinese system

so that we don't have blanket deemed export control policies that really put unnecessary burdens on companies and on universities. As a professor, I am particularly sensitive to the ways in which universities become instruments of national security policy; universities do have national security responsibilities, but we should also recognize that universities serve national needs best in providing forums for the open exchange of ideas and in serving as magnets for the best and brightest technical talent from around the world. So, in considering risks and opportunities, I think we need a much better focus on what this Sino-U.S. science and technology relationship is all about.

If you look at the way the U.S. government, is staffed to interact with China on these matters, it is rather stovepiped. It is really very fragmented and where you're supposed to have coordination the staffing is pitiful—one or two junior officers taking on this major responsibility for the future of the two countries; it's crazy.

So I think a combination of better coordination, better intelligence, not in terms of spying necessarily, but analytical work on what is and is not possible. Because I think ultimately you can't shut this all down; you can't shut it off.

As Denis points out, I think the possibilities for very significant benefits to both countries as well as to the world in many, many areas become important.

That said, I think separately then you have to begin to engage China on security discussions at new levels, saying, you know, we're very worried about what you're doing in space, what we see on industrial espionage, etc. (which I'm sure they know by this time). I don't know if that fully answers the question.

VICE CHAIRMAN WORTZEL: That's very helpful. Thank you.

DR. SIMON: I would go back to the point I made about strategic intent. I think that underlying the U.S.-China relationship still exists a great deal of mistrust and not a great deal of mutual understanding, and we operate at very superficial levels in many cases, and a lot of the discussion about what goes on in each other's countries really is not necessarily very well informed.

For example, in the Japan case, we used to use the role of the National Science Foundation and its overseas offices, particularly in Japan, as a kind of a listening post, not for intelligence collection, but basically as a way of getting more to the heart of what is going on inside of Japanese science and technology circles. There was a reporting function that was very important.

The same thing with the Science and Technology Councilor's role. It used to be in the early '80s, at least from my early experiences, there used to be a very proactive reporting role.

When you speak to these people today, they don't talk about their reporting role as much anymore. In fact, they spend most of their time hand-holding delegations and preparing for high-level visits, but not doing very much in terms of getting into the bowels of Chinese science and technology institutions and really getting a good understanding of what's going on.

There needs to be, I think, a revisiting of the role of those offices and those functions so that when we encounter this kind of problem about who's coming to study or what they may be coming to study for, we have a more well-informed decision.

The U.S. government goes around trying to figure out what to do about visitors. You remember years ago, we used to have an organization called COMEX, which was the Committee on Exchanges, that used to look at visitors, but it became too burdensome to review everyone.

But now, with the onset of computer technology and our Department of Homeland Security, we probably are in a much, much better position now to make judgments in a well-informed way, supported by better data and information. I think that's really what's necessary here.

MR. SZAMOSSZEGI: This isn't really my area of comparative advantage so I'm going to stick to my little study. One of the things that I intended to do since armaments is one of the main industries on the Chinese list of absolute control industries, I wanted to really go in there and find information about a military weapons firm.

I quickly found that no such information exists because these are the state-owned enterprises that closely guard all the information. They're not required to file forms with the stock exchange.

But what we did find were a couple of security-related firms owned by the state-owned enterprises that are the main weapons' manufacturers. And what we found was in the case of one of them, AVI-China, that this particular firm which produces regional jets and helicopters was owned by the Chinese producer SOE AVIC-II. The subsidiary, which is actually listed in Hong Kong, has a series of joint ventures with Airbus and Embraer. It manufactures for Boeing and Airbus.

This isn't the same thing as export controls necessarily, but it's a way, I think, to get technology to go from Western firms which maybe have had a higher level of technology to a Chinese firm that is owned by a state-owned enterprise that produces weapons.

So, in a case like this, we're basically at the mercy of the joint venture partners as to what kind of technology is transferred to China.

Another firm that we found is CASIL. Those are initials that it

uses in its annual report. This particular firm is engaged in construction of science and technology and aerospace parks. I know that we're focusing on the three programs, the Torch Program and the 863 Program, but I think that the Chinese government also is influencing technology in other ways by having state-owned firms support privately-owned firms that raise money in international capital markets to build these nice science and technology parks and aerospace parks.

So that's another area in which the Chinese government is moving this whole technological development forward, and I think it's going to be impacting us increasingly because as they populate those areas, I believe their technological capacity is going to increase.

VICE CHAIRMAN WORTZEL: May I be permitted a short comment?

HEARING COCHAIR SLANE: Sure.

VICE CHAIRMAN WORTZEL: It does blend. We visited a great enterprise last year that was building control mechanisms for environmental control systems in power plants and steel plants, and it looked great.

I opened a cabinet and looked at all the routers, and all the routers and all the electronic and computer control equipment came from a single Chinese firm. 50 miles away we passed that firm and in its parking lot was an electronic warfare and jamming regiment of the People's Liberation Army being outfitted with the same router. So I don't know how you make that separation.

HEARING COCHAIR SLANE: Thank you.

Chairman Bartholomew.

CHAIRMAN BARTHOLOMEW: Thank you very much. Thank you, gentlemen, for your interesting testimony, getting right to the heart of some of the challenges that we face, I think.

Dr. Suttmeier--actually for all of you--I'm interested in this idea of being able to create the conditions in which innovation thrives. You mentioned specifically primary and secondary education, which I think we all recognize we've got to do a much better job of here in the United States. These children, they're our seed capital.

We're talking about that's an investment that won't really provide returns to us for at least a decade and more likely several decades before these kids who are getting new opportunities are going to move into the workforce.

How are things standing, though, in terms of primary and secondary education in China? How is the Chinese government doing in educating its own young people?

DR. SUTTMEIER: I think if you look at statistics, they're not so

impressive. Many people would argue that the Chinese system has been weak on education, but again one of the things that this points to, I think, is perhaps the limits to policy. the drive for education in China I think is not totally a matter of policy; it's much more a matter of culture, of family influences, and things like that.

I think one reason why even the university sector, which arguably is still plagued with enormous problems in China, does as well as it does in terms of producing good people--is because they're driven by other things in some sense.

But there is, I think, a concerted effort now to try to keep building science education, popularization of science throughout the primary and secondary system as well as the general public.

But I think there is also the feeling that there's A terrible underinvestment, lack of professionalization of teachers in large parts of the country. Remember, this is a country where at least half of it is still a pretty underdeveloped place, and you don't have enough highly professionalized people to supply quality education for the entire country. So, this is one reason why I think it's always so difficult to draw conclusions about China. Which China are you talking about? For instance, in terms of the telecom expansion, when we consider subsidies for the expansion of telecom to west China, is that an industrial policy issue or is it a national development issue? We spent a lot of time and money in this country trying to bring electricity and telephones to rural areas as well.

DR. SIMON: I think the Chinese are trying to take a really close look at their primary and secondary education right now. Part of this is because they realize that the roots of creativity, in fact, are established early on.

I am very familiar with several experiments going on. In the city of Dalian, for example, where an individual created a private school, brought back a Chinese Canadian teacher, who had been in Canada for about half a dozen years, and created a K through 3 program for young kids. Basically, there are a lot of the things that we have in our own kindergartens--playgrounds and sandboxes--all of those kind of things for creative expression, free expression, et cetera.

The problem is that after the third grade, they must go back into the Chinese school system so you have a lot of perplexed kids who basically now have gotten a dose of the open classroom in some ways and then back to the traditional very rigid classroom.

I was just going through admissions applications for Penn State for my graduate school, and it's amazing; for every Chinese student, it seems to be the same--750 or 800 on their GRE math and, 500 or lower on the verbal part of their GREs and even lower on their essays.

In fact, it's almost a done deal that the Chinese students when they come to the United States find even our graduate programs in area such as statistics just fairly straightforward, very easy to do, because of the basic foundations they still get in their early education back in China.

So I don't think the Chinese government and the Chinese education authorities are willing to give all of that up and to release the whole education system to be a kind of open classroom for all.

In fact, there probably is some value in looking for some blend of what we do here in the West, which is probably a little bit too open-ended, and what they do in China, which is probably a little too rigid, and trying to figure out a good balance.

The Asia Society in New York has done a couple projects that I would commend to you that take a look at the comparative nature of early education that I think would lend some examples to this committee and help you understand more about that situation.

I think we need to learn a lot more about what makes the Chinese education system good and they want to learn a lot more about us, and exchanges of teachers and academic administrators would go a long way to transferring some of that understanding in both directions.

CHAIRMAN BARTHOLOMEW: Just one comment and I'll have a second round if we have a second round of questions.

Dr. Simon, I think the challenge always is when you talk about a new paradigm of cooperation, making sure that we have an idea what we want to get out of that cooperation because the Chinese government always seems to have a much better idea of what they want to get out of the cooperation. I'll raise that if we have an opportunity on the second round.

HEARING COCHAIR SLANE: Commissioner Blumenthal.

COMMISSIONER BLUMENTHAL: Yes. Thank you all very much.

I'm particularly happy to see Dr. Simon and Dr. Suttmeier here. I'm a big fan of your work in general. No offense--I haven't seen your work yet.

MR. SZAMOSSZEGI: None taken.

COMMISSIONER BLUMENTHAL: I'm looking forward to being familiar with your work.

But I have a couple of questions. One is this innovation paradigm. I guess my question would be, first, to flesh out what you mean by that. I don't remember which one of you said it.

And the second would be about what you described in terms of lack of creativity in science and risk aversion; I think it gels very much with the research I've done on this topic myself. But are you

seeing certain areas where, not copycatting cell phones, there are actual breakthroughs that are scientifically applicable, actual breakthroughs that actually start to compete with U.S. breakthroughs?

Which particular areas would those be, and how would that potentially harm us or hurt us? When we talk about competition, usually as Americans, we think competition is a good thing, but how could that actually harm or hurt us?

So a two-part question. One is what do you mean by a cooperative innovation paradigm? And the other is certain areas of science and technology where breakthroughs, commercial breakthroughs, may actually start to compete with the United States in harmful or helpful ways?

And it's really to both of you.

DR. SIMON: I gave you the example of what's been going on with respect to supercomputing. I think high performance computing is an area that not only has China targeted but they've actually made some substantial progress.

Clearly, in the version that I talked about, I pointed out that the architecture is their own, but they're still using AMD microprocessor technology. It would be a big leap forward, for example, for them to use this Loongson chip, the processor they developed to be the main core processors for something like this. That's their intent. It's their stated intent, clearly, to do this, and they clearly want to bring high performance computing into the marketplace, probably first to what I would call into intermediate markets.

That is, they want to introduce these first into developing country markets, grab some market share, use that to enhance and improve performance, and bring those products then to the higher-end markets in the West.

And, I think what we're seeing in the Chinese case is a very different technology strategy than one where they immediately have to leapfrog right to the very top. There's a lot of discussion about leapfrogging in China.

But I think that if we actually look at the way China is moving through the stages of technological development, it is a learning curve process, and we see them steadfastly engaged in first being a taker, then being a marginal contributor, and then embedding themselves through their marginal contributions in these technology networks that are being formed, and using those as a replacement for the traditional modalities of technology acquisition.

So, this expanded participation is getting them access into networks where new knowledge is being created at the frontier. If you look at the papers that are being written and the conferences that are

being held, you see significant Chinese participation, Chinese contributions, and Chinese co-authorship. These are some of the drivers that are pushing forward progress in areas in such as bio chips, for example, in the life sciences field, in key areas of IT, and in some aspects of nanotech—which you'll hear about from Rich Appelbaum this afternoon. And while not right at the forefront, China's progress clearly is substantial enough to make them a player in the game, which then allows them to rub shoulders with the state-of-the-art players and allows them to do a lot of immediate and rapid learning.

COMMISSIONER BLUMENTHAL: Does that hurt us economically? And if so, how?

DR. SUTTMEIER: Does it hurt? It probably hurts individual companies that lose market share to the Huaweis, for instance, or the ZTEs.

Does it necessarily hurt all of us? I don't know, because gains in one part of an industry may lead to losses in other parts of the industry. Remember, an awful lot of this technology policy that you're seeing in China comes as a result of this perception that they are, although in absolute terms, gainers, but in relative terms they are not doing so well because it is the people who control the technological architecture, and that is the IP and the standards, who are getting the lion's share of the benefits.

So what I think is driving an awful lot of the work then in technological innovation in China is an attempt to sort of change that balance somehow.

As for the innovation in this report, we talk a little bit about types of innovation because I think when you get into this question of innovation, you do have to be a little bit sensitive to whether you're talking about some kind of incremental innovation, major disruptive innovations.

I think the people who have been looking at a lot of the innovation in ICT would say that you're seeing more of the incremental stuff--but this can pay off because it can give new functionality to products in the domestic market where the Chinese companies may be especially sensitive to demand and new functionality in international markets as well. So Chinese companies can be expected to be internationally competitive not only on price, but also on innovative features of their products even though those innovations tend to be incremental.

The one other thing I would add in terms of new innovation paradigm, goes back to Commissioner Wortzel's point, and deemed export issue. We are really in an increasingly interdependent relationship with China on research and development.

This is true in terms of universities. Look at who's staffing up our faculties, and where the students are coming from. It is true in the corporate world, as well. I'm increasingly tempted to use the term "Chimerica," or "Chimerican science" (to borrow Niall Ferguson's term used to describe financial relations between the two countries) to describe relations in research and innovation. In light of this growing interdependence, we have to figure out new ways to build a trusting relationship, and, you cannot do that if you're turning people away at the U.S. consulates in China—we still do that a lot much more than we should.

COMMISSIONER BLUMENTHAL: If we have time, I'll follow up.

HEARING COCHAIR SLANE: Great. Okay.

COMMISSIONER BLUMENTHAL: Thank you very much.

HEARING COCHAIR SLANE: I have a quick question for Dr. Suttmeier and Dr. Simon. Your Chinese graduate students, do you find that they come with the intent of returning or do you find that they come and hope to stay?

DR. SIMON: I think it's about 50-50. I think half of them come with the expectation and maybe the obligation, depending on who's paying the bill when they come to go home. If they're gongfei, or government-sponsored, students, they have an obligation to return. And since there is no longer a June 4th or other kind of precipitant to allow them to stay freely, then they will probably will return.

On the other hand, the other 50 percent, those who are zifei or self-financed, increasingly, I think they are coming with the notion that they will try to get employment once they--let's say get a Ph.D. in the United States, they will get employment and their hope, at least initially, may be to stay.

The ideal paradigm for many of them is to come for their graduate degree, stay in the U.S. for "x" numbers of years, and use that as a jumping off point to go back and get a very high-paying job, either with a multinational company back in China or with a Chinese private sector company or, in some cases, and I think this is very important, become the new wave of technological entrepreneur in China that I think is going to become an important catalyst for change in China's technology sector.

I think more and more of those young entrepreneurs who have had experience on both sides of the ocean, they will become critical players in the game of helping China change its innovation culture and they will be an important catalyst.

So the fact that they return, there are some good aspects to that and there are some not so good aspects to that. We can't have our cake

and eat it too. We can't always have the benefits of both, such as half here and half there. There are many Chinese who are so-called amphibians; this is what they call them now, that is, they have one foot in the U.S. and they have one foot in China. Under the 863 Program, for example, they may have a laboratory and a project that's partially funded by the Chinese government: in the U.S. they have a project that's funded by the National Science Foundation. They have a lab there with graduate students and they have a lab here with graduate students. They're running basically multiple sets of experiments and multiple sets of projects. All of these are very powerful factors that help drive not only American science but also Chinese science.

DR. SUTTMEIER: I would agree with most of what I think Denis is saying. I would just add that in some ways we don't know as much about that question as we might. NSF has done surveys of intentions to stay or not stay. But I think it touches on some very interesting questions about cultural attachments, identity issues, as well as market forces.

I think that if you're talking in market terms, you'll find these folks can finesse many of the immigration issues they might face--they're part of this global workforce, and they migrate around.

So you can go to the laboratories of U.S. companies in Shanghai and meet some guys who are working there, ethnic Chinese who finished their work in the United States in the late '80s. They then went to work in the corporate laboratories in the U.S. for ten years, and they expect to go back to the U.S. after China, and then perhaps move on to India after that.

That's why this issue of competing for talent and making this economy one where people really want to come becomes so important, I think.

HEARING COCHAIR SLANE: Thank you.

COMMISSIONER REINSCH: May I follow up on that?

HEARING COCHAIR SLANE: Please, yes.

COMMISSIONER REINSCH: Those are very interesting examples, and you make some important points. Dr. Simon, you reminded me that a few years ago, I did a conference on this where I spoke along with the then Jordanian Ambassador to the United States, and he added the commercial element to this.

It may not be quite as true for China as it was for Jordan, but I thought it was an interesting comment. He said there are thousands of Jordanians who come to the United States to go to medical school, and they all graduate, and he said they all go back, and they all buy GE medical equipment.

The point that he was making was that the relationships and

bonds that they form here, as well as the language that they learn, not necessarily here but the language they speak and the language they're educated in, creates a relationship which transcends where they're located.

And the mentors they have, the people they look at, are here, and that forms a set of relationships that cause me to conclude that in a lot of cases having foreign students here is win-win. It doesn't matter whether they stay here or whether they go back; we win either way.

Now, in some of your areas, it's not quite that clear because there are security implications, which brings me to a question, which I want to ask Dr. Suttmeier, because you brought up the National Academy study. Larry and I probably don't entirely agree on it although I do think it's probably the most compelling indictment of the status quo that I've ever read, and the status quo deserves to be indicted.

But I'd like you to comment briefly, not only the export control part of it, but on the visa part of it, the travel part of it, because frankly in the public debate over the document, that piece has gotten very short shrift. Most of the focus and much of the controversy has surrounded the rest of it. Do you endorse the recommendations? Do you think that what they propose as far as both student travel and also, as I recall, sort of visa application process is the right way to go?

DR. SUTTMEIER: I think a good part of it was to have recognized scientists vouch for the reputation--

COMMISSIONER REINSCH: Yes.

DR. SUTTMEIER: --and intentions of the people.

COMMISSIONER REINSCH: That was one piece of it.

DR. SUTTMEIER: Yes, I think in general I do. And you say, in reference to the Jordanian case, it's always a win-win thing. I'm not sure it always is a win-win thing.

In fact, I would argue that if we're not careful, we're really turning it into a win-lose situation where we're the losers. I have many discussions with people from the Chinese technical community who have their educations here who are likely to buy GE equipment and HP equipment and want to maintain an active professional engagement with U.S. science, who then get turned away when applying for a visa at the U.S. consulate. I mean, there is something--

COMMISSIONER REINSCH: So there's a loss through our policy though; right? It's not from their exposure to the United States?

DR. SUTTMEIER: Exactly.

COMMISSIONER REINSCH: That's from our failure to allow the relationship to grow.

DR. SUTTMEIER: Yes.

COMMISSIONER REINSCH: That's well-taken.

DR. SUTTMEIER: How do you win in that circumstance? Here you've invested in building goodwill: we have a whole long history of Chinese scientists who studied here, they've become a great resource for our interests, and so forth, and we have now this policy discriminates against them and makes them feel like they are being treated as inferiors, if not as enemies. Eventually, some cease to even think about getting a U.S. visa. Go build their overseas professional relationships with others. They'll go to Australia for a meeting or they'll go someplace else.

COMMISSIONER REINSCH: There's also a strategic component to it. In my day job, I represent big companies, and they've had to deal with this problem from the standpoint of the engineers and scientists they want to hire or who already are working for them overseas. I got more complaints about exactly what you're talking about in 2002, '3, '4, than any other issue I dealt with.

I get a lot fewer complaints now except until recently, which is a footnote that we don't have time to get into, but the reason the volume of complaints diminished was not because the problem was solved, but because if you're GE, you have things you can do about it.

And what you do about it is you move your conference to Singapore or Vancouver, and ultimately what you do about it is you move your research lab to Tianjin, which it seems to me is not in our national security interest or our job creation or employment interests. But that's what's happening as a direct consequence of the policies that you're talking about.

I've taken too much time. I'm sorry.

DR. SUTTMEIER: If you then turn it back to the question of industrial policy, you can make a case, I think, that U.S. immigration policy actually does great things for Chinese industrial policy.

COMMISSIONER REINSCH: I need to say for the record that the reference to GE was a hypothetical one. I was picking on a company and not citing a specific example.

HEARING COCHAIR SLANE: Commissioner Wessel.

COMMISSIONER WESSEL: Thank you for being here today.

I want to ask some questions about a real-life issue we're going through right now here, and whether you support or oppose the recent stimulus bill and the "Buy America" provisions that were included within it, which is now the law of the land.

NTIA, the National Telecommunications Information Administration, has been looking at how to implement the law as it relates to the telecom IT sector, and they apparently under pressure from the Chinese and others are looking at creating a blanket

exemption from the Buy America provisions as it relates to the telecom IT sector for the sourcing that's funded by the bill.

As we look at the comments you've made about the standard setting in China, as we look at what has happened to the migration of production, not necessarily development but production of much of the electronics and commodities that go into the IT sector, how should we be viewing that right now?

We talked about win-lose, lose-lose, et cetera, and we just talked about this GE situation, about the question--

COMMISSIONER REINSCH: Hypothetical.

COMMISSIONER WESSEL: --hypothetical GE situation as it relates to R&D, et cetera. Most engineers, as I understand it, like to have production close to R&D so that they can tinker on the shop floor and go back and forth. What's happening to our industry?

Is it migrating to China as they develop the standards, as we look at the serving a one plus billion dollar market, as we look at the migration of what's happened here? Has it now gotten to the point where we couldn't even enforce Buy America policy because we don't make it here?

DR. SIMON: In many ways, that's exactly what is happening. As we've seen in the semiconductor area, putting aside the short-term dislocations that will occur over the next year or two, it's very clear that foreign investment not only has followed the opportunities in the Chinese market, foreign investors now see China as the strategic platform for not only the domestic market but also for the global market.

So, the bulk of those semiconductors that do get imported, for example, they tend to go right out in terms of exported products where the Chinese are still doing basically a lot of the assembly and a lot of the screwdriver operations.

One of the things that we missed discussing this morning was this question about local content and what the real value added is from American companies in China. Those exports that are being sent from China back to the United States, what is the real U.S. content in terms of total value added?

Somebody said 25 or 30 percent of the content is really still American content. The other is sourced from other parts of East Asia or other parts of the world, but at least 30 percent of the value of those parts and components in ICT products coming back to the United States belong to the United States originally. The PWC study, which I would commend to you, points this out as well, that rather than sourcing locally, many of the foreign companies inside of China and even local companies buy their chips externally and bring them into

the country because the duties have been now relaxed down to zero.

So it's a very difficult argument to make about what is really U.S. content--and I keep seeing in my mind the picture of that IBM laptop computer that was brought to Congress during the Lenovo discussions and how it was dismantled, and that part was made in Singapore, and this part was made in Taiwan, and what was the real value added in China?

I've seen another analysis just done of the 30 gigabit iPod, a similar kind of analysis about how it all is put together, and what is really Chinese value and what belongs to the U.S. and Japan, et cetera.

This is globalization, and whether we like it or not, I think it will be very tough whether it's an automobile or an airplane or an iPod to begin to discern exactly what is the American portion of it and what is, let's say, the Chinese portion and what belongs to some other part of the world. I think it's just too difficult and probably not worth the effort.

COMMISSIONER WESSEL: Well, I don't know that it's not worth the effort, because of the question of the migration of R&D and production--but if China is actively using standards to drive the production there, the development and the production, from an employment base approach--

DR. SIMON: Right.

COMMISSIONER WESSEL: --not a wealth creation, because you may still have the profits returning to the U.S.; from an employment impact, there are repercussions over time.

If I could ask another question: are there international standard setting bodies in the telecom IT industry that could help mediate this and look at a global solution rather than a nationalistic solution?

DR. SUTTMEIER: Yes. I think one of the things that we found is that there actually has been a kind of internationalization of the Chinese approach to standards. I did my first paper on it at the height of the WAPI business, and I think that the learning curve since then has changed and with it attitudinal changes.

China at that time was not so familiar with most standard setting organizations but since that time, they've recognized that they really need to get involved with formal standards bodies as well as many of the consortia that do standard setting in high-tech fields.

So there is a degree of learning that is going on already with both formal organizations like ISO and ITU, IEC, as well as consortia, and this is having the effect of mediating some of the potential tensions. At the same time, China's increasingly active participation in international standards bodies also provides opportunities for them to challenge established principles and norms in those bodies.

And what we're seeing domestically in China, is a complicated story. Not all Chinese producers are keen on embracing the Chinese developed standards. They're tied in with global networks and the functionality that they want in markets abroad is really tied up with international standards, and the Chinese producers don't want to necessarily give that up. So it's a much more complicated issue I think of how that actually all works.

But the short answer I think is yes. I would only add that there remains--this is not necessarily your purview in this Commission--a big philosophical question that China is part of, but so is India, so is Brazil, so are other places, the nature of the international standard system and especially how intellectual property fits into it.

So that's a separate debate. China is a party of that debate, but it has less to do with industrial policy, and more to do with a larger question about what should be the rules for this global knowledge-based economy when you have new players like India, like China, who have been standard takers in the past and now want to be standard makers, They sometimes have very different views about the role of IP in these standards regimes.

COMMISSIONER WESSEL: Understand. Thank you.

DR. SIMON: Can I add just a quick point to this? One of the things behind Intel's decision to build this \$2.5 billion chip factory in Dalian was an apparent desire by Intel which had been affected initially by their WAPI experience, et cetera, to become an inside player in the Chinese economy.

And, one of the things that Intel has sought to do is to have more and more influence by being an insider over the evolution of standards and the choice of standards, and to focus these standards discussions by using its leverage in this \$2.5 billion facility. Basically, it wants to say, hey look, I made this big commitment, you can't kind of just go run in this or that direction and leave me out in left field.

Now, whether or not they will be able to achieve their goals is another question, but clearly one thing on their mind is that this is at least one source of leverage that they can now have that they didn't have before.

COMMISSIONER WESSEL: It was also, I would say, the hundreds of millions of dollars in subsidies that they got from the Chinese that drove the IRR on the project--

DR. SIMON: Made it look very nice; right.

COMMISSIONER WESSEL: --over the 25 percent margin. So that may have had something to do with it.

HEARING COCHAIR SLANE: Commissioner Mulloy.

HEARING COCHAIR MULLOY: Thank you, Mr. Chairman.

I'm going to ask a couple of quick questions just to get some benchmarks established and then will ask a larger question where you could offer opinion.

So Dr. Leiby, who is on the next panel, he states in his testimony if you stop manufacturing, you will stop innovating. Do you agree with that statement, yes or no? Doctor, if you could just go across.

DR. SUTTMEIER: Not entirely.

HEARING COCHAIR MULLOY: What about you, Dr. Simon?

DR. SIMON: Also not entirely.

HEARING COCHAIR MULLOY: You think there's a lot of truth to it, but--

DR. SIMON: I think there's a lot of truth but not total.

HEARING COCHAIR MULLOY: What about you?

MR. SZAMOSSZEGI: Mostly.

HEARING COCHAIR MULLOY: Okay. Secondly, he says R&D usually follows manufacturing. So when you manufacture, then R&D will follow. If you lose your manufacturing base, you're probably going to lose your R&D base as well.

Do you agree with that?

DR. SUTTMEIER: Yes, I think that there's—yes.

HEARING COCHAIR MULLOY: What about you, Dr. Simon?

DR. SIMON: Yes.

HEARING COCHAIR MULLOY: What about you?

MR. SZAMOSSZEGI: Yes.

HEARING COCHAIR MULLOY: Okay. Then the third point. Dr. Simon, in your testimony you state this: you say that growth of foreign investment in China has proven to be an important vehicle for technology transfer including managerial know-how that has helped China steadily move up the learning curve in terms of taking on more sophisticated, higher value-added production tasks.

So that's I think innovation; isn't it?

DR. SIMON: Not necessarily innovation. It's learning. It's the ability to replicate, the ability to repeat, the ability to produce reliably, on schedule, et cetera, et cetera.

HEARING COCHAIR MULLOY: Does it move you up further to be able to innovate than if you were still doing other things that you could do 30 years ago?

DR. SIMON: Sure. It puts you closer to the edge.

HEARING COCHAIR MULLOY: And they're now closer to being an innovative society.

DR. SIMON: Yes.

HEARING COCHAIR MULLOY: You further state about China's leaders have wanted China to reduce its dependence on external sources of technology, and they want to move China into an innovation society.

And then you say this: China, added to this fact, we should also add China national security imperatives, which continue to be a key driver behind China's desire for strengthening its innovation capabilities.

So am I correct that they see innovation as a national security issue?

DR. SIMON: No doubt.

HEARING COCHAIR MULLOY: How is that? Do you all agree with that?

DR. SUTTMEIER: Oh, yes.

HEARING COCHAIR MULLOY: So, in other words, when they're moving up, would you say if we're helping them innovate, that we're being foolish?

DR. SUTTMEIER: Is that the big question?

HEARING COCHAIR MULLOY: They see it as a national security issue, and they have policies to get them there.

DR. SIMON: They see it as part of a threefold; they see it as part of competitiveness, national security, and sustainability. Those are the three legs of the stool that drive innovation for China today.

HEARING COCHAIR MULLOY: Yes. And what are we doing? I won't ask that.

DR. SIMON: Okay.

HEARING COCHAIR MULLOY: So we've got that established--innovation can be a national security issue and your ability to move up the food chain; correct? There's another witness that will come in later on, Dr. Arthurs, and he states on page three of his testimony, we're talking about all these Chinese students coming to America. And he says: China now has adopted a policy of luring back top scientists. This isn't just happenstance. It's a policy.

He states further: that the Chinese Academy of Sciences announced their plan to entice students to come back only days after the Congress Party of the Central Committee established that policy. And he says that they're calling on state enterprises and academic institutions to attract more leading overseas scientists, especially those on the cutting edge of science and technology, to come back.

If that's going on, does it make as much sense for us to be bringing as many Chinese scientists and engineers over and getting them the top education we could give them, put them in the top laboratories in this country, and then send them back to China? Or

would it make more sense for us to be trying to find ways to nurture American students to get into those positions and advance our innovative capacity?

I ask all of you.

DR. SUTTMEIER: Well, the latter, as Commissioner Bartholomew pointed out, is going to be a longer-term objective, I think, to make that happen because those of us who teach the young, we see the interest in pursuing careers in science and engineering has not been so great. Maybe now that you can't make a million dollars on Wall Street, the best and the brightest will go back into science.

But I think one should be a little bit careful about how you understand those points that you quote. Because, first of all, the best and the brightest have not gone back to China. Our colleague that we have worked with has looked at this question, and by and large, the best and the brightest Chinese stay here because it's so much better to work professionally.

Now, you do have this accelerated effort to lure people back made possible by the financial crisis, in part. The Chinese are willing to get talent wherever they can get it. But interestingly, it's not only Chinese that they're trying to recruit, they're trying to recruit anybody. That's the competition for talent.

HEARING COCHAIR MULLOY: Since my time is limited, Dr. Simon, do you have anything you want to add?

DR. SIMON: In December, the Organization Department of the Communist Party announced the Thousand Person Returnee Program, and this program is designed to take advantage of the financial crisis to bring people back.

But it's very clear, as Dr. Suttmeier said, some of the best still want to be in the United States, and there is an anchor. The anchor are their families and their children who they want to see get education here in the United States, and that's one of the most important reasons why many of them don't go back.

MR. SZAMOSSZEGI: To answer your question, I think that it's better to nourish American students, but I also agree that that's a long-term undertaking.

Dr. Suttmeier mentioned that the financial crisis has probably changed some incentives in the United States. That comment was maybe in jest, I don't know. But I think that that's been a big problem, that we've had incentives that have drawn a lot of the best and the brightest into financial engineering, and that's been to our detriment.

But, finally, I think that by experiencing what we've experienced with manufacturing, about it is increasingly clear that manufacturing and R&D are interlinked; where one goes, the other tends to migrate.

The poor returns in manufacturing and higher returns to financial engineering, are two sides of the same coin.

People don't want to go into financial engineering because it's-- you can make a lot of money, but manufacturing, on the other hand, you're getting beaten down by imports all the time. It's not as profitable. And I think that's part of the same problem.

HEARING COCHAIR MULLOY: Thank you.

That was very helpful. I appreciate all of you giving me that opportunity to get those questions out.

HEARING COCHAIR SLANE: Commissioner Videnieks.

COMMISSIONER VIDENIEKS: Mine will be very brief because we're getting there. Just to kind of sum it up, a lot of important issues--okay--but relatively how large percentage-wise is the IT sector of their national income, the GDP? What are we really talking about?

But then, again, how capital intensive is it? How many satellites do they have up there, communication, civilian, and what are we really talking about in terms of size?

DR. SIMON: Well, about 1.6 percent this past year was spent for R&D as a percentage of GDP.

COMMISSIONER VIDENIEKS: R&D. All of R&D?

DR. SIMON: R&D. All in. And the interesting thing, however, is that if you look at the Battelle Institute's recent study, they say that looking at R&D among all of the countries in the world, China is among the fastest growing—in terms of growth of R&D expenditures.

COMMISSIONER VIDENIEKS: Growing. Not there yet. We're way ahead.

DR. SIMON: Right. According to some OECD data, China still accounts for only about nine-ten percent of global R&D spending. We account for some 30 plus percent.

So the differential is substantial, and I think when Rich Appelbaum talks, he will talk about nanotech, the difference in the investment in nanotech in China versus what our investment is is substantial, though. Again, these are different dollars.

COMMISSIONER VIDENIEKS: How many civilian communication satellites will they have up there and who owns them, who put them up there, who maintains them?

MR. SZAMOSSZEGI: Don't know.

DR. SIMON: Don't know.

COMMISSIONER WESSEL: You stumped them.

DR. SUTTMEIER: Several. I don't think there is too many. And I think most of them probably are state owned.

COMMISSIONER VIDENIEKS: If they were to execute that WTO government procurement agreement, would the communications

sector be open to competition by us and others?

DR. SIMON: According to the WTO requirements, gradual opening of the telecom sector on both the equipment and services side is supposed to be part of the agreement. It's lagged a little bit. It hasn't gone the way or as fast as we had hoped, but it's moving. It's been moving in the right direction, just slowly, very slowly.

COMMISSIONER VIDENIEKS: Are we talking about a minor part of their GDP that's flashing the news or it's something that's got a trend to it or what?

MR. SZAMOSSZEGI: I could probably get you and I'll endeavor to get the Commission the exact data. But I think it's growing given the large amount of investments that have occurred in this sector over the past seven or eight years.

COMMISSIONER VIDENIEKS: It would be nice to know what we're talking about relatively, the relative rates of growth of U.S. IT sector, their IT sector, how it stands globally, how many birds do we have up there, and so forth, you know?

Well, thank you.

HEARING COCHAIR SLANE: Thank you, gentlemen.

It's been very, very helpful. We really appreciate your time coming here and we wish good speedy trip back to Oregon and Pennsylvania, and we'll stand adjourned for ten minutes.

[Whereupon, a short recess was taken.]

PANEL IV: CHINA'S NANOTECHNOLOGY AND OPTOELECTRONICS INDUSTRIES

HEARING COCHAIR MULLOY: This is panel four, and we're looking at "China's Nanotechnology and Optoelectronics Industries." And we're trying to look at these in terms of innovative industries, where China is trying to develop and has a strategy to try and develop these.

We're very fortunate to have three distinguished witnesses. Dr. Michael Leby is the President and CEO of the Optoelectronics Industry Development Association.

Dr. Leby has more than 175 U.S. patents issued in the field of optoelectronics and his career has spanned all aspects of the business from research and development to manufacturing to finance to sales and marketing.

Dr. Eugene Arthurs is the CEO of the International Society for Optics and Photonics. He has a Ph.D. in applied physics and is an active member of numerous scientific societies.

Dr. Richard Appelbaum is the Professor of Sociology and Global and International Studies at the University of California in Santa Barbara.

He is currently engaged in a study of high technology development in China focusing on nanotechnology.

So we're very fortunate to have you gentlemen with us today and why don't we start with you, Dr. Leppy. And we'll try and go seven minute statements, more or less, and then we'll open up to commissioners five minute rounds.

**STATEMENT OF DR. MICHAEL LEBBY
PRESIDENT AND CEO, OPTOELECTRONICS INDUSTRY
DEVELOPMENT ASSOCIATION, WASHINGTON, DC**

DR. LEBBY: Good afternoon.

OIDA has over 18 members who research, manufacture and sell optoelectronic components and systems in applications such as communications, defense, displays, solid-state lighting, sensing, and solar energy.

OIDA is in a unique position to address the issues posed by the Commission. OIDA members include large companies such as General Dynamics, Cisco, Corning, Telcordia, JDSU, and also fast-growing entrepreneurial companies.

In the past five years, the Chinese government has made a concerted effort to transition from a "copy and assemble" economy that relies on low labor and manufacturing costs into a innovation-driven one. It is focusing on higher-value products and is encouraging its companies to move up the value chain. China is seeding a competitive optoelectronics industry by supporting a wide range of R&D activities from materials to devices to manufacturing technology.

As part of its industrial policy, the Chinese government encourages foreign companies to establish facilities in China. The subsidies that the Chinese government offers are a major incentive for U.S. companies to shift R&D and production to China.

They include tax incentives, building subsidies, free trade zones, and low-cost labor. Many U.S. companies see these incentives as a means to survive in an increasingly competitive global business environment.

Corporate strategies that keep product design in the U.S. while moving manufacturing overseas over time will dilute our ability to innovate. Most innovation is incremental, not revolutionary. It consists of constant small improvements to the product and the manufacturing process that result in better performance and lower cost.

In optoelectronics, even the slightest change in the yields of manufacturing processes can affect the economic viability of a company. Maintaining the close proximity of R&D to manufacturing is essential for driving process improvement and innovation.

Initially, jobs that move overseas to China are not jobs that require a highly skilled workforce. China has a large number of highly educated people, and with this result, Chinese companies can readily move up the value chain. Consequently, highly skilled U.S. jobs often are the next ones to follow.

Many OIDA member companies have already moved assembly and packaging to China, but have kept the optoelectronics chip fabrication facilities in the U.S. Chip design is complex and the embedded intellectual property provides the competitive edge for the final product.

U.S. optoelectronics companies are concerned that if the chip fabrication plants move overseas as well, this market sector will also be lost.

Manufacturing your core technology overseas can be perilous. One OIDA member that transferred chip fabrication to China found that the facility making the chips was also selling them to the member's competitors in China.

The intellectual property in optoelectronics often resides in the skills of people as much as in the corporate trade secrets and issued patents. Chinese nationals, who train in U.S. universities, work at U.S. companies, and then return to China, lead to a continuous flow of core skills leaving the U.S.

A leading U.S. producer of optoelectronic components recently opened an optoelectronics R&D center in China. When OIDA asked if China had the requisite talent to run and manage the R&D team, the company responded that it had sent U.S. experts to China to bring the Chinese engineering leaders up to speed.

The U.S. government needs to fund optoelectronics R&D aggressively. It needs to place an increased emphasis, however, on development in addition to supporting pure research. Existing government agencies, which fund research already, have certainly the resources to implement such a shift in focus.

OIDA members believe that direct government support and programs are considerably more effective than indirect support. The impact of direct government support is readily measurable. Focused optoelectronics R&D programs will lead to concrete markets and tangible results.

Indirect government support, such as tax credits, are of little value to entrepreneurial start-ups that are far from generating profits

that tax credits offset. Even larger corporations will not benefit from tax credits if they are not earning profits.

In biophotonics, for example, the National Science Foundation and NIH are the primary sources of government funding. Today, the NSF and NIH primarily fund research at academia and not-for-profit research organizations. OIDA members support an expanded role where these agencies fund innovations at businesses as well.

Areas where government optoelectronics investments can yield results include:

Communications. The implementation of a true high-speed Internet infrastructure--one terabit per second in the core backbone of the network and one gigabit per second to the home. This will require government-sponsored programs that help develop the optoelectronics infrastructure of components, modules, subsystems and fiber.

Displays. Although glass-based flat panel manufacturing takes place almost exclusively in Asia, the U.S. can establish a dominant position in roll-to-roll manufacturing of flexible displays based on organic light emitting diode technology. Large companies, for example, like Kodak and 3M, have the requisite expertise to innovate and manufacture in roll-to-roll processing, but the technical risks are still high. Numerous U.S. start-ups are leaders in this area.

Computation. Invest in next-generation communication for computer processors. Future processors and multi-core silicon integrated circuit engines will need optoelectronics to support chip-to-chip and intra-chip interconnect technology.

Solid state lighting. Accelerate investment in industry-driven R&D in high brightness light emitting diodes. This includes advanced materials systems, manufacturing equipment infrastructure, and device efficiency. For example, set a goal to advance the state-of-art by increasing the wafer size from two inches in an LED plant to eight inches.

Optoelectronic devices. Invest in photonic integrated circuits. This technology is based both on silicon and indium phosphide. PIC devices will transform optoelectronics just as the integrated circuit transformed semiconductor technology 50 years ago. For PICs, Moore's law, made famous by the semiconductor industry, is just beginning.

Image sensors. Invest in integrating silicon image sensors with IC technologies, leading to advanced imaging capability for defense and medicine.

Biophotonics. Support multidisciplinary projects that promote better communication and innovation among the optoelectronics, biological and medical communities. Foster commercial innovation by

supporting optoelectronics R&D for medical and healthcare applications.

Defense. Optoelectronics technology increasingly provides the performance edge in defense and avionics applications. DoD needs a trusted, U.S.-based source of photonic devices. A photonics foundry that develops modeling tools and validated common processes will ensure viable U.S. sources.

Solar photovoltaics. Like displays, photovoltaic technology will benefit from innovations in roll-to-roll processing. The U.S. can capture leadership in this important and growing market, and through it, the alternative energy markets.

Green photonics technology. Optoelectronic components will drive energy efficiency improvements in a wide range of applications such as monitoring--sensors in oil wells; automobile engines; wind turbine blades, for example; in the field of generation, solar cells; and in the field of conservation, solid-state lighting.

OIDA's market research forecasts that by 2020, green photonics applications will account for 54 percent of the optoelectronics components market. This interdisciplinary area is highly appropriate for government-led investment.

In addition to our testimony, I respectfully refer the Commission to the written statement of one of our member companies, Infinera, a company that has really grown very quickly on PICs and recently went public.

In preparing this testimony, many people I contacted stressed the importance of this decisive action by the U.S. government and industry now. Optoelectronics sits at the intersection of multiple technical disciplines. U.S. universities and industry are particularly adept at bringing diverse people together to work on complex problems.

We have, by the nature of our inherent diversity, an advantage. What for many presents a challenge for us comes naturally.

Thank you for this opportunity to present our industry's perspective.

[The statement follows:]

**Prepared Statement of Dr. Michael Lebby
President and CEO, Optoelectronics Industry Development
Association, Washington, DC**

March 24, 2009

Michael Lebby, B.Eng, MBA, PhD, D.Eng, C. Eng

President and CEO, Optoelectronics Industry Development Association
Testimony before the U.S.-China Economic and Security Review Commission
Hearing on China's Industrial Policy and Its Impact
on U.S. Companies, Workers and the American Economy

I am the President and CEO of the Optoelectronics Industry Development Association (OIDA), an industry association based in Washington, DC. OIDA has over 80 members who research, manufacture, and sell optoelectronics components and systems in applications such as communications, defense, displays, solid-state lighting, sensing, and solar energy.

OIDA is in a unique position to address the issues posed by this Commission. OIDA members include large companies such as General Dynamics, Cisco, Corning, Telcordia, and JDSU, and fast-growing entrepreneurial companies.

In the past five years, the Chinese government has made a concerted effort to transition from a “copy and assemble” economy that relies on low labor and manufacturing costs into an innovation-driven one. It is focusing on higher-value products and is encouraging its companies to move up the value chain. China is seeding a competitive optoelectronics industry by supporting a wide range of R&D activities from materials to devices to manufacturing technology.

“If an optoelectronics effort looks promising, China will support a commercial start-up until it's profitable”

The Chinese government supports optoelectronics through the research, development, and production phases (R&D&P). An example is their new multi-million dollar Wuhan National Laboratory for Optoelectronics (WNLO). It is one of the five national laboratories formed and sponsored by the Chinese Ministry of Science and Technology. The mission of WNLO is to become the innovation base for optoelectronics in China, to promote and lead the complete commercialization system for “Wuhan Optics Valley of China,” and to contribute to the growth of optoelectronics industries through technology transfer.

The government also uses consortia such as the Northern Microelectronics R&D Center, which has the Institute of Microelectronics of the Tsinghua University in Beijing as a principle member, to foster academic-industry collaborations.

“U.S. companies are competing with countries not companies”

As part of its industrial policy, the Chinese government encourages foreign companies to establish facilities in China. The subsidies that the Chinese government offers are a major incentive for U.S. companies to shift R&D and production to China. They include tax incentives, building subsidies, free trade zones, and low-cost labor. Many U.S. companies see these incentives as a means to survive in an increasingly competitive global business environment.

Corporate strategies that keep product design in the U.S. while moving manufacturing overseas over time will dilute our ability to innovate. Most innovation is incremental, not revolutionary. It consists of constant small improvements to the product and manufacturing process that result in better performance and lower cost. In optoelectronics, even the slightest change in the yields of manufacturing processes can affect the economic viability of a company. Maintaining the close proximity of R&D to manufacturing is essential for driving process improvement and innovation.

“If you stop manufacturing, you will eventually stop innovating”

Initially, jobs that move overseas to China are not jobs that require a highly skilled workforce. China has a large number of highly educated people and with this resource, Chinese companies can readily move up the value chain. Consequently, highly skilled U.S. jobs often are the next ones to follow.

“R&D usually follows manufacturing; optoelectronics is no different”

Many OIDA member companies have already moved assembly and packaging to China, but have kept the optoelectronics chip fabrication facilities in the U.S. Chip design is complex and the embedded intellectual property provides the competitive edge for the final product. U.S. optoelectronics companies are concerned that if the chip fabrication plants move overseas as well, this market sector will also be lost.

Manufacturing your core technology overseas can be perilous. One OIDA member that transferred chip fabrication to China found that the facility making the chips was also selling them to the member’s competitors in China!

The intellectual property in optoelectronics often resides in the skills of people as much as in corporate trade secrets and issued patents. Chinese nationals who train at U.S. universities, work at U.S. companies, and then return to China, lead to a continuous flow of core skills leaving the U.S.

A leading U.S. producer of optoelectronics components recently opened an optoelectronics R&D center in China. When OIDA asked if China had the requisite talent to run and manage the R&D team, the company responded that it had sent U.S. experts to China to bring the Chinese engineering leaders up to speed.

A number of optoelectronics companies have 90% of their employees in Asia and retain only 10% in the United States. Their U.S.-based jobs are increasingly in sales and marketing – not in engineering or manufacturing. We can expect more optoelectronics companies to move R&D and production to China unless the U.S. government takes effective steps to support the domestic industry.

“U.S. optoelectronics companies are increasingly becoming simply marketing outlets for Chinese-manufactured goods”

The United States government needs to fund optoelectronics R&D aggressively. It needs to place an increased emphasis, however, on Development in addition to supporting pure Research. Existing government agencies, which fund research already, have the resources to implement such a shift in focus.

OIDA members believe that direct government support and programs are considerably more effective than indirect support.¹ The impact of direct government support is readily measurable. Focused optoelectronics R&D programs will lead to concrete markets and tangible results. Indirect government support, such as tax credits, are of little value to entrepreneurial start-ups that are far from generating profits that tax credits offset. Even larger corporations will not benefit from tax credits if they are not earning profits.

The U.S. government should increase its time horizon for measuring program success – perhaps two or three times longer than venture capital expects for its investments. A model could be the New Energy and Industrial Technology Development Organization (NEDO), in Japan.² NEDO’s programs last five to ten years. This gives companies the opportunity to nurture innovative technologies and retain skilled labor.

The government can improve and expand worthwhile existing programs like the Small Business Innovative Research (SBIR). The published SBIR topics are often so narrow, however, that innovative new optoelectronics technologies do not fall within their scope. Broad topics, on the other hand, would allow companies to put forth their concepts and increase the likelihood that these funds will lead to commercial products. OIDA members support recent legislation relaxing Small Business Administration rules that limited

¹ An example of such an indirect subsidy was the tax incentive for repatriating income of foreign subsidiaries contained in the 2004 America Jobs Creation Act, and considered by Congress in the most recent stimulus package. Economists have both supported, (Allen Sinai, “A \$545 Billion Private Stimulus Plan; Let’s Bring Home Foreign Earnings Without Tax Penalty” Wall Street Journal, January 28, 2009,) and criticized (Chye-Ching Huang, “Proposed Tax Break for Multinationals Would be Poor Stimulus; ‘Dividend Repatriation Tax Holiday’ Failed in 2004, Unlikely to Work Now” Center on Budget & Policy Priorities, January 30, 2008) this method for stimulating corporate investment. For additional discussion, please see, David L. Brumbaugh, “Tax Exemption for Repatriated Foreign Earnings: Proposals and Analysis” Congressional Research Service, April 27, 2006.

² NEDO is a semi governmental organization under the Ministry of International Trade and Industry (MITI) http://www.wtec.org/loyola/scpa/09_11.htm.

participation by venture-backed companies.

In biophotonics, the National Science Foundation (NSF) and National Institutes of Health (NIH) are the primary sources of government funding. Today, the NSF and NIH primarily fund research at academia and not-for-profit research organizations³. OIDA members support an expanded role where these agencies fund innovations at businesses as well.

The U.S. has already ceded major sectors of the optoelectronics industry to overseas competitors. Notable examples include displays (South Korea, Japan, Taiwan, China), solar photovoltaic modules (Germany, Japan), image sensors (Japan, Taiwan), and high power lasers (Germany). Notwithstanding this reality, opportunities in optoelectronics still abound. The U.S. government must act aggressively and decisively to help U.S. industry establish dominance in emerging applications domains.

“U.S. needs to act aggressively and decisively now, with focused optoelectronics programs”

Areas where government optoelectronics investment can yield results include:

- a) **Communications:** The implementation of a true high-speed internet infrastructure (1 terabit per second in the core backbone of the network, and 1 gigabit per second to the home) will require government-sponsored programs that help develop the optoelectronics infrastructure of components, modules, subsystems, and fiber.
- b) **Displays:** Although glass-based flat panel manufacturing takes place almost exclusively in Asia, the U.S. can establish a dominant position in roll-to-roll manufacturing of flexible displays based on organic light emitting diode technology. Large companies like Kodak and 3M have the requisite expertise to innovate and manufacture in roll-to-roll processing, but the technical risks are still high. Numerous U.S. start-ups are leaders in this area.
- c) **Computation:** Invest in next-generation communication for computer processors. Future processors and multi-core silicon integrated circuit engines will need optoelectronics to support chip-to-chip and intra chip interconnect technology.
- d) **Solid State Lighting:** Accelerate investment in industry-driven R&D in high brightness light emitting diodes. This includes advanced materials systems, manufacturing equipment infrastructure, and device efficiency. For example, set a

³ At hearings on the 2008 SBIR Reauthorization legislation, Mark Heeson of the National Venture Capital Association stated, “that only 0.4% of extramural grants from NIH went to businesses.”

goal to advance the state-of-the-art by increasing the wafer size from 2 inches to 8 inches.

- e) Optoelectronics Devices: Invest in photonic integrated circuit (PIC) technology based on both silicon and indium phosphide. PIC devices will transform optoelectronics just as the integrated circuit (IC) transformed semiconductor technology 50 years ago. For PICs, Moore's law⁴, made famous by the semiconductor industry, is just beginning.
- f) Image Sensors: Invest in integrating silicon image sensors with IC technologies, leading to advanced imaging capability for defense and medicine.
- g) Biophotonics: Support multi-disciplinary projects that promote better communication and innovation among the optoelectronics, biological, and medical communities. Foster commercial innovation by supporting optoelectronics R&D for medical and healthcare applications.
- h) Defense: Optoelectronics technology increasingly provides the performance edge in defense and avionics applications. DoD needs a trusted, U.S.-based source of photonic devices. A photonics foundry that develops modeling tools and validated common processes will ensure viable U.S. sources.
- i) Solar Photovoltaics: Like displays, photovoltaic technology will benefit from innovations in roll-to-roll processing. The U.S. can capture leadership in this important and growing market and through it, the alternative energy market.

⁴ Moore's law is the empirical observation that the transistor density of integrated circuits doubles every 18 months.

- j) “Green” Photonics Technology: Optoelectronics components will drive energy efficiency improvements in a wide range of applications, such as monitoring – sensors in oil wells, automobile engines, wind turbine blades, generation – solar cells and conservation – solid-state lighting. OIDA’s market research forecasts that by 2020, green photonics applications will account for 54% of the optoelectronics components market. This inter-disciplinary area is highly appropriate for government-led investment.

In addition to our testimony, I respectfully refer the Commission to the written statement of our member company, Infinera.

In preparing this testimony, many people I contacted stressed the importance of decisive action by the U.S. government and industry now. Optoelectronics sits at the intersection of multiple technical disciplines. U.S. universities and industry are particularly adept at bringing diverse people together to work on complex problems. We have, by the nature of our inherent diversity, an advantage. What for many presents a challenge, for us comes naturally.

Thank you for this opportunity to present our industry’s perspective.¹

HEARING COCHAIR MULLOY: Thank you, Dr. Leiby.
Dr. Arthurs.

**STATEMENT OF DR. EUGENE ARTHURS
CEO, SPIE, THE INTERNATIONAL SOCIETY FOR OPTICS AND
PHOTONICS, BELLINGHAM, WASHINGTON**

DR. ARTHURS: Good afternoon. Thank you to the Commission for the opportunity to voice my concerns and those of many of our U.S. members.

We are a not-for-profit society based in Bellingham, Washington. We have about 10,000 members in optoelectronics technologies in the U.S. and about 400 corporate members. We're a little outside the pale in terms of scientific associations in that we value conversion of science into product. We really are more market-driven than technology or science-push driven than the average scientific society.

We run the largest conferences in optoelectronics in the world. In the U.S., particularly, we run Photonics West which has about a thousand exhibiting companies from all over the world, not so much related to the consumer market but technology companies. We also are

going to be running shortly "Defense, Security and Sensing" in Orlando, Florida, with over 500 exhibiting companies in the field of optoelectronics in defense.

When we look at our sister societies in China, they really are very weak, as I say in my testimony, though, that is another target that the government has, to improve them and make them essentially as effective as the societies have been in enhancing U.S. science.

One thing that strikes me about the Chinese Academy of Sciences is that unlike most academies of sciences throughout the world, it actually talks about advanced manufacturing technology and automation technology. This is anathema to most academies of sciences throughout the world.

This is really the central point that I would have: we are about to invest a lot more in R&D. I believe this to be based on models of transforming R&D into economic success that no longer exists. I think that without paying attention to the manufacturing side, as we have not been doing--we did talk about the ATP program, which is gone, I believe--we now have the TIP program at \$100 million a year, which is "in the noise," to use the expression used earlier.

We are not as a nation paying attention to the manufacturing, as I see all the nations in Asia are doing, and China, in particular.

Mike has covered optoelectronics. The field is extraordinarily broad, enables a lot of technology: enables a lot of the economy. One of the things he already mentioned was solar energy. One of the particular ways of doing that, of course, is photovoltaics--probably the most popular way at the moment. And it was last year that China became the world's largest photovoltaic producer.

It exported, some say, 98 percent of what it produced, but it certainly was more than 95 percent. I was at an exhibition in Shanghai last Friday, and it was about photovoltaics, and I noticed there the prominence given to the NREL road map, something that my tax dollars paid for.

Lighting is another huge economic field covered by optoelectronics. It has obviously changed the world already, and I see here we have the soon-to-be-outlawed-in-Australia, an incandescent light.

The third-generation type lights, LED-type lights, China has taken a very strong position there, too. These are actually manufactured in China. What is kind of interesting is that there's absolutely no trace of who manufactured them on the box, which is largely because they're in violation of significant IP of other companies.

Optoelectronics is also vital to national security. It will be

increasingly important to the war fighter. Think of the slogan "We Own the Night." Well, we no longer own the night, but we share it. We still hope to own the day and night in the future with UAVs loaded with optoelectronic sensors and, of course, all the time we have satellites looking down and checking if missiles are being launched anywhere in the world. Again, based entirely on optoelectronic sensors.

The recent demonstration last week of the electric laser as opposed to the long-going-on chemical laser program again falls within our technology, and it moves us much closer to effective battle space anti-missile systems at the speed of light.

If you look at my figures, I have shown one of the trends in electrical engineering Ph.D.s in the U.S. The problem here is not that there are so many foreign-born. It's that the U.S. has so few. Bear in mind that companies like Lockheed Martin essentially only employ U.S.-born electrical engineers.

They actually employ about four percent per year of the output of U.S. universities. It's going up to six percent because of a demographic bulge, but they're finding it increasingly difficult to actually get them.

I also show a graph of the overseas Chinese students returning, something we touched on in the last presentation. I think that there will still be a flood of Chinese students coming here because they're actually graduating now 6.1 million graduates in 2009 as opposed to 1.4 in 2002.

I was in Shanghai last Saturday when there were about a thousand of them taking English as a second language, their passport essentially to a university in the English-speaking world.

I think we will be seeing increasing numbers of Chinese students still coming here in spite of the visa difficulties. We will not be seeing the brightest and best for very much longer because they are the ones who are getting the jobs in the newly expanding Chinese universities.

I also show in one of my graphs the expenditure on R&D. It had come up this morning: where is the R&D going? As you can see in this, we actually spend quite a considerable amount of money on R&D in the U.S. It's been increasing slowly.

China's figures are here both in PPP, which is purchasing power parity under market exchange rates, and in purchasing power parity, China is actually number two in the world now and increasing quite rapidly.

In purchasing power parity, if you do a projection of GDP expansion and their move towards more percentage of the GDP being

spent on R&D, they will pass the U.S. around about 2015 in PPP expenditure on R&D.

But my mark for R&D expenditure is not so much the number of scientific papers that are produced, but the balance of trade, and in here, there's actually the balance of trade graph for advanced technology products from our own Census Bureau.

You can see that in 2008, it actually was a deficit of almost \$80 billion.

HEARING COCHAIR MULLOY: How much?

DR. ARTHURS: \$80 billion in this graph. It actually would be more except for the economic collapse in September. So that's one good thing you can thank that economic collapse for.

There's another graph actually showing the deficit in optoelectronic products, and the deficit from China in optoelectronic products, which is over \$7 billion at the moment.

My final graphs, and I have no more time, are actually about technical papers that show the rise of China as a scientific power. One of the metrics, and I think a misleading metric in many ways, for scientific output, and one that we would prefer to see changed, has been the number of technical publications or the number of citations. And China has been taking off exponentially there.

I think we need as a nation, as indeed China does, more of a look at scientific metrics from the science parks, for example, of how many jobs, how much actually income from the scientific parks. It was mentioned this morning that the Z-Park outside Beijing had a \$14 billion revenue. In fact, from the Chinese paper last week, it's actually \$166 billion revenue. Things change rather quickly in China as they announce new innovation measures in this park in Beijing.

They also have parks in Shanghai and many other Chinese cities. I was in the one in Chengdu last week where they have the largest manufacturer of optical glass in the world.

China is setting about this with determination, and this is not for me about what they are doing wrong, though there is a lot of IP issues; it's why aren't we doing something right?

Thank you.

[The statement follows:]

**Prepared Statement of Dr. Eugene Arthurs
CEO, SPIE, The International Society for Optics and Photonics,
Bellingham, Washington**

**Dr. Eugene G. Arthurs
CEO, SPIE, The International Society for Optics and Photonics**

24 March 2009

**Testimony before the U.S.-China Economic and Security Review Commission
China's Industrial Policy and its Impact on U.S. Companies, Workers and the
American Economy**

I would like to thank the Commission for this opportunity to share my grave concerns over our future competitiveness in key technologies that are vital to our future prosperity. My career has mostly been in the technology industry, leading companies that supplied innovative products and tools to researchers in industry, academia and medicine, and to product integrators for high technology applications. Since 1999 I have been CEO of SPIE, a not-for-profit membership society. SPIE has approximately 17,000 members, most of whom have advanced degrees in science or engineering. More than 50% of our 10,000 U.S. members work in industry. Most of the remainder work in academia and the various government science and technology entities, such as the national laboratories, NASA, NIST, and the many excellent Department of Defense facilities.

Professional associations have played an important and undervalued role in the U.S. and global science and technology (S&T) enterprise. This role is similar to the important role of the legal system in underpinning civilization; they underpin science. Our imprimatur and archiving are fundamental to scientific progress, and we continue the important struggle to keep the internet version of snake oil salesmen from drowning us in pseudo-science. Many engineering associations set technical standards without which we would not have a practical technical infrastructure, and unproductive chaos rather than the quality of life that technology has brought. In a *reductio ad absurdum* example, imagine a world with multiple versions for the colors of traffic lights.

The fact that the strongest scientific associations are based in the U.S. has been good for U.S. science. The networking at meetings and the historic pattern of the top international scientists coming to and presenting at meetings staged by associations in the U.S. has given our community an edge. The exchange and testing of ideas at such events is at the heart of scientific advance. At SPIE's meetings, postgraduate students network with Nobel laureates and industry experts. We just wish there were more U.S. students exposed to these life-influencing opportunities.

Scientific associations in China

China has about 170 scientific societies or associations which are supervised by the Chinese Association of Science and Technology (CAST). CAST has a permanent staff of 1,000 throughout China and a conference/exhibit facility in Beijing. The effective head of CAST operations is Executive Vice President Deng Nan, daughter of former premier Deng Xiao-Ping. The scientific societies in China are highly academic and have large numbers of nominal members, but are not yet staffed or resourced to provide effective networking or services to members. For example, the Chinese Optical Society, the largest and most directly focused of several in the optoelectronics field, has at this stage very poor connections with industry. The reality is that in China, academic science is disconnected from industry research, and many Chinese scientists look to the U.S. as one

of the few nations that have the strong connections they seek.

However, China has the powerful Chinese Academy of Sciences (CAS) that links together and controls many Chinese scientists. The CAS operates many of the larger research laboratories through the country and has an extensive campus in Beijing. Unlike most academies of science worldwide the CAS has an emphasis on manufacturing and technology with “Advanced Manufacturing Technology and Automation Technology” listed alongside the “Physical Science and Related Technology, Life Sciences and Technology etc.” The mention of “technology” is in itself unusual for an academy of science.

SPIE: Science and Industry

There is another very important component of our membership that distinguishes SPIE somewhat from the typical scientific association. We embrace and acknowledge the entrepreneurs, the marketers and the manufacturers who turn research into innovation, whose living depends on knowledge of the science, and whose practicality turns it back into jobs. We run many large technical meetings that are designed to catalyze photonic science and its applications. At our Photonics West meeting in California in January we had more than 1,000 exhibiting companies from all over the world. We will have more than 500 companies at our upcoming meeting in Florida: Defense, Security and Sensing (another annual event). These are not trade shows; at these meetings there are more than 6,000 technical presentations. We have an earned reputation for connecting the disparate multidisciplinary research community with the commercial and user communities. To us the commercialization of science and the success of technology industries are vital to a healthy scientific infrastructure. They provide careers for S&T professionals and the bulk of funding for innovation.

Optoelectronics

Optoelectronics, the subject of the present hearing, is loosely defined and also known as photonics, optics, electro-optics, and optical engineering. Each name for the field has various nuances but I see too much passion for each name to expect agreement. Whatever the name, the field is vast and the technology key to the many sectors of a high technology economy. It covers the fabrication and inspection of computer chips to surveillance equipment, imagers and displays for the health field, cameras and displays for the consumer market, and much more. The internet is optically powered; your DVD player houses a laser and light detectors, the fundamentals of optoelectronics. Most medical diagnostic equipment has significant optoelectronics buried inside, and presents the grisly details on an optoelectronic display. Many researchers use optoelectronic tools unaware that they are using optics or light. “Reading” DNA relies on high performance optoelectronics, but the typical geneticist gives it no more thought than she does to the optical lithography that made her computer’s powerful processor and memory chips.

The field SPIE (and optoelectronics) covers is light. Experts in optoelectronics look at how to best convert sunlight into electrical power or some other form of usable energy, such as liberated hydrogen. Photovoltaics are already well known, but not optimized, and

perhaps even not the ultimate solution. Lighting, conversion of initially gas and then electricity into light, has changed the world. A century after Edison, there is a huge worldwide effort to make lighting more efficient, and China is among numerous countries that have identified the economic potential of solid state lighting (LEDs).

Edison's story is instructive on the commercialization and exploitation of science. He was not a scientific leader in light or lighting. Rather, he was someone with the drive, the single-mindedness, and the persistence to create and dominate a market. Today I only find that type of focus in Asia, and indeed see very successful exploitation of science there that was funded by taxpayers in the U.S. and Europe.

Workforce: The talent wars

I recently watched SPIE's video interview with Kristina Johnson, a former SPIE Board member and current nominee for undersecretary at the Department of Energy.

<http://mfile.akamai.com/65904/mov/spiestorage.download.akamai.com/65904/KristinaJohnson.mov>

She mentions that she went into the field largely because her father was an electrical engineer. Informal surveys of our U.S. based members suggest that many do not recommend the profession to their children. Figure 1 shows the trend in electrical engineering PhDs awarded in the U.S. PhDs are a necessary (but not sufficient) part of our innovation infrastructure. We have been fortunate that over the years many of those who came here for an education stayed and helped sustain our economy. However, relying on historical trends in this regard would be foolhardy. We were the most attractive home for China's best and brightest when we boasted the leading high tech economy, and when the alternative was to return to a nation with an impoverished and dysfunctional S&T enterprise damaged during the anti-intellectualism of the Cultural Revolution. The days when we could rely on imported brain power are gone. The economic picture makes us less attractive in general for those who have a choice of options. More Chinese students now go to the EU than to the U.S.

In the S&T talent stakes, the emphasis by the Chinese leadership on S&T and the obvious commitment to build a world class presence in S&T has changed the pattern. Chinese students still go abroad in large numbers, but China seems willing to invest heavily in luring back top scientists. In January the Chinese Academy of Sciences (CAS) gave a boost to their longstanding efforts to recruit expatriate talent and with them the knowledge and expertise of many of the world's top laboratories.

"The CAS announced the plan only days after a guideline was issued by the General Office of the Communist Party of the China Central Committee, calling on state enterprises and academic institutions to attract more leading overseas scientists, especially those on the cutting edge of science and technology."

<http://english.cas.ac.cn/eng2003/news/detailnewsb.asp?InfoNo=27559>

The "hai gui" ("sea turtles") were already returning in increased numbers before this latest inducement (Fig. 2).

I suspect the timing of the CAS announcement is deliberate, as the recession has stirred concern for the future in many. *Business Week* of March 16th has an article titled

“America’s Immigrant Brain Drain” written by Vivek Wadhwa who holds appointments at Harvard and Duke, and who is well published on the talent wars.

“Immigrants are critical to our long-term economic health. Although they represent just 12% of the U.S. population, they have started 52% of Silicon Valley's tech companies and contributed to more than 25% of U.S. global patents. They make up 24% of science and engineering workers with bachelor's degrees and 47% of those with PhDs.

Now, say human resources directors in India and China, what was a trickle of returnees a decade ago has become a flood. (There are no official numbers on the reverse migration.) Job applications from immigrants in the U.S., they say, have risen tenfold over the past few years.”

Wadhwa quotes the results of a 2008 survey of 1,203 returnees to India and China. His team at Duke conducted this survey with AnnaLee Saxenian of the University of California at Berkeley and Richard B. Freeman of Harvard University.

“The vast majority of returnees, we found, are relatively young—30 on average for Indians, 33 for Chinese. Their degrees are in management, technology, and science. Among the Chinese, 51% have MAs, 41% PhDs. Among Indians, 66% hold MAs and 21% are PhDs. These figures put the returnees in the U.S. population's educational top tier—precisely the kind of people who can make the greatest contribution to innovation and growth.”

Of course there are many who do not return to China. There are other ways of absorbing foreign expertise. For example, Chinese institutions welcome western-based Chinese scientists with faculty appointments in China. I know of several in my own limited circle, one of whom has a full time job leading research in a U.S. lab, and who supervises PhD candidates through his faculty appointments at two different Chinese universities, one in Beijing and one in Shanghai.

The Shanghai Jiao Tong rankings of world universities lists only one (mainland) Chinese university in the top 50 in the engineering category, and none in science. Tsinghua University in Beijing, sometimes called China’s MIT, is ranked #50 in the latest engineering ranking. What is striking though is the rate at which Chinese universities are moving up in the annual science and engineering rankings.

There are obstacles for those Chinese scientists and engineers who stay here in the U.S. One factor covered well in the recent report “Beyond Fortress America” (and aired extensively in the Congressional hearings in February) is the restriction on foreign nationals studying or conducting research in the U.S. While there are very legitimate security concerns, the atmosphere generated by the present regulations and the bureaucratic burden placed on universities and other research institutions in the U.S. are also reasons that we should not expect the historic level of contribution to our S&T capacity from Chinese scientists coming to and staying in the U.S. A group leader at Cal Tech’s Jet Propulsion Laboratory (JPL) told me last year that although quite often the best applicants for openings in this important laboratory are Chinese émigrés, he no longer considers them because the hiring and monitoring requirements are too onerous, and incompatible with the openness that characterizes a productive scientific environment. The unwelcome outcome is that some of our leading national facilities may

tend to be staffed by second tier candidates.

China

The Chinese Ministry of Science and Technology (MOST) is the prime mover in China's S&T. MOST clearly sees science as important to the economy and sees its mandate as much more than increasing scientific knowledge. From the 863 plan, one of the series of five year plans for Chinese S&T:

“Mega-projects of Science Research for the 10th Five-Year Plan

To meet new challenges and demands after China's WTO accession, and cater to domestic strategic economic restructuring, the Ministry of Science and Technology, with the approval of the 10th session of the State Science and Education Steering Group, has decided to organize and implement 12 mega-projects of science research based on the 863 Program and the National Key Technologies R&D Program. Through the implementation of dedicated projects, the Ministry hopes to take favorable positions in the science frontier in the 21st century *and achieve significant technical breakthroughs, leading to industrialization in major fields related to national socio-economic development, all within 3 to 5 years.*

Implementation Guidelines for the 12 Mega-projects are:

Goal: *Develop new products and nurture new industries”*

One of the four scientists who devised the 863 plan is Wang Daheng, widely revered as the father of optics in China. Dr. Daheng studied in the UK. The technical background of Cao Jialin is also in optics; he is Vice President of the Chinese Optical Society as well as the Vice Minister of Science and Technology. These may indicate the importance of optics or optoelectronics in China.

Again showing the official view of the role of scientists, Chinese Premier Wen Jiabao, when presenting awards to Chinese scientists in January, “urged science and technology workers to help businesses and rural areas to speed up development and become productive. *They should help improve management, develop new products and technologies, and actively involve themselves in economic development.*”

A different attitude to science in the U.S.

So while the Chinese leadership is clearly behind science and its application to the economy, and while China has a ministry of science and technology, in recent years the U.S. Executive Branch moved the science advisor out from the White House. Our science investment culture and the community eschew commercialization, and selection or direction of science to economic ends is resisted by some policymakers who decry “Industrial policy.” Our hope is that a technology push will lead to favorable economic outcomes as indeed it did in a different era and global environment. To me, the advanced technology trade balance (Figures 3.a and 3.b), should be evidence that the old model no longer works. I find the data more disturbing if I use a \$200k figure per FTE to translate the 2008 deficit in to 277,500 high technology jobs (–with of course the \$200k spent in

the local community and on taxes.)

When I became CEO of Cleveland Crystals, a company with roots in materials for sonar in the 1940s (materials that became very useful for laser applications), I was told that experience taught that any new crystal product took ten years (and several million dollars) to develop for the market. Though this might be an extreme example, most significant new optoelectronic products (as distinct from incrementally improved products) do indeed take some years before payback. Crossing what Dr. Charles Wessner (Director, Technology, Innovation, and Entrepreneurship, U.S. National Academies) calls the idea to market “valley of death” is costly. Indeed, the route to product (the innovation process) is not the simple linear concept of idea to sales revenue, but much more complex and certainly not implementable to order. Though things may change, the recent expectations for short term financial return for U.S. corporations is incompatible with patient product R&D. When a CEO cuts R&D, the stock price rises and management is rewarded. That is not the case in Asia. In China it seems the financial structure and investments for technology are very focused and patient, not at the whim of meeting quarterly targets. Likewise, careers in S&T are more certain, more prestigious and valued.

Optical materials are an area where the U.S. has lost position, and China has taken leadership. China is the preferred source of some optical crystals used with lasers, a somewhat unusual area where Chinese companies have intellectual property rights in the US.

In 2008 I spoke with then SPIE member James Fergason, a liquid crystal pioneer, and the winner of both the 2006 Lemelson-MIT Prize, and the 1998 Ron Brown Technology Award from the U.S. Department of Commerce. (Sadly, Dr. Fergason died last December.) He received more than 130 U.S. and 500 foreign patents during his wonderfully creative career. Our conversation centered on why almost all the jobs related to liquid crystal display (LCD) technology were in Asia, though most of the invention was in the U.S. He pointed out that the facile response, lower labor costs, was not correct, as the labor content of the typical LCD was tiny. His view was that it was the result of major U.S. corporations’ unwillingness to invest substantially and patiently. He also commented on the lack of visionary leadership in U.S. blue chip companies, and in the particular case of LCDs, attempts to protect older display technology (at that time owned by then substantial U.S. suppliers to the consumer electronics markets).

R&D in China.

Figures 4.a and 4.b show the trends in R&D spending in the U.S., the EU, China, and Japan. They are shown on both a market exchange rate (MER), and at purchasing power parity (PPP). Some argue that PPP gives the true measure of R&D activity, and if so, then China recently passed Japan to become the second largest funder of R&D in the national stakes. The U.S. and the EU conglomerate still outspend China, but the rate of increase should be noted. Chinese R&D spending is estimated at 1.6% of its GDP, with targets of 2% by 2010 and 2.5% by 2020. The EU’s difficulty in having industry invest more so

that it can reach its “Lisbon target” of 3% is in at least in a small way due to the preference of industry to invest in R&D in China.

The nature of R&D expenditure in China differs from that of the U.S. in that there seems little spent in basic science, and less on the life sciences. Applications and engineering are favored.

I have visited many optoelectronic laboratories including several of the key State laboratories in China, and can qualitatively compare them with laboratories in the U.S. and elsewhere. A small number of the premier universities in China have facilities and equipment on par with the best university laboratories in the U.S. Outside the top tier, the equipment for experiments is older and more of it “home built.” Students seem well equipped with up-to-date computers and it is not usual to see rows of students reading sophisticated documents in English on the screen and yet be unable to understand spoken English. Students have fewer options for study in China but my sense is that they pursue S&T with fervor, and not because that is all there is. Faculty at some universities in Beijing and Shanghai have mentioned that with affluence they are seeing less top flight local students, but there is a vast pool of talented students from the countryside. (Growing affluence is also driving labor intensive optics companies further from Beijing and Shanghai.)

Scientific Publications

Associations like SPIE see review, publication and archiving of research papers as part of our mission. The submission of research papers from China provides some measure of the open research activity. The number of papers from China has been growing so quickly that it threatens to overwhelm the capacity of the associations. Not all submitted papers are deemed suitable for publishing, and the ratio of submitted to published papers is lower for Chinese submissions than average, but it is trending upwards (Figures 5.a, 5.b, 5.c, and 6, from the American Institute of Physics (AIP) and SPIE’s flagship journal, the Journal of Optical Engineering). Bear in mind that these are papers published in English. The lower quality and significant plagiarism problems are in part consequences of the extraordinarily rapid expansion of Chinese research and the openly stated policy of quantity first, quality second.

Much scientific publishing has become electronic; SPIE has a Digital Library of close to 300,000 scientific publications, all reports after 1990, and most classifiable as optoelectronic or nanotechnology. Downloads of scientific papers provide another measure of research activity. China is second only to the U.S. in downloading from this library. (This SPIE body of work is the most highly cited source for patents at the USPTO in optoelectronic related fields.)

Intellectual Property in China

Although China has had extensive research programs and manufacturing operations in optoelectronics for a number of years, particularly in communications, there are as yet relatively few Chinese origin patents granted by the USPTO or EPO. Patent numbers are growing more rapidly at the Chinese patent office and the World Intellectual Property

Organization (WIPO). Since neither of these bodies access SPIE's prior art, the patent scrutiny in optoelectronics is suspect.

Fit, form and finish copies of optoelectronic communications devices are entering supply chains in China and displacing legitimate company product (Figure 7). Anecdotes of companies being called for service under warranty only to find the product was not actually theirs are increasing, but there is no good data on how pervasive this problem may be.

Manufacturing of optoelectronics in China

China is the manufacturing or assembly base for many of the world's leading optoelectronic manufacturing companies. Shenzhen and Wuhan are optoelectronic manufacturing hubs for communications products, and more recently light emitting diodes (LEDs). As for most high tech goods, China is chosen for assembly and packaging rather than for fabrication of key components. However, Chinese optoelectronic companies are springing up and quickly becoming competitive in world markets.

Huawei is an indigenous company in the communication component and system sector, including optical networks. It had \$12.6 billion in revenue in 2007, and has become a force in the world market. Han's Laser has grown quickly to become a top five "laser company" (with \$100 million in annual revenue). Chinese companies and foreign owned plants producing solar panels (photovoltaics PV) are growing rapidly. (The Chinese government has identified this industry as one of the nation's targets.) China's PV production has been growing at 25.5% per year since 2001, and in 2008 China seemed to be the world's largest producer of PV. The U.S., home to much of the original R&D for PV, had about 1/5 of China's PV production output in 2007. Suntech is the largest of more than 50 PV companies in China, and is ranked as the third largest producer in the world.

Recommendations

The recently enacted American Recovery and Reinvestment Act of 2009 (ARRA) as well as the FY 2009 Omnibus Budget legislation include boosts for R&D in the U.S. This is a necessary and important step. However, in itself it is unlikely to bring us back to a healthy U.S. high technology economy. Undirected scientific research is deserving and important for the future. What we need to do is examine whether the conditions where R&D gave us economic leadership still exist, and if as I believe, we find they do not, then we must move aggressively to establish a new innovation infrastructure that will make us competitive again. We no longer have research powerhouses like Bell Labs that straddle academia and industry, but we do have small innovative companies, and support for science parks will strengthen that sector. Taiwan has brought this to a new level; way beyond what we envisaged for science parks.

Many of our small companies scale up manufacturing in Asia, just as our admired larger innovators do. The value is added to the iPod and the iPhone in Asia, with components from around Asia and assembly in China, all far from Silicon Valley. We need investment in key manufacturing technologies of the future. The TIP program at NIST is

a small step in the right direction, but its funding is totally inadequate.

The excellent SBIR program should be expanded and the evaluation process should place more emphasis on local job creation. Repeat applicants who can show a record of local job creation should be strongly favored. The part of the SBIR program that serves to support the DOD laboratories with their technology needs should be recognized as different and treated accordingly.

We need a comprehensive informed review of our fragmented national technology portfolio and ongoing active guidance. Much more emphasis on capital investment in manufacturing technologies and training of people will be vital. Yes, we need the science base, but we will not remain competitive if the \$200 billion or so currently spent by industry annually in the U.S. follows manufacturing to offshore places, as it inevitably will with the explosion in S&T capability in populous China.

We may continue to be world leaders in the science of LEDs or the semiconductor lasers that power the internet, but the location of the semiconductor foundries and the know-how to manufacture in volume suggest that the manufacturing jobs will be in Asia, many of these in China. We need to select key manufacturing technologies and do what is needed to have world leading “plants” in the U.S. The decades of work in the DOE laboratories, notably NREL, should lead to solar energy manufacturing here, not to installation and maintenance of imported panels and outflow of incentive dollars to support jobs elsewhere.

Science, Technology, Engineering & Mathematics (STEM) education for our workforce will be vital, and in this we are no longer competitive. Excellent initiatives have been proposed in the “Rising Against the Gathering Storm” report. We must also devise opportunities and strong incentives for career retraining; this is crucial for lifetime technology careers. Again these educational thrusts must be part of an overall plan for rebuilding our technology economy. We should not expect young people to pursue careers that will not exist in this nation.

I have little doubt that my recommendations do not meet free market criteria, nor will they be to the liking of those opposed to government involvement. My response is that I love the principles of the free market, but when I look at our trade deficit (especially the trend in high technology trade), I can’t help but think it is due in part to other governments attending to the economic wellbeing of their people. I suspect they are the strongest proponents of keeping the U.S. market “free.”

Figure 1:

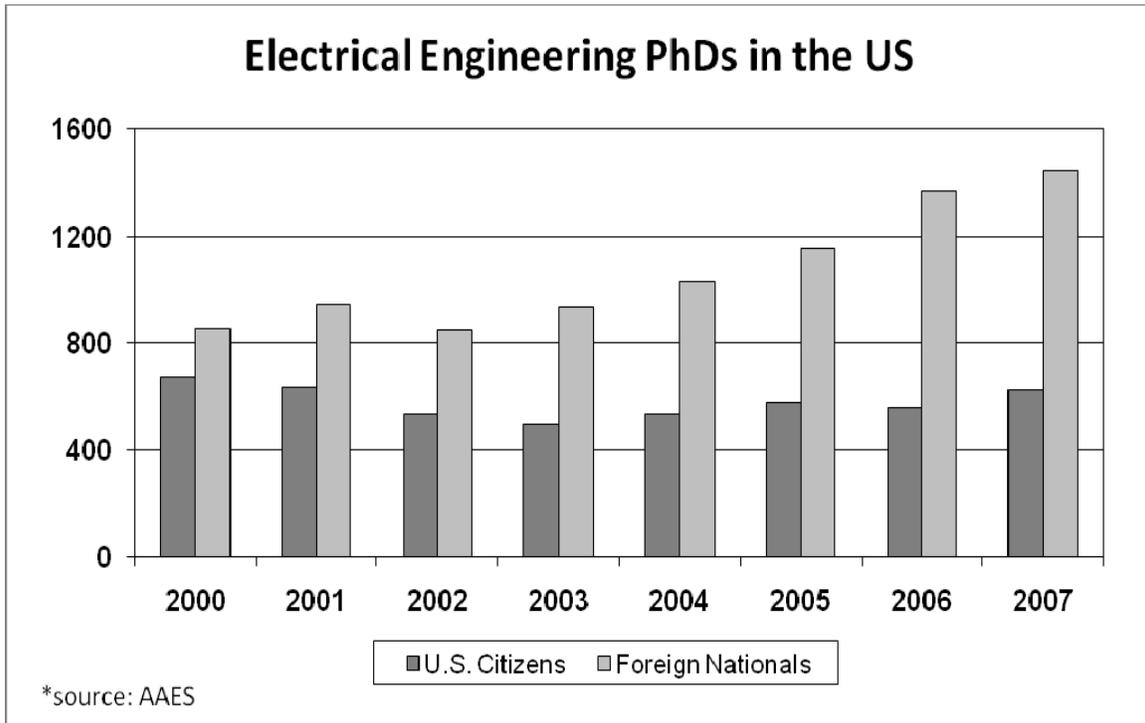


Figure 2:

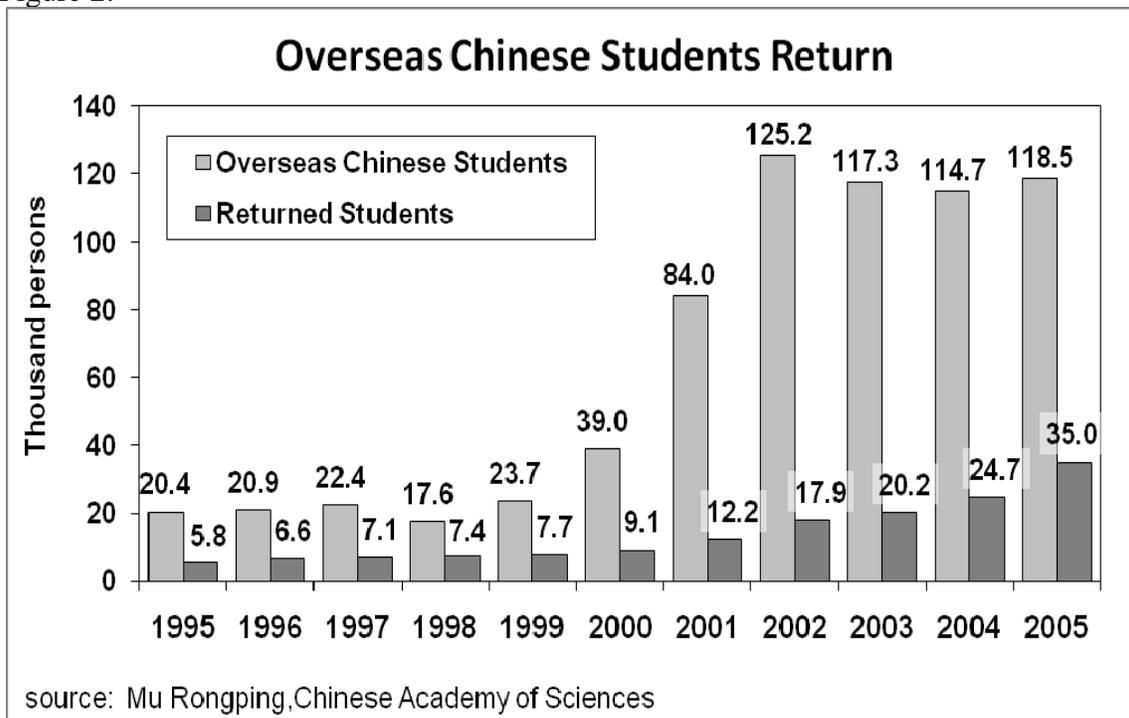


Figure 3.a:

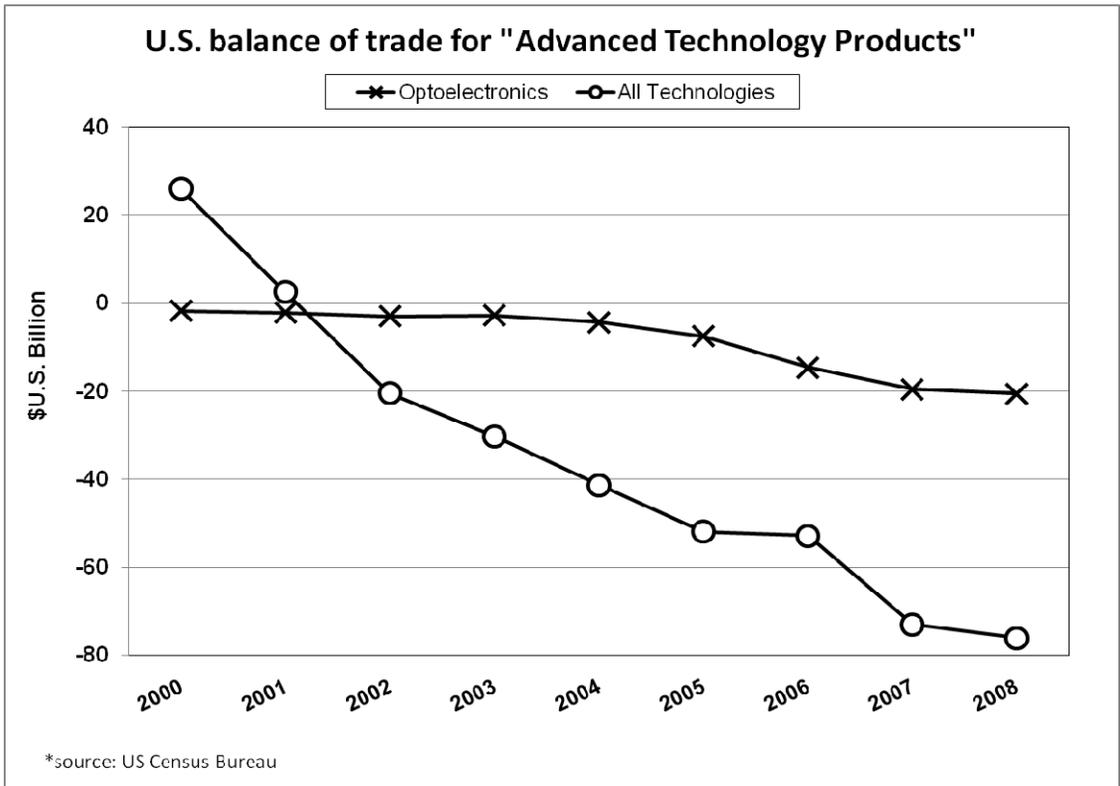


Figure 3.b:

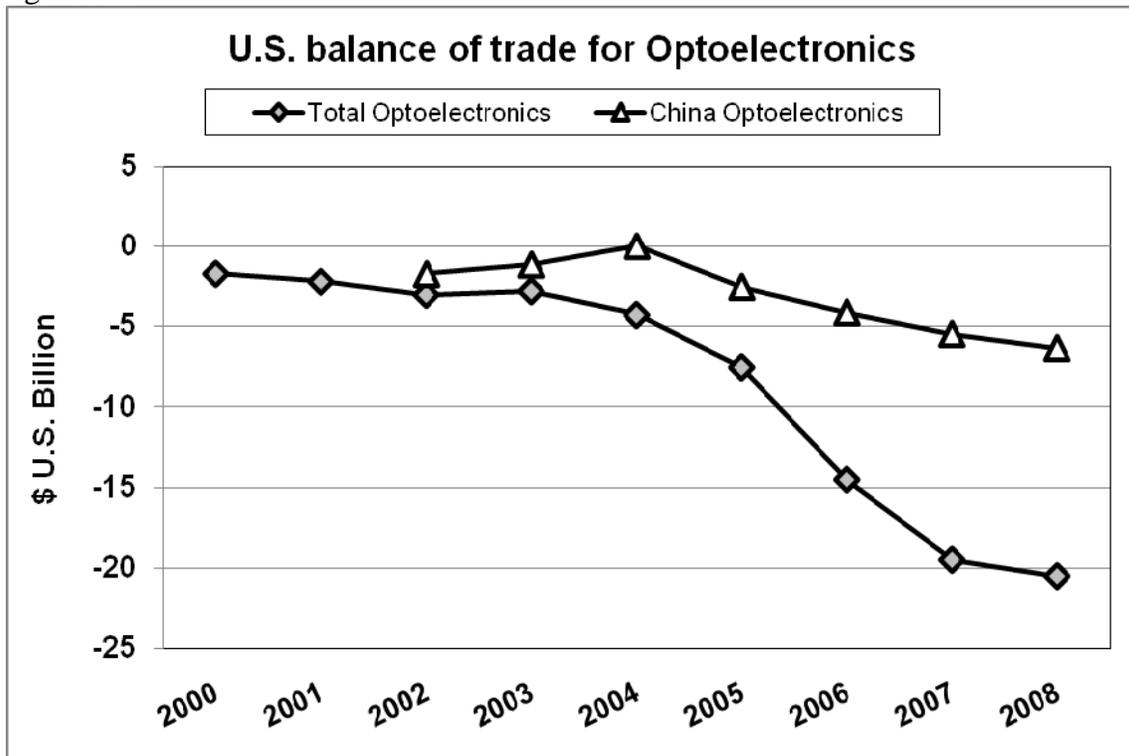


Figure 4.a:

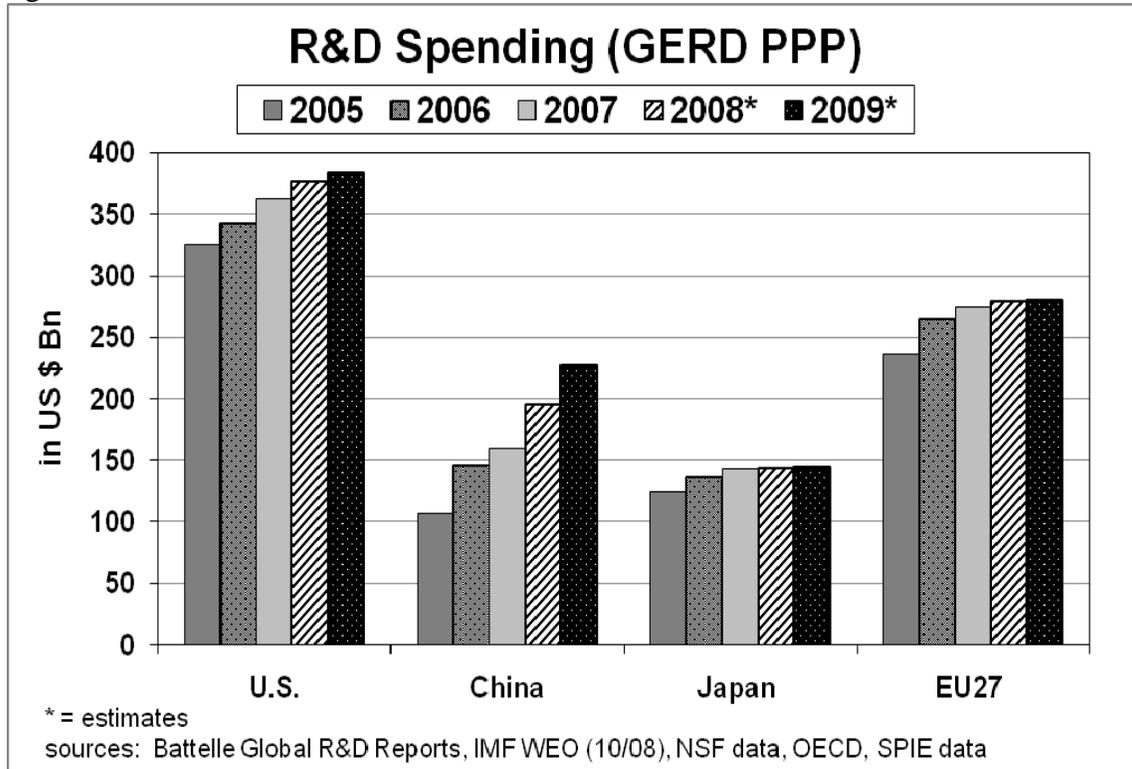


Figure 4.b:

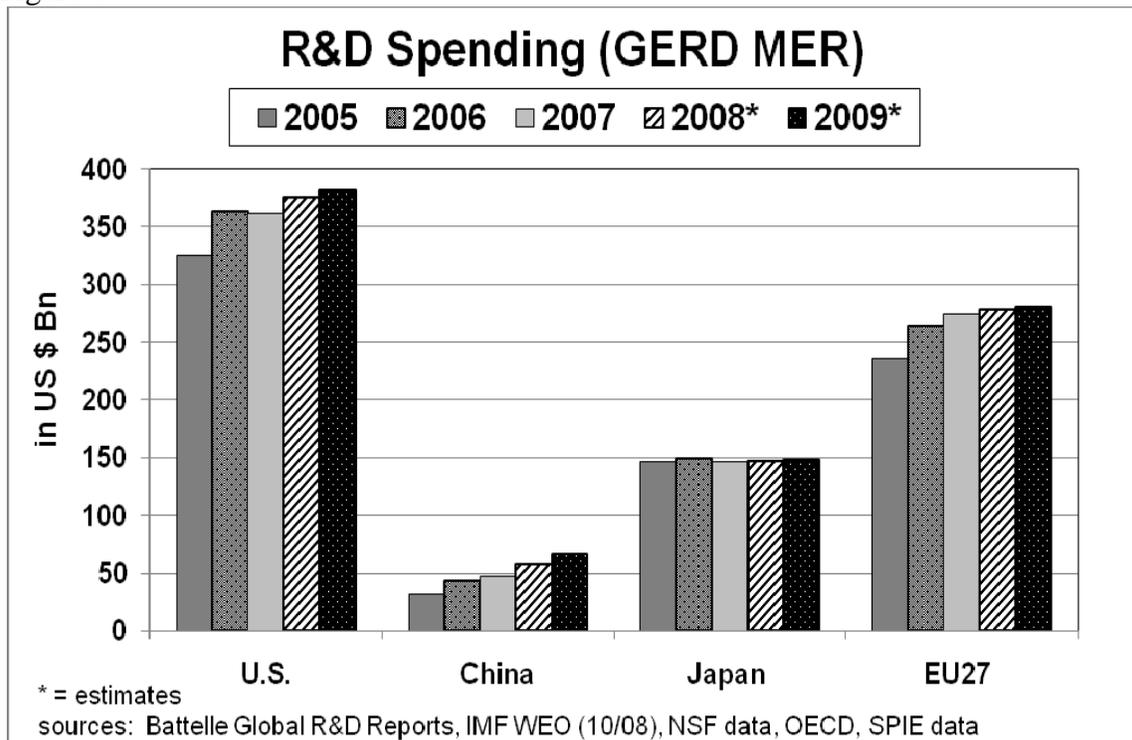


Figure 5.a:

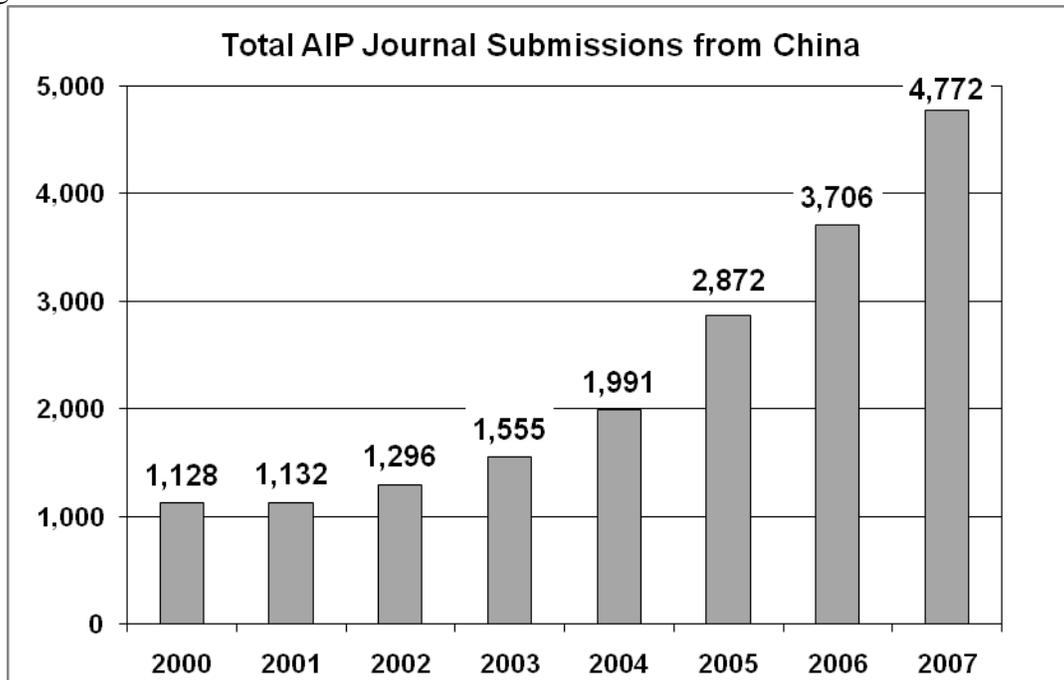


Figure 5.b:

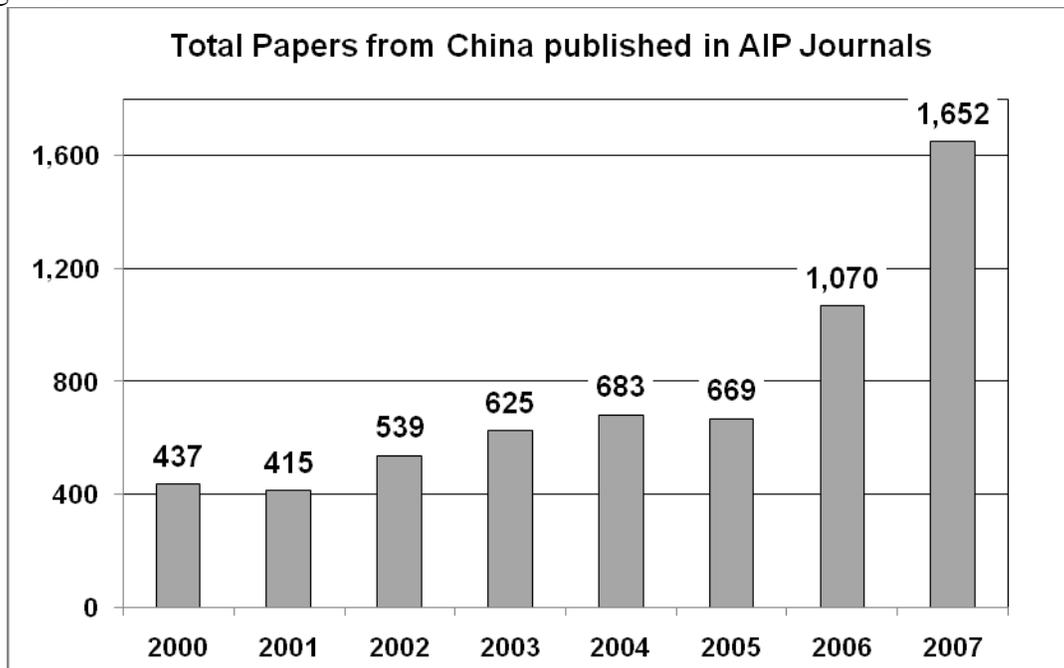


Figure 5.c:

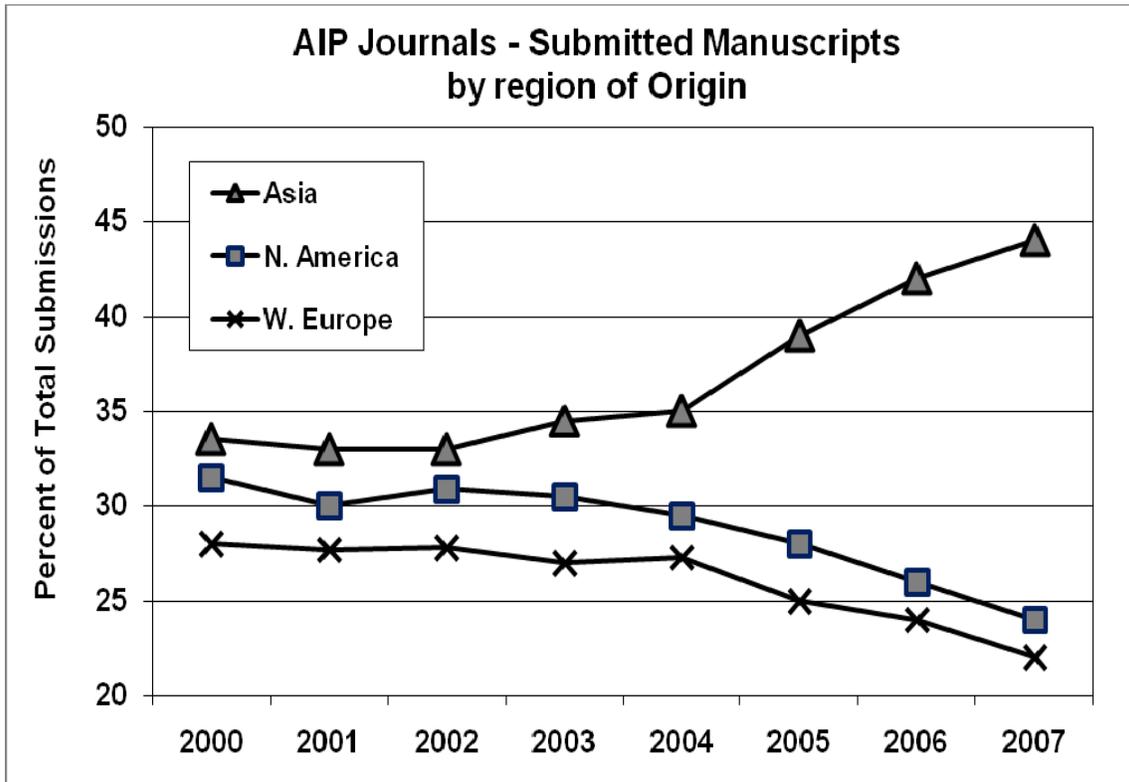


Figure 6:

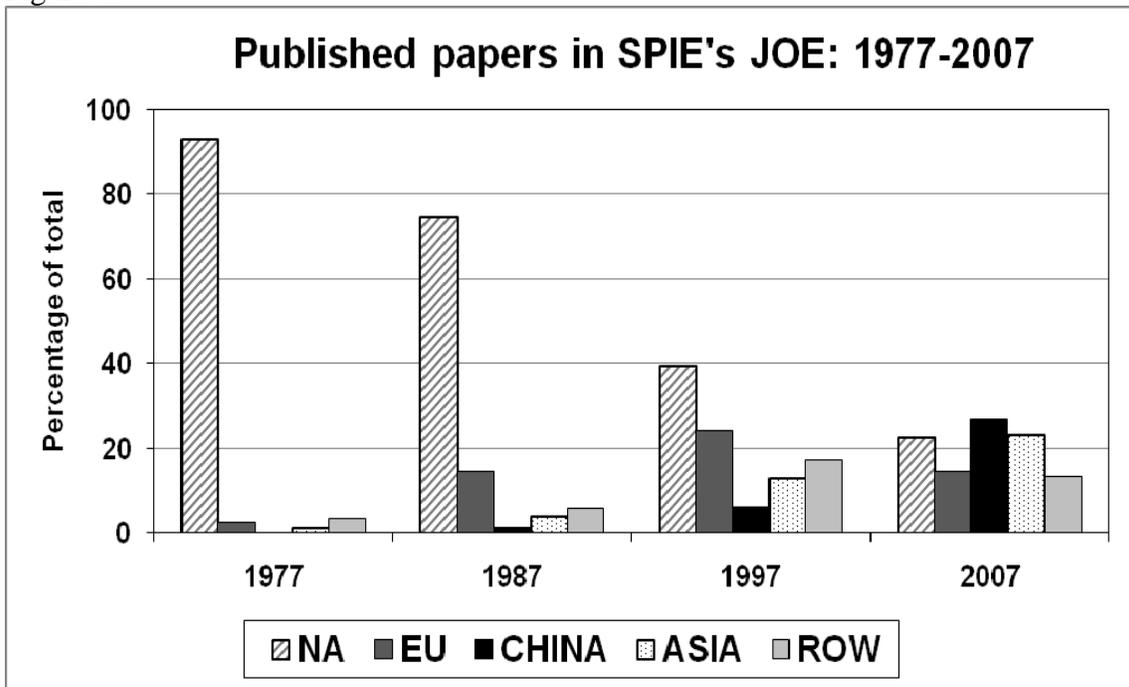


Figure 7:



HEARING COCHAIR MULLOY: Thank you, Doctor.
I just want to note for the record that this Commission visited that science park outside of Beijing about three years ago. And it really wakes you up to the sense of the challenge that's in front of us.
Thank you for bringing that up.
Dr. Appelbaum.

**STATEMENT OF DR. RICHARD P. APPELBAUM
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DR. APPELBAUM: First, I want to thank the Commission for the invitation to speak here today.
I'm going to try to briefly summarize in seven minutes a much longer paper that you have. I want to give you a little bit of background on nanotechnology very briefly, then talk about China's rise as a nanotech power, and then I'm going to finish by talking about the payoff in China, and my comments echo very closely the ones that just preceded me.

For those of you who might be unfamiliar with nanotechnology, it's the newest emerging technology that is supposed to result in great changes for all of us. Sort of a global stimulus package which according to Lux Research would generate a \$3.1 trillion economy by the year 2015.

At this scale, quantum effects give rise to new materials with novel properties. Super-fast carbon-based computing, incredibly strong lightweight materials, plastic paint-on solar cells, targeted drug delivery, and--I'm not making this up--there's even research looking into making a space elevator with carbon nanofibers which would loft up people to geostationary satellites.

Since the U.S. enacted the National Nanotechnology Initiative in the year 2000, some 40 nations have followed suit. Global nanotech investments exceeded \$12 billion in the year 2007 divided fully evenly between governments and private enterprise with a little bit from venture capital, not too much.

The U.S. government is the undisputed world leader in public investment and nanotechnology, having spent some seven to \$8 billion since 2001. This year it's spending 1.5 to \$1.6 billion for the National Nanotechnology Initiative, which is a quarter of the global governmental total.

Almost all of this, some 95 percent, is for basic research under the assumption that, and this is, I think, a fairly correct assumption, in the United States, the market will commercialize the research results.

China is a different story. China lacks in venture capital and much private funding so the Chinese government has played a very large role in funding nanotechnology development across the value chain from basic research to commercialization.

As I'm sure you've heard from many speakers today, China's goal is to become an "innovation-oriented society" by the year 2020, emphasizing indigenous innovation. This is the approach that is supposed to bring economic prosperity in the future.

I talked about this in great detail in the paper, but just a couple of highlights. In China's last two Five Year Plans, and more importantly in the Medium and Long-Term Plan for Technology Development (MLP for short), which I know that Denis Simon talked about, China with the blessings and encouragement of its top leadership has made nanotechnology one of four science megaprojects slated for significant public investment.

Under the MLP, the bets are on achieving what China calls "leapfrog development," that is bypassing the usual rungs of the development ladder. Its vast foreign currency reserves pay for science parks, university campuses, advanced instrumentation and, most

importantly, human capital.

Major funding comes from Beijing--the Ministry of Science and Technology (MIOST), but also from the National Natural Science Foundation of China, the Chinese Academy of Sciences, and other government agencies.

In nanotechnology, China has chosen to focus on those areas that promise to have the most immediate payoff both commercially and, interestingly, in terms of environment and energy, nanoporous air and water filtration, creating materials with great tensile strength, and targeted drug delivery.

China already sees itself as a world leader in the production of carbon nanotubes which is the one commodity based on technology it currently exports in fairly large quantities to companies around the world.

Government support in China is crucial since the domestic market is dominated by small and medium enterprises that are ill-equipped to make the long-term kinds of investments that are needed for commercialization. We estimate that the Chinese government is spending around \$250 million a year. That's low in comparison with the 1.5 billion the U.S. is spending, but if you adjust it for purchasing power parity, it rises to about \$900 million making China number two in the world.

I should also emphasize there are many programs under the Ministry of Science and Technology, such as the Torch Program and the 863 Program, which you've heard about earlier today.

The National and Natural Science Foundation of China supports fundamental research. As of summer 2007, it had nearly 700 ongoing projects with "nano" in the title. Localities also play an extremely important role, and at the local level, there is much more pressure to commercialize results.

In the interest of time, I won't go into some of the places that we visited, but Shanghai and Beijing both have nanotechnology promotion centers, incubators of various sorts that are paid for with local funding. Zhejiang University has a partnership with UCLA, the Zhejiang-California Nanosystems Institute. There's a lot happening in that area.

So what is the payoff? In terms of academic research, the rise in publications in top peer reviewed scientific and engineering journals has been meteoric. China has come out of nowhere to now equal (in terms of quantity at least) the number of U.S. publications with "nano" in the title.

Many of these are of questionable or derivative quality, but the vectors are all unquestionably in an impressive direction.

Results are much more mixed at the commercial level. Much of what China is doing in terms of actual products is fairly prosaic--self-cleaning ovens, air filters; and so forth. My ties have had much water poured on them in various contexts to show the effectiveness of textiles with nanocoatings, things of that sort--but nothing that is likely in the short-run to really lead to huge commercial payoff.

China is ahead of the curve internationally in developing standardization techniques to characterize nanotechnology, which is very important. They're active participants in the International Standardization Organization in this area.

In the long-term, however, I think China will do well. Lux Research, which monitors this, predicts that as various reforms, including privatization and increasing attention to intellectual property protections, take hold, China will move up into the dominant area along with the U.S. by 2015.

One thing that I have found especially impressive, and I'm sure you've heard about this also, is China's partnerships around the world.

There are many Chinese scientists operating in laboratories and centers, national labs, around the world, that partner with researchers in China. Many Chinese students and postdocs that come and study in the U.S., Europe, and Japan not only carry back with them the knowledge they've gained but new habits, which are much more innovative than the ones which historically have been practiced in Chinese laboratories.

China has many, many weaknesses in this area. Bai Chunli, who is the leading driver behind China's nanotechnology efforts, has identified such shortcomings as the lack of government spending, the absence of coordination across agencies. Commercialization is long way off. Small and medium-enterprises are loathe to invest in anything where the payoff isn't evident. So there remains a gap in terms of commercialization.

IP protections are a major factor which was mentioned to me repeatedly in the interviews I've done there. The number of patents in China has grown enormously, but as one person described it to me--one scientist--most of those patents "sleep in the safe."

Patents are reportedly often taken out to prove to funding agencies that a lot is happening, but their really impressive inventions are not patented for fear that the ideas will be stolen. So that remains a problem.

Xie Sishen, who runs the National Nanoscience and Technology Center in Beijing, Summarizes China's situation as follows: "As a whole, China is in the rear of the first echelon or the front of the second echelon, ranking fifth or sixth in the world in nanotech. More,

but few. More scientific papers but few higher citation papers. More original ideas but few original achievements. More patents but less tech transfer. More purchased advanced instruments; few indigenously made."

Thank you very much.

[The statement follows:]

**Prepared Statement of Dr. Richard P. Appelbaum
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Testimony of

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**Before the
US-China Economic and Security
Review Commission
March 24, 2009**

**“China’s Industrial Policy and its Impact on U.S. Companies, Workers and the
American Economy”**

**CHINA’S (NOT SO HIDDEN) DEVELOPMENTAL STATE:
BECOMING A LEADING NANOTECHNOLOGY INNOVATOR IN THE 21ST CENTURY**

**Richard P. Appelbaum, Center for Nanotechnology in Society
University of California at Santa Barbara**

¹ This testimony is based on “China’s (Not So Hidden) Developmental State: Becoming a Leading Nanotechnology Innovator in the 21st Century,” a forthcoming research paper co-authored by Richard P. Appelbaum, Center for Nanotechnology in Society, University of California at Santa Barbara; Rachel Parker, Center for Nanotechnology in Society, University of California at Santa Barbara; Cong Cao, State University of New York, Levin Institute; and Gary Gereffi, Department of Sociology, Duke University.

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Abstract

In this paper we examine the role of the Chinese Government in fostering advances in nanotechnology, looking at the promises and pitfalls of state-led development in the world's fastest-growing major economy. Like many countries involved in catch-up development, China is convinced that manufacturing prowess alone is insufficient to becoming a leading economic power in the 21st century. Our concern is how the debate over innovation is reflected in China's approach to national development, with a particular application to nanotechnology. In many countries, including the United States, government spending on nanotechnology is seen as essential to creating world leadership in this emerging fielding. The U.S, for example, is currently spending \$1.5 billion annually on its National Nanotechnology Initiative – primarily to foster basic research and development. In comparison with the U.S. approach, in China – which has an economy that is transitioning from state-owned to privately-owned enterprises, and still suffers from a lack of private investment capital – nanotechnology is being funded largely through government sources. Moreover, in China, such funding extends more broadly across the value chain than in the United States, from fundamental research to commercialization. Through field research and extensive interviews, this paper documents China's state-led efforts to become a global nanotech leader, evaluating the effectiveness of these efforts.

Introduction: The Push for High-Tech Global Leadership

Like many countries involved in catch-up development, China is convinced that manufacturing prowess alone is insufficient to becoming a leading economic power in the 21st century. China's overarching goal is to become an "innovation-oriented" society by the year 2020 (OECD 2007: 17). Innovation is difficult to define, and even harder to operationalize. The Organization for Economic Cooperation and Development (OECD)

defines innovation as “new products, business processes and organic changes that create wealth or social welfare,” while Richard Lyons, Dean of UC Berkeley’s Hass School of Business, offers an even more succinct formulation: “fresh thinking that creates value” (*The Economist* 2007: 2). How to become innovative in the contemporary global economy, and why it matters, has generated a plethora of ideas, concepts, and hypotheses.² Our particular concern here is how the debate over innovation is reflected in China’s approach to national development, with a particular application to nanotechnology.³

By way of background, China is not alone in its push to become a leader in nanotechnology: the United States, Germany, Japan, and some 40 other countries are betting that nanotechnology, among other high-tech approaches, will provide the key to a \$2.6 trillion market by 2014—sufficient to confer global economic leadership on the country that attains first mover advantage through innovation (Holman *et al* 2007: iii). It is estimated that \$11.8 billion was invested globally in nanotechnology research and development (R&D) and commercialization in 2006 - \$5.8 billion from governments, \$5.3 billion from corporations, and \$700 million from venture capital (Holman *et al* 2007: 11-12). Private investment slightly outstripped public investment for the first time in that year. Governments worldwide have clearly been drivers of nanotechnology during its early stages, and private venture capital remains limited.

In terms of government spending, the United States is the world leader, with \$1.53 billion allocated for 2009, roughly a quarter of global central government investment in nanotechnology. U.S. government spending is coordinated through the National Nanotechnology Initiative (NNI), “a multi-agency U.S. government program aimed at accelerating the discovery, development, and deployment of nanometer-scale science, engineering, and technology” (US NNI 2008e). Initiated during the last year of the Clinton Administration, the NNI has invested some \$7.2 billion since it began funding programs and projects in 2001 (AZoNano 2008). Today it encompasses 26 Federal agencies with nanotechnology-related programs, providing funding for 13 of them. More than half of the proposed FY 2009 funding (\$818 million, or 54 percent) is directed at those agencies that fall under the American Competitiveness Initiative: the

² See *The Economist’s* (2007) special report on innovation for a review of some of these views.

³ The US National Nanotechnology Initiative defines nanotechnology as “the understanding and control of matter at dimensions of roughly 1 to 100 nanometers [where] the physical, chemical, and biological properties of materials differ in fundamental and valuable ways from the properties of atoms and molecules or bulk matter. Nanotechnology R&D is directed toward understanding and creating improved materials, devices, and systems that exploit these new properties” (US NNI 2008). Lux Research (a private firm that tracks nanotechnology) offers a similar but pithier definition: “the purposeful engineering of matter at scales of less than 100 nanometers to achieve size-dependent properties and functions” (Holman *et al*, 2007: Figure 1.2). A nanometer is one billionth of a meter. Human hair averages roughly 100,000 nanometers thick (there is considerable variation depending on hair color and texture), while a DNA molecule is 2-3 nanometers in width.

National Science Foundation (NSF), the Department of Energy's Office of Science (DOE-OS), and the Department of Commerce's National Institute of Standards and Technology (DOC-NIST). These three agencies have seen their combined budgets grow by 22 percent during the three-year period since 2006, reflecting the Bush Administration's plan to "double funding for key agencies supporting innovation-enabling research in the physical sciences and engineering over the next ten years, as part of the American Competitiveness Initiative" (US NNI 2008a).⁴

Apart from Defense and Homeland Security related applications, the principal force driving public investment in nanotechnology has been the goal of competitiveness: to make the U.S. a world leader in this emerging technology. The NNI identifies four overarching goals on its website (US NNI 2008b):

- Advance a world-class nanotechnology R&D program.
- Foster the transfer of new technologies into products for commercial and public benefit.
- Develop and sustain educational resources, a skilled workforce, and the supporting infrastructure and tools to advance nanotechnology.
- Support responsible development of nanotechnology.

NNI funding thus far has been largely directed at supporting basic R&D, for example, through the funding of more than 60 multidisciplinary research and education centers across the United States – primarily universities, but also the National Laboratories and some government agency facilities (US NNI 2008c).⁵ The budget proposed for 2009 identifies eight different program component areas, almost all of which are primarily directed at basic research (US NNI 2008d). While there is clearly spill-over from basic R&D to commercialization, the U.S. approach has largely been on government support for the former. The NNI has called for working with industry to foster technology transfer and commercialization. For example, its Nanoscale Science, Engineering, and Technology (NSET) Subcommittee in 2006 announced plans to "expand its activities to reach out to U.S. industry for input on research needs and to identify opportunities for technology transfer from NNI-funded research activities" (US

⁴ The overall growth in NNI funding during the same period was 13%. Among the 13 agencies funded under the NNI, the largest share proposed for 2009 goes to the Department of Defense (\$431 million, 28.2% of the total); NSF is to receive \$397 million (26.0%), DOE \$311 million (20.4%), NIH \$226 million (14.8%), and NIST \$110 million (7.2%). The other eight agencies (NASA, EPA, NIOSH, USDA Forest Service, USDA Extension, DOJ, DHS, and DOT) share the remaining \$52 million (3.4%). Source: calculated from US NNI 2008, 2009.

⁵ The principal vehicle for NSF funding (as of October 2008) has been 15 Nanoscale Science and Engineering Centers (NSECs) on 15 university campuses, and 22 university-based Materials Research Science and Engineering Centers (MERSECs), 4 of which are fully dedicated to nanotechnology research, with while 18 have one or more nanotechnology research groups. The DOE has Nanoscale Science Research Centers at 5 National Laboratories (Argonne, Lawrence Berkeley, Sandia/Los Alamos, Brookhaven, and Oak Ridge). For a complete listing (and websites) of NNI centers, networks, and facilities, see <http://www.nano.gov/html/centers/nnicenters.html>.

NNI 2006: 41), as well as “increase Federal-State coordination and improve knowledge management of and access to NNI assets [such as] user facilities and instrumentation” (vi).

Some limited U.S. federal funding has gone to directly promote the commercialization of nanotechnology, primarily through Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants, made to businesses with fewer than 500 employees (Holman *et al* 2008: 29). Between 2007 and 2007, federal government SBIR/STTR programs provided between \$80 and \$90 million in nanotechnology-related grants each year, about 17 percent coming from the NSF⁶ (US NNI 2006: Tables 7 and 8; Rudd 2007). While these grants are seen as an important source for the commercialization of nanotechnology, they are minor in relation to total funding.

In comparison with the US approach, in China – which has an economy that is transitioning from state-owned to privately-owned enterprises, and still suffers from a lack of private investment capital – nanotechnology is being funded largely through government sources. Moreover, in China, such funding extends more broadly across the value chain than in the United States, from fundamental research to commercialization.

In this paper we shall examine the role of the Chinese Government in fostering advances in this emerging technology area, looking at the promises and pitfalls of state-led development in the world’s fastest-growing major economy.

Data Sources

The following analysis is based on an examination of Chinese government publications (in Chinese and English), as well as field interviews conducted during five weeks of research carried out during the summers of 2006 and 2007. To date we have conducted 59 interviews: 38 in China (Beijing, Tianjin, Shanghai, Hangzhou, Suzhou, and Dalian), six in Hong Kong, eight in Taiwan, and seven in the United States. One of the authors (Cong Cao) has done extensive previous research on China’s high technology policy.⁷ The breakdown of our interviews, by type of organization, is summarized in Table 1:

Table 1: Organizational Setting of Interviews

⁶ In 2005, for example, under the NNI seven agencies granted a total of \$87.4 million in SBIR and STTR awards. Nearly half (47.7%) were made by the Department of Defense. Other agencies included NIH (18.6%), NSF (16.3%), DOE (9.3%), NASA (6.9%), EPA (1.1%), and NIST (0.1%).

⁷ Cong Cao, *China’s Scientific Elite*, London and New York: Routledge 2004; Cong Cao and Denis Fred Simon, *Talent and China’s Technological Edge*, Cambridge and New York: Cambridge University Press, forthcoming; Richard Suttmeier, Cong Cao, and Denis Fred Simon, “China’s Innovation Challenge and the Remaking of the Chinese Academy of Sciences,” *Innovations* (summer 2006): 78-97; Cong Cao, Richard P. Suttmeier, and Denis Fred Simon 2006, “China’s 15-year Science and Technology Plan,” *Physics Today* 59: 12 (December 2006): 8-120

| Type of organization | Number of Interviews |
|-----------------------------------|-----------------------------|
| Governmental | 10 |
| Quasi-governmental (semi-private) | 3 |
| Government-funded Incubator | 5 |
| University, including labs | 19 |
| Companies | 17 |
| Other | 5 |
| Total | 59 |

China’s Emphasis on Government Support for Indigenous Innovation

During the past 20 years China has invested heavily in science and technology (S&T), using reforms in the S&T management system, including higher education, to boost the emergence of a national innovation system that could generate indigenous innovation (*zizhu chuangxin*) of technologies in areas including biology, information technology, and nanotechnology. Beginning with the Third National Conference on Science and Technology in 1995 when the “Decision on Accelerating Scientific and Technological Progress” was announced (U.S. 1996), “indigenous innovation”⁸ has been heralded as a major source of China’s future economic development. Science, technology and education were identified as the tools that will create national prosperity.

In October 2000, Chinese Communist Party Secretary and Chinese President Jiang Zemin pointed out in his report in the fifth plenary session of the fifteenth party central committee: “We should concentrate our efforts to make breakthroughs on such fields as genome science, information science, nano-science, life science and geosciences” (NIBC 2006, p. 14). By the time the 11th Five-Year Plan (2006-2011) was unveiled in 2005, innovation had become the centerpiece of China’s economic strategy, and the goal was to harness China’s human capital to promote indigenous innovation through S&T in order to address the country’s social, environmental and global competitive challenges.

In our project, the emphasis is not on whether the development of nanotechnology will be successful in an ultimate sense (“revolutionary breakthroughs” are rare in such early-stage technologies), nor do we even need to demonstrate China’s relative accomplishments vis-à-vis the United States and other advanced economies. Rather, our analytical focus is twofold: To better understand China’s current development strategy, which both designates nanotechnology as a major national priority and provides substantial resources to achieve its objectives, and to shed light on some of the

⁸ While the 1995 Conference did not formally use the term “indigenous innovation,” it did call for an increased capacity “to create technology indigenously and master key industrial technologies and systems design technologies” (section 4, as reported in U.S. 1996). At the same time it also stated that “while developing scientific and technological capabilities primarily on our indigenous efforts, adequate attention should also be assigned to the acquisition and assimilation of foreign technology. On the basis of equality and mutual benefit, a significantly greater level of international S & T cooperation and exchange through official, non-governmental, bilateral and multilateral channels should be vigorously assumed” (PRC 2003).

institutional and policy challenges that must be addressed for technological leapfrogging to work. A key question is whether China's seemingly top-down and government-centered approach toward S&T policy can succeed in creating the bases for genuine innovation, in the current absence of strong market signals and private capital support for high-tech commercialization. Whether or not the Chinese government is in a position to target certain technology areas as frontrunners for funding is a hotly contested topic.

As we shall show, such concerns may be at odds with several distinctive features of the innovation process, including China's approach to technological leapfrogging, the institutional features of China's innovation system (which in practice blur the top down/bottom up distinction), and nanotechnology's status as an early stage emerging technology.

Leapfrogging Development: the New “Great Leap” Forward?

The concept of technological leapfrogging (essentially taking an industrialization short cut) was coined in 1985 by Luc Soete with specific reference to the international diffusion of technology and the industrial development of economic growth associated with the microelectronics industry. Soete (1985) highlights the significant advantages that can be felt by “late industrializers” in terms of catching up to global technological leaders, citing Japan as the most apt example (at the time). More recently, it has been linked to countries such as China, which has explicitly jettisoned the traditional notion of sequential or “catch up” industrialization typically advocated for developing economies - notions dating back a half a century or more (see, for example, Rostow 1960).

China in particular is racing toward high-technology development, while continuing to exploit its comparative advantage in labor-intensive industries (Friedman 2006). In doing so, China – and by implication other developing countries, if they follow China's example – could potentially prompt considerable shifts in the global economy. What makes China unique, however, is its attempt to combine its low-cost advantage in export-oriented industrialization, its large domestic market for advanced manufactures via import-substituting industrialization, and its burgeoning talent pool of scientists and engineers associated with the R&D process in high-technology development into a single development strategy.

Two powerful forces, globalization and the rapid advance of information technologies, have made China's distinctive approach to technological leapfrogging possible. These forces have compressed both space and time to the point where China is able to upgrade on several very different levels simultaneously: labor-intensive exports (e.g., nondurable consumer goods), advanced manufacturing (e.g., autos and electronics), infrastructure development (e.g., highways, ports, logistics, and communications), and knowledge industries (e.g., biotechnology and nanotechnology). The choice of this development strategy can only be explained by China's expansive vision of its role as an emerging global power and its domestic politics oriented toward rapid economic growth and so-called “market socialism.” Whether China can successfully sustain this strategy is an open question, but it will require a complex and evolving set of policies and institutions to concurrently manage everything from exchange rates and industrial

incentives, to education, migration, labor market, and S&T policies. Nanotechnology in China illustrates both the potential and difficulties of this leapfrogging strategy, which ultimately seeks to bypass the traditional movement up the value chain.

In the eyes of some China-watchers, technological leapfrogging – driven by initiatives that originate in the central government – is doomed to fail. Efforts to create an “innovative society” via leapfrogging are seen as hampered by a lack of private sector resources in China, as well as by bureaucratic rivalries among key state agencies (Suttmeier, Cao, and Simon 2006b). Innovation is said to require market-driven incentives, while China’s investment- and export-driven growth is said to have been at the expense of consumption, and hence is a drag on the economy (Lardy 2006). Furthermore, as a strategy for growth, “indigenous innovation” is viewed as suffering from “techno-nationalism,” which is largely at odds with the FDI-oriented development model China has thus far used effectively to bring in new technologies (Serger and Breidne 2007).

We question the dismissal of China’s innovation potential on the grounds that it is based on an exclusively Beijing-led model of development. We prefer more nuanced formulations that emphasize modular, loosely coupled approaches to innovation – for example, John Hagel III and John Seely Brown’s focus on “creation nets,” “open innovation,” and “process networks” (Brown and Hagel 2005; Hagel and Brown 2006). Such approaches favor open over closed systems, recognizing that a balance needs to be struck between open “pull” and closed “push.” Similarly, Lynn and Salzman (2007a; 2007b) argue that real “innovation shifts” are occurring in places like China, but that to understand these we need to look at the role of cumulative and incremental innovations, the dynamics of collaborative advantage, and the role of local technology entrepreneurs.

Finally, we need to consider the distinction between “technology push” and “demand pull” as it relates to nanotechnological innovation in China. The implication is that new or unexpected sources of demand can help a technology take off.⁹ The flip side of this argument is that potential roadblocks to expected demand can arise, such as the concerns about potential environmental and/or health risks of nanotechnologies or that a backlash to consumer goods similar to the controversy surrounding genetically modified organisms (GMOs) might occur. In either case, we would need a more open-ended and flexible understanding of how innovation occurs in the real world.

China’s Developmental State: Science and Technology Policy

Technological leapfrogging requires state investment in areas where the market is unable or unwilling to provide the resources for growth, such as promising technologies with longer-term commercial horizons, such as nanotechnology. Given the importance of the central government as a driver of S&T in China, in this section we focus on the role of the key central governmental institutions in shaping China’s efforts. The National

⁹ This is a key element in Clayton Christensen’s influential notion of “disruptive technologies” (see Christensen, 2000).

People's Congress (NPC), China's highest organ of the state power and legislature, through its Standing Committee and the Committee on Science, Technology, Education, and Health, has the authority to enact and amend an S&T related law, which is typically drafted by a government agency. The NPC also monitors the implementation of such laws and approves state budget on S&T. Constituting ministries of the State Council, China's cabinet, such as the Ministry of Science and Technology (MOST), Education (MOE), Agriculture (MOA), Health (MOH), Industry and Information Technology (MIIT), Environmental Protection (MOEP), the National Development and Reform Commission (NDRC), the now defunct Commission of Science, Technology, and Industry for National Defense (COSTIND), and so on, allocate resources to programs related to their respective ministerial missions.

The Chinese Academy of Sciences (CAS), an entity with multiple functions in research, high-tech industrialization, technology transfer, and training, plays a significant role in S&T policy-making through its honorific members, along with members of the Chinese Academy of Engineering (CAE), an advisory institution providing services for decision-making of the nation's key issues in engineering and technological sciences (Cao 2004). The National Natural Science Foundation of China (NSFC) mainly supports basic research and mission-oriented research projects through a competitive peer review process. Finally, the Ministry of Finance (MOF) has become increasingly important in scrutinizing budgets put forward by ministries and monitoring the usage of the funds. During the policy-making process, members of the Chinese People's Political Consultative Conference (CPPCC), an advisory body, also voice their opinions; this body includes many who are not members of the Chinese Communist Party (CCP).

Nevertheless, it is the CCP that has final say in S&T policy formulation, as it does in virtually all matters in China. Although the CCP Central Committee does not set S&T policy directly, it inserts influence through the State's leading group mechanism. A leading group usually is set up within the State Council to tackle issues involving more than one government agency and it is chaired at least by a vice premier who is likely a member of the CCP Central Committee Politburo or its Standing Committee – China's de facto governing body – so as to mobilize resources and coordinate efforts. Given the importance attached to “strengthening the nation through science, technology, and education” (*kejiao xingguo*), China's S&T policy has become a national development strategy since the mid-1990s, and the State Leading Group for Science, Technology, and Education has been led by the premier.

In May 2000, a group of experts jointly proposed to the CPC Central Committee and the State Council that “our country should accelerate the industrialization of the nanotechnology and occupy this world-wide frontier area as soon as possible,” which was quickly taken up as a priority research area by members of the CPC Central Committee (NIBC 2006). A vice premier or a state councilor runs the operations of the leading group, which is also composed of the chiefs of the leading science, education, and economic agencies from MOST, NDRC, MOE, MOA, MOH, MII, MOEP, COSTIND, and MOF; the presidents of CAS and CAE; and a deputy secretary-general from the State Council. Many of the bureaucrats working at this level are scientists or

engineers by training.

The State Leading Group for Science, Technology, and Education is responsible for studying and reviewing the nation's strategy and key policies, and for discussing and reviewing major tasks and programs, related to these three areas, and for coordinating important issues related to science education involving agencies under the State Council and regions. The Leading Group seems to be considerably more active and important in setting the nation's science, technology, and education policy. It meets a couple of times a year, usually prior to major national policy announcements or conferences, to discuss critical issues the nation faces in science and education, and to approve important initiatives and programs. The Leading Group also has invited leading scientists to update its members and members of the State Council on "hot" science, technology, and education related topics, including nanotechnology.

The drafting of the Medium and Long-Term Plan for the Development of Science and Technology toward 2020 (MLP) was the most important task of the Leading Group and one of the major tasks of the State Council and the CCP between 2003 and 2006. Soon after Wen Jiabao assumed the premiership at the Tenth National Party Congress in March 2003, he convened a Leading Group meeting on 30 May to launch the drafting of the MLP (in fact, the MLP was first discussed at a Leading Group meeting early the year when Zhu Rongji was still the premier and chair of the Leading Group). Premier Wen also chaired the leading group of the MLP drafting with MOST coordinating the process. He presided over a series of State Council sessions on results of strategic research for the MLP between April and August 2004 and convened an MLP leading group meeting and a State Council meeting on 10 May and 8 June, 2005 respectively to deliberate on the plan.

The CCP Central Committee Politburo not only devoted a late December 2004 study session to the discussion on China's S&T development strategy toward 2020, but also approved the MLP in late June 2005. In February 2006, the State Council formally issued the MLP, presumably after intensive negotiations between governmental agencies, especially on mega science and engineering programs which may involve some billion yuan for each. In May 2006, Premier Wen convened another Leading Group meeting to discuss how to implement the MLP, after which the State Council issued a series of detailed implementation measures assigned to various government agencies.

As previously noted, one of the themes underlining the MLP and indeed China's S&T policy in recent decades is that China should achieve leapfrog development in S&T. With such rapid economic growth over the past three decades, the reasoning goes, China can afford to invest previously unthinkable sums of money in S&T areas whose long range breakthroughs may not only significantly change the scientific landscape but also bring about significant economic benefit. Nonetheless, given its limited financial and human resources, it is impossible for China to launch an effort on all fronts; instead, China should "do what it needs and attempt nothing where it does not" (*you suo wei, you suo bu wei*), which has been another important theme of China's S&T policy.¹⁰ China

¹⁰ This theme was taken from the then CCP General Secretary Jiang Zemin's report to the 15th

arguably has little choice but to be selective in supporting research endeavors to concentrate and best utilize scarce resources. The challenge then becomes how to make the right choices that not only embraces a global strategy of S&T development, but also leverages China's existing advantages to realize its potential.

Although MOST gets the mandate for China's S&T related matters, reinforced by its power over the implementation of mega science programs authorized by the MLP, it is not the only government ministry that plays a significant role in China's S&T policy making and implementation. In fact, according to some estimates, MOST controls only about 15 percent of R&D expenditure appropriated by the Chinese government, which means other government agencies are as important as (if not more important than) MOST in planning, budgeting, and organizing S&T and R&D activities.

Nevertheless, there is risk associated with the Chinese approach. If the bet is wrongly placed, as Japan did for its fifth generation computer program in the 1980s, the policy could be detrimental. In the MLP case, if the areas most critical to the basic scientific breakthrough are not the four chosen, not only would China be wasting enormous amounts of resources – both financial and human – and missing a new scientific revolution, the nation would also be trapped at its current level of S&T development for a prolonged period. This is why some Chinese scientists – especially those working overseas, who presumably had a better understanding of how science is “supposed to work” – were critical of the approach of picking champions. Unhappy with the way that MOST organized the State High-Tech Research and Development Program (also known as the 863 Program)¹¹ and the State Key Basic Research and Development Program (also known as the 973 Program),¹² whose achievements were viewed by some as incommensurate with the amount of investment, skeptical scientists proposed limiting MOST's power or even dissolving MOST and replacing it with an Office of Science and Technology under the premier which would be responsible for formulating China's S&T policy only. They also campaigned to divert MOST's funding power to mission-oriented

CCP Congress in 1997, which reads, “We should formulate a long-term plan for the development of science from the needs of long-range development of the country, taking a panoramic view of the situation, emphasizing key points, *doing what we need and attempting nothing where we do not*, strengthening fundamental research, and accelerating the transformation of achievements from high-tech research into industrialization” (emphasis added). This was in turn adapted from the May 1995 decision of the CCP and the State Council to push forward China's S&T progress, although the wording was slight different – “catching up what we need and attempting nothing where we do not” (*you suo gan, you suo bu gan*).

¹¹ The 863 Program was seen as a key vehicle for improving China's high-tech competitiveness, through the development of six advanced technologies selected as central to promoting economic growth: electronics, supercomputers, telecommunications, avionics, GPS, and nanotechnology (MOST 863 2001, Larson, 2004).

¹² The 973 Program sought “to strengthen the original innovations and to address the important scientific issues concerning the national economic and social development at a deeper level and in a wider scope, so as to improve China's capabilities of independent innovations and to provide scientific support for the future development of the country” (MOST 973 2004).

government agencies and to increase funding to NSFC, which has been doing relatively well in administering resources for basic research in China. As it turns out, their opinions were not taken seriously in the final deliberation (Suttmeier, Cao, and Simon 2006).¹³

China's Nanotechnology Initiative: Top Down or Bottom Up?

It has been argued that China, as a state-centered economy, is trying to drive nanotechnology development from the top through large government investments. As early as 2001, addressing an international forum on nanomaterials, President Jiang Zemin stated explicitly that “the development of nanotechnology and new materials should be regarded as an important task of the development and innovation in S&T. The development and application of nanomaterials and nanotechnology is of strategic significance to the development of high technology and national economy in China” (NIBC 2006).

Yet this exclusively state-centered, top down view of China's high-tech planning does not adequately take into account the complexities of China's approach. China's approach is a hybrid model blending government and market forces (Xu *et al* 2006). Moreover, there are large and growing scientific and professional communities that are heavily invested in promoting the advance of nanotechnology. These include the physicists and chemists who have long worked in such areas as carbon nanotubes and nanopowders, the applied scientists and engineers who are transforming nanomaterials into commercial products, and the rising class of entrepreneurs and venture capitalists who are concerned about bringing new nano-enabled products to the market. In many regards, the innovation and commercialization ends of the R&D spectrum have been working in relative isolation from each other in nanotechnology. Each group has its own agenda. In between are the engineers, who often seem to be working alongside the applied scientists, but who often have close communications with potential customers as well, linking the R&D aspects of the innovation process – for example, in biomedical engineering, where the drug delivery prospects of nanotech are most apparent. The complex ties between these different communities of scientists, engineers, and business people make it difficult to think of innovation exclusively in terms of top-down versus bottom-up or even government versus market influences.

In broader institutional terms, it is not accurate to simply equate “top down” with governmental and “bottom up” with market-led investments in nanotechnology; China's

¹³ In recent years, MOST also has been criticized for its inaction in handling misconduct in scientific research in China. The appointment of Wan Gang, a non-CCP member, as the minister of science and technology in April 2007, bypassing another non-CCP member high-ranking vice minister, seems not only to signal that the importance of non-CCP members in government but also to indicate that the government may not be satisfied with MOST leadership, and in turn the progress of Chinese science, in spite of tremendous money put into it. They may want someone with no previous relations with the ministry to bring in new ways of thinking and management.

approach is more complex than this simple dichotomy suggests. Different levels of governmental support (central, provincial and local) and different government agencies vary in the degree to which they can be accurately characterized as either top down or bottom up. Nanotechnology is supported by a variety of public sector ministries and agencies that operate at diverse levels of government. These governmental actors have different agendas and incentive structures, and as a result nanotechnology projects are subject to conflicting and sometimes contradictory performance criteria. There is a division of labor in what and how they fund projects (e.g., people, equipment, cheap land, tax reductions). They also tend to have very different time horizons and attitudes toward financial risk: as one moves from central to provincial to local levels of government funding, the time horizon for return on investment becomes shorter, and there is a tendency to move from intangible (basic research) to tangible (commercial products) results. At the local level especially, government officials expect a quick turn-around in terms of technological development and market applications (Cheng 2007).

The central government is the principal funder of nanotechnology. The largest source of funds, and the biggest individual grants, come from the Ministry of Science and Technology (MOST). The National Natural Science Foundation of China (NSFC) provides much smaller grants (roughly equivalent to \$30,000-\$45,000 over three years), which are administered using more objective and universal criteria. The Chinese Academy of Sciences (CAS) also supports nanotechnology initiatives, but it has a more diversified funding philosophy than MOST. Even within central government support for R&D in China, there is a contrast between MOST (top down, “mega science”) vs. CAS (bottom up, including its Knowledge Innovation Program, which is touted as a bottom-up initiative).¹⁴ Provincial governments can also be significant – not only in those containing the major cities (such as Beijing and Shanghai), but also provinces such as Zhejiang, which neighbors Shanghai, that hope to promote their regional universities as major players by setting up collaborative university science centers (Zhejiang, for example, has partnered with UCLA to set up the Zhejiang-California International Nanosystems Institute, although with mixed results). Finally, local governments also frequently play a key role, particularly in major cities (examples include the Shanghai Nanotechnology Promotion Center and the Suzhou Industrial Park). Both provincial and local governments can also partner with foreign investors, as with the China-Singapore Suzhou Industrial Park Development Corporation.

When choices have been made for public investment, they often address the most pressing challenges facing China in agriculture, the environment, population, health, and national defense. The selection of four mega programs in basic science areas by the MLP – nanotechnology, development and reproductive biology, protein science, and quantum research – in fact represents an effort to do this. Within nanotechnology, China plans to

¹⁴ Many CAS members privately report that this is in fact a “top design” (*ding ceng she ji*) approach, originating under the initiative of Lu Yongxian who was president of the CAS in 1998 (for a discussion of the CAs and Knowledge Innovation Program, see Suttmeier, Cao, and Simon 2006a, 2006b).

focus on those nanomaterials and nanodevices that promise to have the most immediate payoff in addressing such immediate problems as air and water purification, materials with great tensile strength that can be used in a variety of industrial applications, as well as targeted drug delivery. China is already a world leader in the production of carbon nanotubes, for example (Fan 2007). According to Liu Zhongfan, Professor of Physical Chemistry at Peking University, “China is far better now than it was ten years ago – more people are working here and more [and better] instrumentation is appearing in China... policymakers are beginning to understand that nanodevices are actually the most important part of nanotechnology, not synthesis or incorporation” (Liu 2006).

China’s political leadership has lent its support for nanotechnology, with an added push from leading scientists both inside and outside of China. CAS Executive Vice President Bai Chunli, a pioneer and champion of nanotechnology research in China, has been an alternate member of the CCP Central Committee,¹⁵ whose lecture to the Politburo and the State Council in 2000 was deemed to be an influential one. Yet China did not realize the value and significance of nanotechnology to science as well as application potentials for the economy until much later than other, more technologically advanced countries. The fact that countries such as the United States had formulated national nanotechnology initiatives made it easier for Chinese scientists to make their case to the scientific and political leadership. Xie Sishen, who now heads up the National Center for Nanoscience and Technology in Beijing, explained that well-respected foreign scientists suggested to Jiang Zemin, Hu Jintao and others that nanotechnology was worth paying attention to:

Governments around the world and delegations from other countries, especially those from advanced countries, frequently mentioned nanotechnology and conducted exchanges and collaborations with China... [this] provided information continuously, which made the Government realize its importance from pure basic research to application to impacts on economy and society (Xie 2007a).

The connection of Chinese scientists to the international nanotechnology community, and especially to Chinese-origin nano-scientists and engineers overseas, has helped China move toward the frontier of international nanotechnology research. Chinese nanotechnology researchers have thus far achieved some impressive results, especially in nanomaterials. Furthermore, returnees and exchanges with overseas Chinese scholars have brought new ideas into the laboratory, along with increased participation by Chinese scientists and engineers in international exchanges, widespread international collaborations, and attendance at high-level symposiums (Xie 2007a).

In nanotechnology, it was MOST, the State Planning Commission (the

¹⁵Bai, executive vice president of the CAS with the rank of a full minister, is in line to succeed Lu Yongxiang as president. But Bai, an alternate member of the CCP Central Committee since the 15th CCP Congress in 1997, was not promoted a full member in the recently concluded 17th CCP Congress while Lu kept his full membership, which is rare as he is over 65, the age limit for being a full member. Therefore, it will be interesting to see whether a changing of the guard will happen at the CAS.

predecessor of NDRC), MOE, NSFC, and CAS that jointly analyzed the strength, weakness, opportunities, and threats in the development of nanotechnology in China (Diagram 1). The outcome of the exercise was to establish a national steering committee on nanotechnology in 2001, which in turn formulated an Outline for the National Nano Science and Technology Development (2001-2010) as a roadmap. Under the guidance and coordination of the national steering committee, chaired by the Minister of Science and Technology, various nanotechnology related programs have been supported and implemented at MOST, MOE, CAS, and NSFC; in the meantime, NDRC has provided funds for infrastructure building and innovation activities at enterprises. A new national steering committee was appointed in June 2007.

[Diagram 1 about here]

There is a division of labor among these state institutional players. MOST, for example, through the 863 Program and the 973 Program, funds mission-oriented nanotechnology projects (the 973 Program no longer supports nanotech projects as they are now under the aegis of the MLP, also administered by MOST); CAS positions itself in the national nanotech landscape with its forward-looking and strategic advantage; universities have the responsibility of not only conducting cutting-edge research themselves but also turning out students with the capabilities to do so; and NSFC awards grants to the best projects and researchers with possibility to achieve breakthrough at frontier of international research, mainly on the basis of scientific merit judged by peer review. Nevertheless, such a division is not rigorously observed. With competition for funding getting intense, leading nanotechnology scientists and institutions are likely to receive funding from many available sources, which then outsource or subcontract the projects.

In the first two years of the MLP implementation, 22 institutions have been selected to lead 29 projects (Table 2). Of them, 12 are CAS institutes, including the Chinese University of Science and Technology and the National Center for Nano Science and Technology (NCNST) which are also CAS affiliates; the rest are key (*zhongdian*) universities, with the CAS Institute of Chemistry, Beijing University, the CAS Institute of Physics, NCNST, and Tsinghua University having more than one project. Beijing, Shanghai, Jiangsu, and Anhui stand out as the leading centers of nanotechnology and well-known nanotech scientists, such as Jiang Lei at the CAS Institute of Chemistry, Peng Lianmao and Liu Zhongfan at Beijing University, Li Yadong at Tsinghua University, Yang Hui at the CAS Suzhou Institute of Nano-Tech and Nano-Bionics, among others, are among the chief scientists leading the efforts. The projects are in the categories of nanomaterials, devices and electronics, biology and medicine, and characterization and structure.

[Table 2 about here]

While it remains to be seen whether the projects selected will contribute to China's ability to leapfrog in nanotechnology, it is arguable that there is a resource concentration factor in the current arrangement. The first two-year fund of 262 million RMB(\$38 million) has been allocated for the 29 projects which presumably are composed of researchers from more than one institution, and the funding intensity for

each project – less than 5 million RMB per year on average (\$721,000) – is hardly significant. Also of concern is how scientists working on different projects collaborate with each other to generate synergy and what benchmark will be used to evaluate the first two-year performance and determine their continuous funding (in fact, one would also be interested in knowing how these projects have been selected and whether scientists were on equal footing in the process). Although the projects are supposed to be basic-research oriented under the MLP, some deal with applied nanotechnology. There are further questions about how they are related to other MOST-administered programs related to nanotechnology, especially the 863 Program and the Torch Program,¹⁶ which are focused on high-tech industrialization, and presumably some are led by the same chief scientists.

Private Capital: A Limited Resource

In our focus on the developmental state in China, we have not directly addressed the role of private capital, in part because the bulk of nanotechnology's global commercial promise remains in the future, and thus commercialization prospects remain limited. Nonetheless, we can offer some preliminary thoughts of the role of market investments, based on our research to date. These include centralized investments by large vertically integrated multinationals, various forms of network-based international collaborations, and small-scale new firm startups that focus on commercial products.

Multinationals: A great deal of attention has been given to the more than 1,000 R&D centers that have been established by foreign multinationals in China during the past decade. In many cases, these R&D centers seem much closer to the “D” of development than the “R” of research (e.g., localization and de-bugging of products). However, the Microsoft Research Center in Beijing has been touted as “the Bell Labs of China” for its pioneering research activities (see Buderer and Huang 2006), and IBM, General Electric, Siemens, and other top multinationals are also doing innovative projects in China. Lynn and Salzman (2007a) make the case that significant innovation is taking place in emerging economies, but often this is in the form of “process innovations” rather than the functionality of products.

International collaborations: There are many forms of international collaboration, including: formal institutional partnerships involving universities and corporations; study abroad programs, in particular post-graduate degrees earned by Chinese in the USA, Japan, and Europe; ethnic ties, most notably the recruitment of overseas Chinese scientists and engineers to return to China; and informal personal ties, such as the mentoring of former graduate students. Universities are an important component of China's nanotechnology initiative because it is first and foremost a science-based

¹⁶The Torch Program is intended to produce high-tech products involving new materials, biotechnology, electronic information, integrative mechanical-electrical technology, and advanced and energy-saving technology – products that have commercial potential for both Chinese and foreign markets. It involves, among other things, the creation of high-tech industrial development zones.

program.¹⁷

Entrepreneurial initiatives, such as small firm startups: These are most common in Hong Kong and Taiwan, although we have seen examples of these in China as well. It is also clear that investors, including venture capitalists and local governments, expect to see real products as a tangible result of their investments. This is a relatively weak area in China, although we identified more cases in Taiwan and Hong Kong. In the nanotechnology value chain, companies occupy different positions on the innovation → applied research → commercialization spectrum.

The Long March Through the Valley of Death: The Central Role of Public Funding

In business terms, the “valley of death” refers to the transitional period between basic R&D for a new technology (technology creation) – when public funding typically provides support – and commercialization, when a marketable product attracts private sector support. In China, the valley is long and deep. State-run firms – which still account for an estimated 43 percent of GDP, despite China’s commitment to privatization¹⁸ – tend to be bureaucratic and conservative, shunning potentially risky investments in favor of short-term, more predictable returns. The emerging private sector, including many small and medium enterprises (SMEs), remains small, under-capitalized, and generally risk-averse. This poses a challenge for the Chinese government’s heightened emphasis on leapfrogging development through nanotechnology, whose major payback remains ten or more years in the future. The amount of money allocated from Beijing for nanotechnology is not large by international standards (Xie 2007b), although it is difficult to accurately estimate total public spending for nanotechnology in China, given the wide range of funding sources and the difficulty of defining what qualifies as nanotechnology, and as a result estimates vary widely. Estimates range from as little as \$230 million for the five-year period 2000-2004 (Bai 2005: 63), to \$160 million in 2005 alone (Bai and Wang 2007: 75), to \$250 million in that same year (Holman *et al* 2006: 25). Although even the highest figures are still considerably less than the U.S. is publicly investing (as noted previously, \$1.5 billion in 2008), China’s governmental spending on nanotechnology may not be far off when adjusted for purchasing power parity, by taking into account labor and infrastructure cost differences (nanotechwire.com 2005). As noted by one of China’s nanotechnology leaders:

¹⁷ Why should we consider international collaborations as a form of market investment in high technology development? If we view nanotechnology as a value chain that has distinctive governance structures, then international collaborations may be a form of relational governance, which has different characteristics than hierarchies (vertical firms) and markets (entrepreneurial start ups). “Captive” and “modular” forms of governance, which complete the fivefold global value chains typology, may also have analogues in nanotechnology (see Gereffi et al., 2006).

¹⁸ OECD (1995) “Policy Brief: China’s Governance in Transition” (September) (<http://www.oecd.org/dataoecd/49/13/35312075.pdf>). In 1997 President Jiang Zemin called for privatization (*feigongyou*, or “non-public ownership”) of state-owned enterprises (SOEs), a plan that was ratified by the 9th National People’s Congress the following year.

The Chinese government should develop nanotechnology and at least aid in the national program, but there are so many important issues that should be considered, so I don't think that nanotechnology will be the top priority. Nanotechnology is in the basic research stage right now. So, nanotechnology cannot bring the benefits immediately (Xie 2006).

Throughout our interviews, the most pervasive theme to emerge was that of the importance of government funding and support for nanotechnology throughout the value chain, not only for basic research, but well into commercialization (this topic came up in more than half of our interviews). Esther Levy, editor of the journal *Advanced Materials*, who has reviewed numerous submissions to her journal by Chinese scientists, saw the question of government funding as key: "The Chinese are very hard working, As long as the government keeps funding them, they will progress. The question is, will the government funding be patient long enough"(Levy 2006)? As one interviewee commented, "there is a saying in China that those who do research on atomic bombs (*yuanzi dan*) don't make as much as those who sell tea eggs (*chaye dan*)" (Xu 2006). He noted that this situation has to change, since economic returns (rather than pure patriotism) will be required if China is to achieve its high-tech aspirations. Another informant – an Academician with the Chinese Academy of Engineering, and Chairman of China's Desalination and Water Reuse Society – explained the challenges of developing seawater filtration that employs nanotechnology, a NSFC-funded project that has yielded promising results in the laboratory:¹⁹

However, it is a little hard to estimate the timeframe for industrializing the new process. China Water Tech is currently working on optimizing the process. And speed for it to move to industrialization will depend on government funding and industrial interest. Government funding is usually not at all enough to industrialize a technological process, industrial involvement is crucial. However, larger scale demonstration of this process needs to be done (likely via government funding) before industry would become interested (Gao 2006).

Usually, different government funding sources are used for each step on the chain of technology towards industrialization. The 973 program of MOST is dedicated to fundamental research, the 863 program (also of MOST) funds applied research, while the "Industrialization Support Plan" (also of MOST) supports projects in initial stages of industrialization. For real industrialization projects, usually the central and local Commission of Development and Reform provides funding. However, usually the Commission only provides 15% of the total of what is needed to set up the company, and 85% has to be raised by the company (which is yet to be formed).

At the level of basic research, funding comes primarily from the central government agencies mentioned earlier. For example, NSFC provides growing support for nanoscience and technology through both its General Program, as well as its Major Program (focused on major scientific and technological issues that are interdisciplinary in

¹⁹ Dr. Gao is one of the founders for membrane technology in China. He is also the first one who introduced the term nano filtration to China in 1993.

nature, such as nanotechnology). As of summer 2007, there were some 670 ongoing projects with “nano” in the title, totaling 800 million RMB (roughly \$115 million), 8% of the total budget (Li 2007). Most of these were relatively small grants (300,000 RMB, approximately \$43,000) for three years of project funding, in such areas as nanomechanics, novel nanostructures, quantum dots, carbon nanotubes, and novel cancer and gene therapies. Proposals are peer reviewed, and awards issued on a competitive basis. One challenge, we were told, is that since nanotechnology is multidisciplinary, it is sometimes difficult to know where to apply. On the other hand, this also provides new opportunities for funding, if researchers are able to identify their work as nanotechnology (Liu 2006).²⁰

At the local level, various forms of incubation play a key role. For the Beijing region, the Nanotechnology Industrialization Base of China (NIBC) – located 100 km from Beijing, in the Tianjin Economic and Technological Development Area – serves this role. NIBC was established by MOST in December 2000, in conjunction with CAS, universities, and private enterprises. Its distinguishing feature is that it is essentially “a government organization run by market forces,” reflecting the belief that

...pure state ownership does not work well for technology innovation or management... What the NIBC does is to take results from university and institutes, and help scientists to commercialize the results. It takes a systematic approach that goes to the end of the commercialization pipeline.²¹

The NIBC Entrepreneurship Investment Co. Ltd is the vehicle for incubating new companies, acquiring existing companies, and preparing initial public offerings. In 2005, the Chinese National Academy of Nanoscience and Engineering (CNANE) was established under the same administration, with a primary focus on R&D rather than commercialization. It is unclear to us how large a role these institutions actually play; during our visit in 2006, the principal operation we observed was the manufacturing of non-nano pharmaceuticals, as a form of income generation for the facility.

Shanghai has its own incubator in the form of the Shanghai Nanotechnology Promotion Center (SNPC), which is funded largely by government initiative, particularly the Shanghai municipal government as well as the NDRC, although local enterprises have also contributed.²² It was founded in July 2000, with the Center’s formal establishment in 2001. SNPC is subordinate to the Science and Technology Commission, the lead organization in Shanghai concerned with advancing the city’s

²⁰ The relabeling of earlier work as nanotechnology, in pursuit of the increased funding that available for this emerging technology, is something we have not yet explored in China. We suspect, however, that it may be significant – as it likely is in the United States and other countries that have directed increased funding into this area.

²¹ Handout from NIBC (August 3, 2006)

²² Information was obtained in interviews at the SNPC with LI Xiaoli (Project Manager), SHI Liyi, and Min Guoquan (August 7, 2006), and with ZHU Simon (SNPC Chinese Industry Association for Antimicrobial Materials & Products; Shanghai NML Nanotechnology Co., Ltd), ZHANG Bo (Shanghai AJ Nano-Science Development Co., Ltd), and Fu Lefeng (Shanghai Sunrise Chemical Company) (August 3, 2007).

high-technology profile. The SNPC provides training for scientists and engineers on the specialized instruments used in nanoscale research, and has several university-affiliated ‘industrialization bases’ for the purpose of transferring research on nanomaterials and nanoparticles to the estimated 100-200 SMEs reportedly engaged in nano-related R&D in the Shanghai area. Roughly a third of its 25 person staff are science and engineering professionals.

The Center’s main focus is to promote commercialization. This is achieved in various ways: by funding basic application research;²³ through a research platform designed to help with the commercialization process; through the provision of nano materials testing; through the hosting of workshops and international conferences on nanotechnology; and through education (including a certificate program) and outreach to raise public awareness about nanotechnology. As an incubator,²⁴ the SNPC provides services for startups before and as they enter the market – services that include legal advice for establishing a company, a variety of technology-related services, and help with marketing products. The Center also loans out lab and office space as well as a testing center that provides the costly equipment required for nanomaterial characterization – equipment that most startups could not afford. It currently supports some 70-80 companies, of which perhaps half are nano-related, with grants ranging from 50,000 RMB for smaller projects to 1 million RMB for large ones.

While there is some private industry investment in nanotechnology (local examples include limited investments by Baosteel and Shanghai Electronics), it is clear that local government funding plays a key role. During our visit to the SNPC, we saw a number of examples of such support – firms housed within the Center’s complex that receive public funding as well as access to Center support and services. Three examples are illustrative. The Shanghai Sunrise Chemical Company, which employs about 80 people making nano-coatings and nano-photo catalysts, received two-fifths of its initial capitalization of 5 million RMB (\$721,000) from government sources. The Shanghai NML Nanotechnology Co., Ltd develops anti-bacterial and photo catalysts for use in textiles and plastics. Last year they began exporting the final products employing their materials (such as coffee cups that use nanopowders) to the U.S. and Australia. While the company has not received money from SNPC, it does have access to the Center’s training and information services. One final example is the Shanghai AJ Nano-Science Development Company, which manufactures Atomic and Scanning Tunneling Microscopes, two key instruments used in nanotechnology. AJ Nanoscience’s principal funding comes from the Shanghai Aijian Trust Investment Company, a Chinese firm with

²³ As one prominent example, we were told that SNPC helped to fund and manage a project involving the use of atomic force microscope tips to locate DNA molecules that involved CAS and Shanghai Jiao Tong University, which was featured on the cover of *Nano Letters*.

²⁴ The SNPC has three incubators, each associated with a university: one affiliated with Shanghai University, and two with the Hua Dong Science and Technology University (East China University of Science and Technology).

significant Hong Kong ownership²⁵ that invests in SMEs. The company gets public support as well: it receives funding from the Shanghai municipal government for R&D, relies on technology developed initially in CAS's Institute of Applied Physics, and has some projects with the Shanghai branch of CAS.²⁶ AJ Nanoscience, which was established in 2001, reportedly has 60 percent of the domestic market in their area of instrumentation – although the market is dominated by international players such as the U.S.-based Veeco Instruments.²⁷

Shanghai also supports the “Climbing Mountain” (*Dengshan*) Action Plan, which provides dedicated funding for joint projects that must be led by companies in collaboration with an academic partner. Within the plan, most work is contracted between university researchers and engineers/business partners from companies. The Plan specifically earmarks funding for nanotechnology, with projects divided between basic and applied research intended for nanotechnology commercialization (Jia 2006). In Shanghai, as is typical of funding at the local level, the government provides funding both for local players and local collaboration with foreign companies such as Unilever (Li and Wang 2006). Particularly at the provincial and local levels, funding for nanotechnology R&D thus blurs the line between top-down and bottom-up approaches (Li, Shi, and Min 2006).

Conclusion: China's Developmental State

China's dedication to high-technology growth is evident in its policies supporting efforts to leapfrog development through targeted science megaprojects in nanotechnology, development and reproductive biology, protein science, and quantum research. As we have shown, China's approach to nanotechnology is heavily state-centered, with public investment originating at all levels of government, and ranging from support for basic research to funding intended to promote commercialization. While the United States has not been a focus of this paper, we noted in the introduction that the U.S. National Nanotechnology Initiative is primarily directed at the research end of the value chain, with more limited inroads into direct support for bringing products to market. In this China clearly differs from the United States – a divergence that is not surprising, given the more restricted business environment for “indigenous development” in China.

While the CCP Central Committee does not have its mandate to set S&T policy directly, it does maintain a significant level of influence vis-à-vis a state leading group mechanism. The leading group for S&T policy formation has been set up within the

²⁵ Hong Kong Mingli Co. bought more than 40 percent of Shanghai Aijian Trust Company in 2004, signaling a much greater openness to foreign investors on the part of Chinese trust companies. See Zhao 2005.

²⁶ We were told that when profits are realized, they are shared with CAS members who created the technology.

²⁷ AJ Nano-Science's instruments typically sell for roughly one-quarter the price of their foreign counterparts. Interview with ZHANG Bo, Manager of Research & Production Department, Shanghai AJ Nano-Science Development Company (August 3, 2007).

State Council to tackle issues involved with large-scale planning involving more than one government agencies. There is a National Steering Committee for Nanotechnology, chaired by the Minister of Science and Technology, that coordinates the efforts in nanotech research and industrialization and determines the priority areas for support. Under the Medium and Long-Term Plan, the money comes from MOST, although the chief scientist, Bai Chunli, is from CAS.

The Chinese model is not as clear cut as the “top down/bottom up” debate would suggest, since both are seen in the development of nanotechnology. For example, the Chinese Academy of Science’s Knowledge Innovation Program (KIP) is typically treated as a “bottom up” example, but it in fact involves something called “top design” within the academy. While the 863 and 973 Programs are primarily bottom up, they would never have gone forth without the support from the top leadership, Deng Xiaoping in the case of the 863 Program and Jiang Zemin in the case of KIP (which is funded largely through the 973 Program). On the other hand, the management of these programs, especially those under MOST, is top down, with significant input/decision-making from bureaucrats, which has been criticized within the Chinese scientific community (Suttmeier and Cao 2004)

Whether China’s efforts to achieve first-mover status in nanotechnology are successful remains to be seen. Whether there will be any large-scale pay off also remains an outstanding issue in the future development of nanotechnology-enabled market applications. However, China has clearly shown itself to be very committed to adding high-technology initiatives like nanotechnology to its top national priorities, thereby showing the dynamism of its contemporary developmental state.

Diagram 1 The Framework of Nanotechnology Research in China

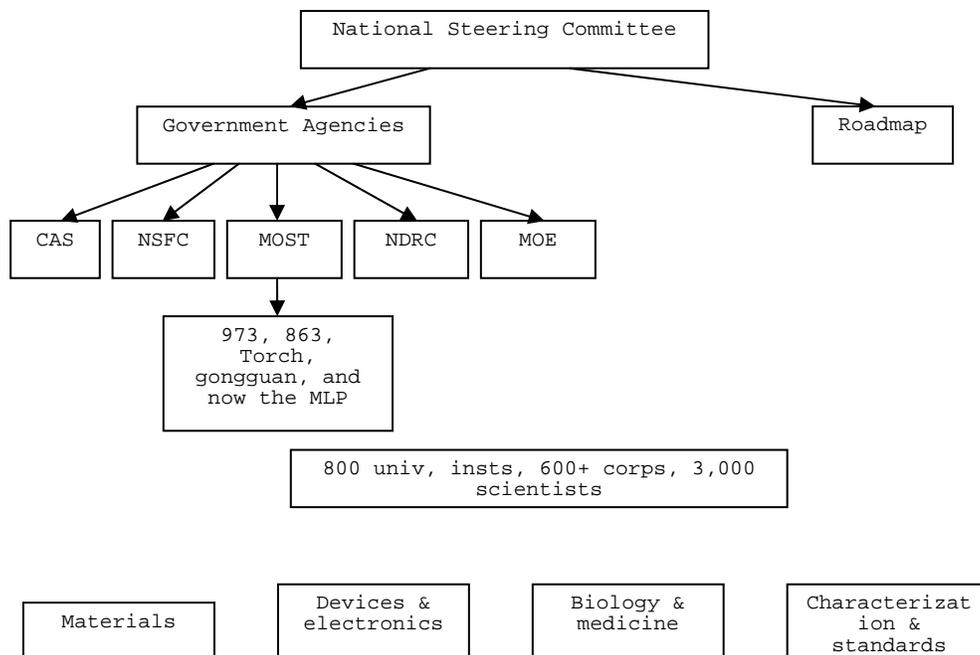


Table 2 Nanotechnology Projects under the MLP (2006-2007)

| Leading Institution | Location | Number of projects | Funding (RMB million) |
|---|-----------|--------------------|-----------------------|
| Dongnan University | Jiangsu | 1 | 4.9 |
| Chinese University of Science and Technology | Anhui | 1 | 4.8 |
| CAS Shanghai Institute of Applied Physics | Shanghai | 1 | 11.2 |
| CAS Shanghai Institute of Microsystems and Information Technology | Shanghai | 1 | 14.0 |
| CAS Institute of Chemistry | Beijing | 3 | 35.5 |
| CAS Institute of Semiconductor | Beijing | 1 | 4.6 |
| CAS Hefei Institute of Physical Science | Anhui | 1 | 13.6 |
| CAS Institute of Physics | Beijing | 2 | 13.3 |
| CAS Technical Institute of Physics and Chemistry | Beijing | 1 | 5.0 |
| CAS Institute of Theoretical Physics | Beijing | 1 | 9.0 |
| CAS Institute of Metal Research | Liaoning | 1 | 5.8 |
| Sun Yat-sen University | Guangdong | 1 | 11.7 |
| Beijing University | Beijing | 3 | 31.3 |
| Beijing University of Aeronautics and Astronautics | Beijing | 1 | 9.3 |
| Nanjing University | Jiangsu | 1 | 8.7 |
| Nankai University | Tianjin | 1 | 4.8 |

| | | | |
|--|----------|----|-------|
| Sichuan University | Sichuan | 1 | 10.8 |
| National Center for Nano Science and Technology | Beijing | 2 | 16.2 |
| Fudan University | Shanghai | 1 | 11.2 |
| Wuhan University | Hubei | 1 | 5.5 |
| Tsinghua University | Beijing | 2 | 17.3 |
| CAS Suzhou Institute of Nano-Tech and Nano-Bionics | Jiangsu | 1 | 13.6 |
| Total | | 29 | 261.8 |

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Panel IV: Discussion, Questions and Answers

HEARING COCHAIR MULLOY: Thank you. Thank you, Doctor.
Commissioner Slane.

HEARING COCHAIR SLANE: My first question is for Dr. Lebbly and Dr. Arthurs. The optoelectronics industry in the United States seems to be moving lock, stock and barrel to China. I would be interested in hearing what you think the federal government should do to stem that and how we can keep that industry here in the United States?

And then for Dr. Appelbaum, you know, I'd like you to address what are the issues in nanotechnology in that area?

And we can start with you, Dr. Lebbly.

DR. LEBBY: Yes. That is indeed true. If you look across our membership, many of our members have manufacturing, packaging, and assembly facilities in China. A lot of these companies were drawn to do this, going back, in the 2000 dot-com bubble, where we had a lot of euphoric behavior, and a lot of the optoelectronic companies, especially in the communication space, geared up and put a lot of automatic tooling facilities in this country, companies like Lucent, and we had a big, a big effect by Nortel in Canada.

And when that bubble burst in 2001-2002, there was no volume there to really drive these factories so a lot of these companies looked for a low-labor solution, and it was like a herd mentality. Everybody went across to Asia, and so a lot of the packaging and the back end has gone there.

And now what we're beginning to see, after I interviewed a number of our companies in the last two or three weeks, is that some of the R&D is going over there, too. So it's not just manufacturing.

And one of the lessons that we're beginning to understand here is that if you're not close to the manufacturing process and optimizing the yield, then you really can't design your next generation products. And so what we're beginning to see is that the engineers who tweak the

manufacturing lines to get the maximum yield, if they don't pass that information back to the R&D designers here in the U.S., you just cannot design the next generation products.

And so what that means is you really want to have a really tight connection between R&D and your manufacturing facility so, hence, we're seeing R&D facilities crop up actually in the same places as the manufacturing centers.

So from an optoelectronics U.S. standpoint, yes, things are leaving this country. But there are some things that we can do here. I listed those in the different sectors of the statement, and when I asked this question to a lot of our members, yes, clearly, I had a lot of responses, but one of the things people would really like to see in the optoelectronics field is the direct government support as opposed to indirect government support because many of the companies in our field are really unprofitable, large or small, and they're really struggling.

You could argue they were profitable before the dot-com bubble, but since 2002-2003, a lot of them have really been struggling, and so I think if you really want to have a big impact in the optoelectronics industry in the U.S., you need direct government support.

Now, the ideas that we have been floating around ourselves between our members and OIDA is what does that really mean? We have a lot of government agencies that do fund optoelectronics in a sort of fragmented style.

We have DARPA doing some things. We have NSF doing some things. Academia. We have DOE, NIST. And so the list is quite long, but what we would like to see is more focused programs, and focused programs will actually help our industry really do some innovation and R&D back here. And that will allow us to come up with some new ideas like the roll-to-roll manufacturing I suggested or PICs. That would also be a good way to establish leadership, even maintain that leadership.

Quickly, before I stop, one thing we did notice when we called up some of these companies is that the last remaining optoelectronics manufacturer these companies have is the chip fabs, and in the whole length of the process, the back end, the assembly and the manufacturing is over in China, but the fab that actually makes the

laser diodes and the LEDs and the photo detectors remains in the U.S.

So the question was why are these places still in the U.S.? Well, the answer that came back was because they're very complex. They have complex IP, and if these facilities went to China, we'll be dead. So clinging on to the fabs with their fingernails is what's happening to a lot of these companies.

If we can provide some focused government, direct government, support, we would really build upon that.

HEARING COCHAIR MULLOY: Thank you, Dr. Leppy.

Let me just pause for a minute. Senator Sherrod Brown is here, and we want to introduce him now and let him make his statement.

Thank you, Senator.

HEARING COCHAIR SLANE: Today, we're pleased to hear from Senator Sherrod Brown of Ohio. Senator Brown was first elected to the United States Senate in 2006 and is currently serving his first term. Prior to his time in the Senate, Senator Brown served in the U.S. House of Representatives since 1992 as a member from the 13th district of Ohio.

In the House of Representatives, Representative Brown increased funding for the International Trade Administration's Office of China Compliance by \$3 million. In both the House and the Senate, he has been an outspoken advocate of his beliefs in fair trade, which he also outlined in his 2004 book entitled Myths of Free Trade.

I understand you have to leave immediately after you've given your statement due to your scheduling constraints. As always, we appreciate your time and look forward to hearing your perspectives on the effects of China's industrial policy on U.S. workers, business and the American economy.

PANEL V: CONGRESSIONAL PERSPECTIVE

STATEMENT OF SHERROD BROWN, A U.S. SENATOR FROM THE STATE OF OHIO

SENATOR BROWN: Good. Commissioner Slane, thank you, and Patrick and Carolyn, all of you, thank you. Thank you for your public service and thanks for allowing me to appear here several times over the years and appreciate the work this Commission does and good to see an Ohio boy do well. Thank you, Commissioner Slane.

I apologize for the interruption, and thank you for stepping aside for a moment--I really appreciate that.

The current financial crisis paints our economic relationship with China in perhaps broader relief than we have in the past. I know this Commission has a much deeper and better and broader understanding of what China's economy is all about, what ours is, and their interaction, than most of the rest of this country. But I think that people are understanding it a little better as this financial crisis wears on.

Our economies, Chinese economy, our economy, neither is particularly healthy now and worse that they are codependent. The U.S. official unemployment rate is 8.1 percent. My state of Ohio, which has been in recession, we think, probably a year longer than the officially recognized national recession, is about 9.4 percent. It's the highest rate we've seen in 25 years.

Meanwhile, thousands of factories in China have closed over the past six months. China is one enormous export platform, and the United States, its biggest customer, has in some sense stopped buying.

Morgan Stanley economists report that exports account for 47 percent of the economy of China and other East Asian nations, while in the United States, consumption accounts for more than 70 percent of our GDP. Put that together.

This economic codependency has bred a dangerously skewed financial relationship. As revenues flow into China and out of the United States, China becomes our biggest lender. I don't need to detail the risks this relationship breeds. We know more and more about sovereign wealth funds and the risks, the short-term, medium and long-term risks that debt can bring. But our roots lie in our economic codependency, and our economic codependency is rooted in our nation's passive trade policy.

Ohio is one of the great manufacturing states in this country. We make paper and steel and aluminum and glass and cars and tires. We are first or second in the nation in number of solar energy workers.

We make solar panels and polymers and wind turbines and more. Look around you today; you'll find something that was made in my state.

Let's for purposes of illustration look at a typical Ohio manufacturer and compare that manufacturer with a typical Chinese

manufacturer. The Ohio manufacturer has a minimum wage to pay his workers. He has clean air and workplace and product safety standards by which to abide, helping to keep his workers healthy and productive and his consumers and his customers safe. The Chinese manufacturer has no minimum wage to maintain, is allowed to pollute local water sources and let workers use perhaps even dangerous and faulty machinery.

The Ohio manufacturer pays taxes, health benefits, pays into Social Security and Medicare. He typically allows family leave. He's required to give WARN notices when there is a plant closing. The Chinese manufacturer, on the other hand, sometimes allows child labor.

The Ohio manufacturer receives no government subsidies in most cases, although things have changed recently. The Chinese manufacturer often receives subsidies for development of new technology or for export assistance.

The Chinese manufacturer benefits from China's manipulation of its currency, which gives it, depending on what economist study, at anywhere from 15 to 40. I remember Clyde Prestowitz sometime ago said far in excess of 40 percent even advantage.

The Ohio manufacturer is increasingly going green and investing in new technologies and efficiencies to create more sustainable production practices. Ohio manufacturers are part of the movement to become more energy efficient. Joining manufacturers in the other 49 states, they will do their part to reduce carbon emissions, but not at the expense of jobs if China and other countries do not take comparable action.

Now when the Ohio manufacturer petitions for relief, when he says I can't compete--when he says I can compete with anyone, but this is not a level playing field, the Chinese government cries protectionism. Or when the Ohio manufacturer says he wants to emit less carbon but needs to see his competitors from China bear the same costs on similar timelines, what does the Chinese government say? Again, the government calls it protectionism.

Just last week, our new Energy Secretary, Nobel Prize winner Secretary Chu, noted in a hearing that unless other countries also bear a cost for carbon emissions, the United States will be at a disadvantage. The response from a Chinese official, again, he said I will oppose using climate change as an excuse to practice protectionism on trade.

Chinese officials are quick to call the U.S. protectionist despite all the protections it affords its own manufacturers, while our country has the world's--as we should--has the world's most open economy.

And, of course, Chinese officials are often joined by multinational CEOs, by Ivy League economists, by people in the high echelons of our own government, and by most editorial boards, in casting any efforts to rebuild American manufacturing protectionist. Argument over.

That is why I feel such a sense of urgency with the hearing you're holding today. China's industrial policy is based on unfair trade practices and involves direct export subsidies, indirect subsidies like currency manipulation and copyright piracy, and hidden subsidies like lax standards and low labor costs. In total, it results in the loss of millions of American jobs.

It is depressing wages and income levels worldwide, while China's exploitation of environmental and health and safety standards is killing Chinese workers and citizens, adding to our own climate change challenges, and in some cases, harming children and other consumers around the world.

The health of our economy and strength of our middle class depend on how Congress and the Obama administration engage with China on all of these issues.

I thank you for investigating these and for the leadership and the public service that you all have shown.

HEARING COCHAIR SLANE: Thank you, Senator.

SENATOR BROWN: Thanks.

HEARING COCHAIR MULLOY: Thank you for being here, Senator.

SENATOR BROWN: Thanks, Dan. Thanks. Good to see you again. Thanks, Carolyn.

PANEL IV: (Resumes discussion, questions and answers)

HEARING COCHAIR SLANE: Dr. Arthurs, we'll continue.

DR. ARTHURS: The question was, I think, if the optoelectronics industry is moving out of the United States, how do we prevent that or how do we reverse that?

I would say that certainly for any volume application, once anything was into volume, it moves offshore, particularly to China, now Shenzhen being perhaps the great hub of optoelectronics manufacturing in the world. There's a large part of the industry that is low volume and more actually high tech that is still staying here and still providing something of an advantage in the U.S., but that is not growing.

I think that we really have to figure out how to do volume manufacturing in the U.S. Now, we have not invested in the

manufacturing technology, and it's not interesting to the science community. I see in Taiwan, for example, the universities where Taiwan has got the most MOCVD reactors in the world. These are big machines for depositing thin filaments crucial to optoelectronic components.

The universities have people doing research on those and operating them as undergraduates. They're preparing a manufacturing workforce with an edge. We don't have that type of thinking here. We need a strategy.

The Europeans have produced a strategy on photonics. The Canadians have just done it. We are actually--and Mike's--we're now trying to get the funds to do a study on the economic impact of what we call photonics, but it's the same word as optoelectronics, in the U.S., and getting even the funds to do a strategy once you mention "economic impact," to people--there is no real mechanism for doing that.

The NSF, who actually to their credit are coming up with half of the funds, had difficulty in doing that because once you mention commercialization, then it somehow is impure science and not to be supported.

That's a real issue for our scientific community here. I think we've got to change the metrics. We've got to change the incentive system and the reward system for our scientific and technical community, counting jobs and economic impact here.

DR. APPELBAUM: I'll comment briefly on the loss of jobs in nanotechnology, and then I'll propose a kind of a four-point program for this industry, but I want to first make a response to Senator Brown's comments. He's not here, of course, but I'll do it anyhow.

In an earlier life before I began studying China's rise as a technology power, my focus was on China's labor conditions. And I spent a lot of time in Chinese factories looking at sweatshop production, environmental problems, and so forth. So I'm very sympathetic with his comments.

But I think there's a danger in attributing China's success only to that side of the equation. And I also want to say that one of their top priorities now has to do with environmental issues. They're quite conscious of the environment destruction that is occurring in their factories and in their cities.

They've also enacted a new Contract Labor Law which took effect last year, which has driven some businesses out of China, because it gives workers rights they've never had before. It will not be honored entirely, obviously, but it's a step in the right direction.

So while I think the playing field has to be leveled, I think the

important thing to know is that China is also making a full-court press when it comes to investing its huge foreign currency surpluses and becoming a global competitor. And that I think is where we really should be focusing our efforts.

In terms of the loss of jobs in nanotechnology, there aren't that many jobs in this industry yet so there haven't been many jobs lost. So I guess in a way that that's good news. While I think that some projections of the future commercial impact of nanotechnology may be exaggerated, if it does, in fact, create a \$3.1 trillion economy, as Lux Research (which tracks nanotechnology) claims it will by 2015—much of that economic growth will be through the addition of components made through nanotechnology to existing products such as tennis rackets, golf clubs, lightweight bicycles, airframes, and things of that sort. As I recall, Lux also predicts that the number of jobs created by nanotechnology may not be all that great.

Ultimately, as China moves up the value chain, which it will, and starts to actually make those products itself, could those industries be kept in the United States? I think that's the way I would frame the question.

Now, my four-point program. Well, the first thing I would do is revise immigration laws. I know many people today have talked about that. At my campus, as many as half the applicants to the Department of Electrical and Computer Engineering, are from China or other countries: an increasing number of them are likely to return to China after they graduate.

Tom Friedman, with characteristic verve in his latest book, *Hot, Flat and Crowded*, says that we should pin a green card to every foreign graduate of a U.S. university. A recent survey of Silicon Valley entrepreneurs done by Vivek Wadhwa and his colleague, (Gary Gereffi, who has testified before this Commission), claims that something like a half of all Silicon Valley start-ups over the last ten years were created by immigrants--mainly from India, some from China, some from elsewhere.

According to the same study, roughly a quarter of all technology start-ups in the United States between 1995 and 2005, accounting for 450,000 jobs, were started by immigrants, and I think also the same study found that a nearly quarter of all international patents came from companies in which either the CEO or the Chief Technology Officer were immigrants. So I think we are shooting ourselves in the foot by making it so difficult for immigrant entrepreneurs to stay here. Immigrants have always been a rich part of American history; I don't see them competing for jobs in nanotechnology.

That leads me to my second point. It would be nice if we were

producing students who would compete with immigrants for these kinds of technology jobs. And there I think we've really fallen down. I'm told that the second part of the stimulus package will focus on education in science, technology and math education, engineering and math (STEM) education. I think that's an important thing to do. I'm not an expert in this area, but just intuitively it seems to me that we should somehow make it easier and more encouraging for U.S. students to advance in STEM education. The U.S. remains the world's leading innovation-oriented society. *The Economist magazine* recently had a feature article on the U.S., which provides ample evidence that the U.S. remains the most innovative country in the world in terms of pretty much every measure--even though a lot of the innovation currently is being done by immigrants.

We need to encourage our own talent to move into that area and not just at Ivy League colleges. Kids who aren't finishing high school today constitute a huge wasted talent pool, quite apart from the human cost.

The third thing is a little more direct. I mentioned earlier in my remarks that 95 percent of the funding of the \$1.5 billion in the U.S. National Nanotechnology Initiative goes for basic research. There are some small programs that are more closely tied to funding commercialization: the Small Business Innovation Research (SBIR) program; the Small Business Technology Transfer (STTR) program, which encourages technology transfer, and the EPSCoR program in the National Science Foundation, which is the Experimental Program to Stimulate Competitive Research. We could be putting much more money into supporting commercialization. I know that that's a debatable point in terms of the U.S. The notion of industrial policy has a bit of a bad reputation, but I think more could be done.

Just to give you one example, in the textile industry, which I've done some research on, a great deal of research is being done now on nanofabrics, using nanotechnology to make Kevlar, for example, or, you know, swimsuits or ties that wick off stains and water.

Money could be put into that so we could actually compete with the Chinese who are certainly going to do it, and moving up the value chain into the design and manufacture of nano-enabled fabrics. Hong Kong Polytechnic University has created an innovative program in this area – one that was inspired by a similar program at North Carolina State University's College of Textiles.

So the basic idea here is to invest public funds to developing nanotechnologies that have commercial payoff in now-declining industries, such as textiles and apparel. Providing the job retraining

for people who could then work in those industries could make us competitive. In other words, protectionism is not the answer making our own industries more competitive is.

Finally, the fourth thing I would do would be to encourage more international exchanges and collaborations. It is often said that “good ideas have no borders.” This is certainly true of nanotechnology, which emerged at a time when scientific research had already become highly internationalized. In recent years there has been an explosion of high-impact scientific articles, published in various fields of nanotechnology, authored by Chinese nationals –authored by Chinese nationals – to the point where the quantity (if not the quality) now equals that of the U.S. Many of these are co-authored with colleagues in the U.S., Europe, and Japan. There are some (but in my view insufficient) programs that encourage international cooperation and mutual learning. One, for example, is the National Science Foundation’s Partnership in International Research and Education (PIRE), which encourages student and faculty exchanges and collaborations. Our own campus has such a program with the Dalian Institute of Chemical Physics, in the area of nano-catalysis. Such exchanges should be encouraged: we all benefit to the extent that knowledge advances across a level playing field

HEARING COCHAIR SLANE: I have one follow up. I struggle with this issue of manufacturing. When you look at the iPod, the iPod was designed and developed by Apple. It's all manufactured in China. The manufacturer gets \$4; Apple gets \$80. Does this apply to optoelectronics?

Are we going down the wrong road here; my focus is we're losing these jobs. This is \$160 billion industry it's projected to become, but a lot of the manufacturing seems to be on the low-end side.

DR. LEBBY: I think if I can try and address that question. The iPod or the iPhone is designed here and manufactured in China, agreed. Optoelectronics, once the R&D goes, you won't be able to do any design. So the whole thing goes.

HEARING COCHAIR SLANE: That's the problem.

DR. LEBBY: So you lose the value.

HEARING COCHAIR SLANE: Thank you.

HEARING COCHAIR MULLOY: Commissioner Wortzel.

VICE CHAIRMAN WORTZEL: I have a question I would pose to Dr. Leby and Dr. Appelbaum, and then a broader one for Dr. Arthurs.

For Dr. Leby and Dr. Appelbaum, would your companies or

your society object if the U.S. government support that you seem to require was legislated to be conducted in the United States by Americans? Would you object if these funds you ask for was legislated to be so that the research had to be conducted in the United States by Americans?

And then, Dr. Arthurs, I wonder if I could take advantage of the fact that you have focused on things like lasers, and if you could characterize for us where China is on weaponizing lasers? They have dazzled a U.S. satellite with a ground-based laser. Their military literature discusses the potential for space-based laser and anti-satellite weapons, but that requires significant miniaturization, I think.

And then they have done quite a bit of work on undersea laser communications and submarine laser sensors. So I wonder if you could talk about what you may know in those areas. I'll turn it over to you, first.

DR. LEBBY: In reference to your question on would our members object if funds were legislated to do R&D, and let's call it now innovative manufacturing techniques in the U.S., I do not think so at all. Many of our members do have facilities, manufacturing facilities in China and Asia, Taiwan, and I think you're referring to Gene's comment on high volume manufacturing. I don't think you're going to see those processes come back at all. So once the manufacturing is gone, it's gone.

I think what we really need to do, what our members really want from government agencies is help in designing and innovating the next generation products. And really when you do that, look for the new manufacturing platforms that we can establish here.

So I'll give you two examples. The PICs, the photonic integrated circuits, is a bit like the old silicon IC 50 years ago, when it had like ten transistors and now it's like ten million. Well, in photonics, we're in about 50 to 100 photonic devices on a piece of indium phosphate or silicon, and it's sort of beginning, and companies like Infinera, they claim they're four years ahead. Other people claim they're a couple years ahead.

But the fact remains is we're ahead. And so the question is, can we keep that lead and can we maintain the manufacturing of those chips here in the U.S., and the answer is yes. And so I think to resolve and to answer your question I don't think you'll see any of our members complain at all.

DR. APPELBAUM: I can't speak on behalf of any members, but I'll tell you my own thoughts on this. If I understood your question correctly, I don't think legislation to keep research, development, or more generally innovation in the U.S. is a good idea. I think the

approach instead should be to support innovative work here so more high school and college graduates become innovators, so foreign-born innovators choose to come to (and remain in) the U.S., rather than return to China or India.

In terms of the manufacturing jobs in nanotechnology, I don't think it makes sense to try to develop the low-end jobs. I'll give you one illustration. Shenzhen Nanotech Port Company was a pioneer in the production of carbon nanotubes, which are basic materials used in many nano-enabled products. It's sort of the bottom of the value chain, and they had a lock on that. Now, they're struggling. Why? Because carbon nanotubes have become a commodity. There are how many companies making this basic nano material, and when a product becomes a commodity rather than something unique, I think those jobs should go elsewhere.

I don't think that's what we should be building. We should be building at the higher end of the value chain. Only a small percentage of the value-added of the iPod is in the manufacturing; most of the value comes at the high end of the value chain--design, marketing, innovation. That's where we should be focusing.

VICE CHAIRMAN WORTZEL: Dr. Arthurs.

DR. ARTHURS: Okay. In answer to your question, when given a pretty comprehensive tour of Fudan University, which is the number three or so in China, they said they were sorry they couldn't take me into this particular area because that actually was a classified area for optics, and they pointed out that this, in fact, was one of the only areas that had survived during the Cultural Revolution when intellectuals were driven to the countryside.

I sense that there's a lot of intense laser work going on in China; we know that. We also know what papers are of interest. They do not have, to my knowledge, right now the capability of manufacturing the chips that Mike was talking about, particularly for pumping the smaller and more powerful, more compact lasers that I think will be vitally important for future security reasons.

So they don't have them now, but the semiconductor plants there can adapt to have them as they are trying to adapt right now to do solar panels in the current downturn in the semiconductor industry.

I think there is a challenge as to how we're going to keep them here. I don't think they're just going to stay here if we simply go on as we're going. I think we need intervention to ensure that they don't follow the entire lithography industry out of the country, and that does need intervention.

To the question as to whether our members would regard their research must be done in the United States, I would say certainly the

U.S. members would have absolutely no problem with that. The European members could not have a problem with it because the whole Framework 7 Program is only open to Europeans.

There's a small little thing for cooperation, but essentially, and I don't think that China is doing much funding or Taiwan or other countries--I'm not harping on China here--of research in the U.S. or by non-natives. So I don't think that there would be a particular objection to that at all.

Our corporate members, by and large, would see the reasonableness in that. They just could not let that go to there, if they were large and have labs in Shanghai or Bangalore, they could not let it go there, but they have plenty of researchers still in the U.S., and this might encourage them to keep a few more.

DR. LEBBY: Actually I'll just add to that. We do receive a lot of calls from our members here in Washington for access to government agencies. They call up and say we'd really like to get involved with a photonics based program that could leverage our next generation products, but there is only a few people in DARPA and one of two people in NSF. And they ask us who they are. Can we introduce them? Can we show them how to get a government program? And of course, it's extremely competitive right now. There are very few programs.

And so I think the request we have, very few of those people are really successful in actually securing what I would call direct government support for their photonics work. I think we can really change this.

DR. ARTHURS: If I could return for a moment to the strategy question, I think Mike pointed out that optoelectronics in the U.S. is spread across all sorts of agencies. NASA does a lot of it. DARPA, NSF, NIH, practically everybody. But there is no one overlooking the entire activity and saying what's good for the economic interests of the U.S.

And when you go around and try and find someone, it's always "not my job." But there is, I think, in many of these places and in the defense labs significant concern about no one doing anything about it.

VICE CHAIRMAN WORTZEL: Where would that strategy be? Is that the National Science Foundation? Is that the Office of the Science Advisor to the President and the White House?

CHAIRMAN BARTHOLOMEW: National Economic--

DR. ARTHURS: I'm from the other Washington so I can't answer that question.

DR. LEBBY: Well, let me give you an example. I don't think I can answer your question clearly, but I just returned from Brussels last

week. I gave a talk on green photonics energy efficiency at the European Commission, and both Gene and myself are very aware that three years ago the Europeans put together a program called Photonics 21, and that brought together the whole of the industry as well as academia to actually put a strategic road map together.

This is three years ago, and I think that there is probably 90 to 100 million euro funding, and I met some of the senior people of that organization last week, and they're very focused. They brought together photonics from many different disciplines and different areas, and they actually have raised the profile of the industry.

VICE CHAIRMAN WORTZEL: So the legislature essentially established the strategy and funded it?

DR. LEBBY: Yes, correct.

HEARING COCHAIR MULLOY: No. Did you say that? Or you said the Commission; didn't you?

DR. LEBBY: This is under the European Commission, yes.

HEARING COCHAIR MULLOY: That's more like their executive.

DR. APPELBAUM: I wonder if the National Nanotechnology Initiative might be an example of the kind of coordination. You're all familiar with how that operates? Should I say a word about that? I don't want to--

CHAIRMAN BARTHOLOMEW: Go ahead.

DR. APPELBAUM: The National Nanotechnology Initiative (NNI), Headed by Mike Roco, was established in fiscal year 2001. It currently spans federal government agencies, 13 of which have budgets relating to nanotechnology. Coordination, planning, budgeting, review and so forth are the responsibility of the Nanoscale Science Engineering and Technology (NSET) subcommittee of the President's cabinet-level National Science and Technology Council (NSTC). NSET, in turn, is supported by the National Nanotechnology Coordination Office (NNC), which – like the NNI – was created in j2001. All of this represents an effort to provide some degree of coordinated federal support for nanotechnology – support which, as I mentioned earlier, has grown to \$1.5 billion annually. Whether this rises to the level of industrial policy is debatable, since almost all of the NNI's efforts are directed at basic research rather than commercialization. But it is an example of how focused governmental resources can be focused on a particular technology, one aim of which is to make the U.S. a global leader in this emerging technology. I don't know if this would work in other areas (such as optoelectronics), but at least it gives some public face and accountability to government support for innovation.

DR. ARTHURS: I think Mike Roco has done a great job with the National Nanotechnology Initiative. However, it is not driven by economics, and that's the missing piece. I think if we were talking here about a program to coordinate scientific effort or technical effort across optoelectronics, the NSF would be a good home, but it's not what I'm talking about.

DR. LEBBY: When we look at NSF, they're very biased toward the academic support. And one of the missing areas is what I would call industrial research or industrial development, or applied research. In fact, one anecdote would be about me and how I cut my teeth at Bell Labs back in the late '80s, and doing corporate research. And if I wanted to go back into corporate research today in this country, I'm not sure there's any place I could go.

All the facilities that Lucent had, which was originally AT&T, and there was IBM and Motorola and H-P, they've diversified their optoelectronic facilities to smaller companies and really the corporate research that was done in those areas is gone. And so if we could sort of encourage agencies like the NSF or even DARPA to really focus on supporting the commercial R&D as opposed to pure academic research. I think we would see next generation products and innovation really come back in this field.

DR. APPELBAUM: One vehicle for that would be these existing small business programs that are pretty small, less than \$100 million total, but they could be a vehicle to expand commercial support. But I think you would have to change the culture, not just in the NSF, but generally in the U.S. government, which seems to be generally opposed to funding anything at the commercial end.

CHAIRMAN BARTHOLOMEW: Not so much these days. That's changing these days.

DR. APPELBAUM: That's another story. Let's hope so.

DR. ARTHURS: The SBIR program, which is about 2.5 billion overall, I think has the central idea, is wonderful. However, it has gotten somewhat overtaken by SBIR foundries rather than companies creating jobs, to my mind, and that does need attention.

HEARING COCHAIR MULLOY: Commissioner Bartholomew.

CHAIRMAN BARTHOLOMEW: Thank you.

COMMISSIONER VIDENIEKS: I want to get one in, too.

HEARING COCHAIR MULLOY: And then you'll come in, Pete.

CHAIRMAN BARTHOLOMEW: Gentlemen, thank you.

This is very interesting and also very troubling. I look at you and I think essentially the product, the research, the technology sectors that you are representing here are probably two-thirds of what we see in sunrise industries.

You are here and you are representing what is supposed to be the economic future for this country, and as I hear, we had thought about putting this together in part because we wanted to focus some on sunrise industries and what are the challenges that they're going to be facing from China so that five years from now, ten years from now, you don't sit in front of a body like this and say, well, we had this opportunity and we missed it, and look what's happened.

So I think your contributions are really important. I'm troubled because it sounds like we are missing the boat already on a lot of things.

Dr. Arthurs, I think that your comment about needing some focus that's driven by economics is particularly important. Dr. Appelbaum, I have found that as we have heard from scientists, their focus on the fact that science has no boundaries is important for knowledge acquisition, but especially when we ask the U.S. taxpayer to be paying for some of this, we need to make sure, and for our own economic future, that we accrue some of the benefits from the investments that are being made on the research.

That aside, I'd like to go back to this issue of the connection between R&D and manufacturing. Because you all have spoken of the need for government support, for R&D, but do you also see a need for U.S. government financial support for manufacturing?

DR. LEBBY: I think one of the things I personally would like to address, and I think it comes from some of our members, is that they're taking manufacturing to Asia because there's really no other choice. If they had a choice to do something here, they would gladly do it.

And so one of the areas I focused on in my testimony is giving you a couple of examples. One is the photonic integrated circuits, where we are doing the manufacturing in the front end and we could actually do a lot more.

The second one is the roll-to-roll manufacturing. If you can just imagine for a second when you make an LCD display, like in a television or in a computer monitor, Asia really owns the whole manufacturing process of that glass and how you deal with the glass panel and how you put the liquid crystal into it and you seal it up.

If we look forward five or ten years, some of the displays are going to be organic, organic LED's. You may have seen the new television by Sony. It's just 11 inches. It costs \$2,500, but if you look at the screen, it's just beautiful, a million-to-one contrast ratio. And this technology, this organic LED technology, can be used for lighting.

So you can imagine those white panels. Ten years time, you're just going to roll the stuff on like wallpaper. You can put it on your

windows. I saw a demonstration in Brussels last week. You turn it on and it turns white with light, and you turn it off and it's clear.

So here's the technology that's going to change the way we look at displays in five to ten years time. If we do this on newspaper reel roll-to-roll manufacturing, which is what the Europeans are doing some research already, we don't have to manufacture that in Asia. We can manufacture that here.

So I think the message is if we're creative about what we think we're going to do, and how we see the technology going in the next decade, we can actually think about investing in technologies that don't need to be manufactured in Asia.

If you've got a high volume traditional line, you may want to take it over there because that's the right thing to do, and they have the infrastructure set up. But for things like roll-to-roll, the infrastructure is not set up. We can quite easily do that here.

So let's think outside of the box here. So it's not just R&D. It's R&D plus really creative manufacturing techniques.

CHAIRMAN BARTHOLOMEW: Dr. Arthurs.

DR. ARTHURS: I think certainly continued investment in science; I have no question about that. That's vital. But unless we start to do things like pilot plants, (companies aren't necessarily going to do them) I think that's got to be intervention again by the government to set up pilot plants, say, for something like this OLED production on roll-to-roll, and work around that, support for that.

Kodak, one of the pioneers of this technology, and they were pioneers of much else in this country, but now they don't make a camera. It's made by Flextronics in Asia. But I don't see Kodak really putting any effort--maybe they're not incentivized to develop OLED technology plants in the United States.

CHAIRMAN BARTHOLOMEW: Dr. Appelbaum.

DR. APPELBAUM: Well, I don't have a specific proposal, but I completely agree. China, Taiwan, South Korea, all these Asian economies, came out of nowhere to be competitive because of industrial policy because their governments in various ways were willing to invest more directly at the manufacturing end.

I think that we need to do the same if we're going to compete with them. You mentioned solar energy; Suntech, a Chinese firm, is the fourth largest manufacturer.

DR. ARTHURS: Third now.

DR. APPELBAUM: Now it's the third largest. They've opened offices in San Francisco. Their story is their founder and CEO, Dr. Shi Zhengrong, was educated at the University of New South Wales in Australia, returned to China, launched Suntech, and now he's a very

rich man. They're incorporated, I am told, in the Cayman Islands. So they are truly a cosmopolitan company, and they've hired as Director of External Relations for their California office a woman who was previously a Senior Regulatory Analyst for the California Public Utilities Commission, whose job was to implement the PUC's portion of California's multibillion dollar solar initiative. So Suntech knows what it needs to do to compete.

CHAIRMAN BARTHOLOMEW: They're going to be manufacturing in the United States? No?

DR. APPELBAUM: No.

DR. ARTHURS: Not at this stage.

DR. APPELBAUM: Right. Not at this stage. Also, interestingly, as near as I can tell, they're not moving to third generation thin-film solar, employs nanotechnology. They have their own technology.

CHAIRMAN BARTHOLOMEW: Mr. Chairman, just one comment. What I also think that we forget when we talk about focusing on the high end of the value chain here, is that we like everywhere else have a mixed population. Not everybody in this country is going to be able to be engineers, scientists, mathematicians, and we need to make sure that we have a diverse economy that reaches everybody, and I think that's some of what we're seeing right now.

DR. APPELBAUM: Right. But if the Georgia textile industry were to upgrade sufficiently and produce competitive products using nanotechnology as appropriate to textiles and fabrics, and if the workers there were trained to use that technology, you could have it at both ends, I think.

So that's why I think it has to involve job training, skills upgrading.

HEARING COCHAIR MULLOY: Thank you.

I'm going to call on now Commissioner Videnieks.

COMMISSIONER VIDENIEKS: I think Dr. Leiby alluded that the process doesn't go from basic research to manufacturing. You've got applied research; you've got development; you've got design; you've got prototype fabrication. Then, if things work out, one goes to manufacturing.

Maybe if the requests to the government agencies were for other than basic research if one were to structure these requests more functionally, and maybe lead to a prototype or development of an improvement to a process, if people could see things better, maybe the request would sell better than basic research. A contract for development-specific methods is a different matter. Basically I want to make that comment, that maybe that's where we're falling short with it. It could be the problem. I don't know.

DR. LEBBY: I can give you an example. I've worked with DARPA programs, and yes, that's defense related, but that's a project-based agency, and it is looked upon by Asia as well as Europe as a sort of the gold standard of actually doing applied research and really setting go/no go and specific goals for prototypes and brand new technology.

And I think if you look back at DARPA over the last 50 years, there's been a really good track record.

In fact, personally, I'm quite excited to hear and talk about ARPA-E, which is the Energy ARPA, and hopefully that will be a project related agency that looks at energy efficiency which I guess goes in line with the current administration.

But what we would like to see as OIDA is these types of projects with clear prototype type goals that would really sort of focus things in photonics.

COMMISSIONER VIDENIEKS: Something visible.

DR. LEBBY: Yes.

COMMISSIONER VIDENIEKS: Basic research in my mind, not being technically educated, it seems like something hard to sell maybe in times of hard money, difficult money.

DR. ARTHURS: I agree there should be much more backing for that type of approach. Basic research is adding to the store of knowledge and then moving on. And I am a big supporter of it. It's necessary, but it's not sufficient.

I think also we should explore the concept of science parks much more aggressively. We have some lessons, I think, to learn from--

COMMISSIONER VIDENIEKS: Quick question. Should they be called something else than R&D parks?

DR. ARTHURS: Oh, yes, I think so. I think so.

COMMISSIONER VIDENIEKS: Because everything is there.

DR. ARTHURS: As I look at both Taiwan and China, they have Ministries of Science and Technology that look after science parks among other things.

COMMISSIONER VIDENIEKS: Yes.

DR. ARTHURS: In Taiwan, for example, the Ministry has, it's not just like our NSF, though they do control science, they are looking at their metrics; how much income did the science park in Hsinchu get this year and how is it going to be 15 percent more next year? And Hsinchu Science Park, that one science park in Taiwan, exports more high tech stuff than the whole of California.

CHAIRMAN BARTHOLOMEW: Gee. Think about that. California, the place that led the nation in innovation for a new economy.

HEARING COCHAIR MULLOY: It's depressing.

CHAIRMAN BARTHOLOMEW: It's very depressing.

DR. APPELBAUM: Was that deliberately past tense?

CHAIRMAN BARTHOLOMEW: Well, that's what I think we--

DR. ARTHURS: Numbers say it is.

HEARING COCHAIR MULLOY: Yes, we're paying a price.

COMMISSIONER VIDENIEKS: Thank you. I'm finished.

HEARING COCHAIR MULLOY: Okay. I have a question or two. Dr. Arthurs, when you were talking about R&D, and you said the new money we're putting into R&D, we may be basing that on a concept of how to move a society forward that is no longer relevant.

Could you expand on that point for us? DR. ARTHURS: I hear the economic argument that R&D is basic to the economy and our economic success, and there is no doubt that in history there are examples, there are very strong correlations between our investment in R&D and our economic prowess, our technology leadership, and our national security leadership.

That, however, was in days when the world was an entirely different place and the U.S. was a relatively closed system in the scientific sense. We no longer have the Bell Labs that Mike talked about. We no longer have these, the RCA Labs, the Hewlett-Packard Labs that were really turning out innovative products.

If we don't have those, and I think recent evidence shows, and the significant deficit in advanced technology products shows, even though we've been spending \$360 billion or even though \$360 billion is being spent in the country each year, 130, whatever it is, from federal sources, on R&D, it would indicate to me that that model is no longer working.

HEARING COCHAIR MULLOY: Let me take you the next step. It used to be that the R&D was done in private companies, Bell Labs and other things. Most of it now is done in the universities, from what I understand.

DR. ARTHURS: I'd say most of the R is done in universities.

A good portion of the D is still done in industry here.

HEARING COCHAIR MULLOY: My thought is, and I'll be happy if you take this on, that when you put all this money into the universities, and then you have your science departments all with Chinese who are there, who are going back, we're funding the competition. I think there is some sense of that going on in me.

Let me just couple it with one other thought. I remember reading Tom Friedman's book *The World is Flat*. I don't think he understands what's going on, to be honest with you. And it was like,

oh, wow, wonderful. What I don't understand, there's tremendous public policy driving some of these trends.

I thought Clyde Prestowitz' book Three Billion New Capitalists was a much better assessment of what is going on. But anyway, I think it was on page 164 of the Friedman book, the president of Johns Hopkins University, some parents were saying to him, my son can't understand the classroom teacher, and that's when he realized that all the mathematics departments were Chinese immigrants.

Nothing wrong with that. My own son went to an Ivy League university, was in the mathematics and engineering, and he says I can't understand these guys. I remember when I was a student, professors would pick out the smart kids and nurture them and try to bring them into their field. I don't think that's going on in the sciences and engineering like it used to in this country 30 years ago.

I think the guys who are making the decisions said, well, we'll bring in the kids from China. I don't know whether that's true or not, but it would be interesting to hear what you think.

DR. ARTHURS: I think in many ways we should be grateful we have non-U.S. people teaching in our science and math faculty throughout the nation because otherwise we'd have nobody.

But I do think we need to do something about changing that. We are to a large extent funding indirectly the economic success of Taiwan, Korea, and other nations. They have many people in our universities, and there is great technology leakage, including many of them going back and starting up companies their entrepreneurship back at home where they've got good advantages to be entrepreneurs, I think, now. They're getting the support.

But how we get from here is going to take quite some time, and we're going to have to not just change the funding. That's not the issue here. When my members by and large would not advise their children to go into science and engineering, we have a problem.

HEARING COCHAIR MULLOY: Yes.

CHAIRMAN BARTHOLOMEW: Yes.

DR. ARTHURS: When I was in Taiwan in December, and the economic downturn happened, and engineers were being let go, the government came to the universities and said we will pay you to take these people for one year at least.

This sends a signal that engineering and science is important, that it's a valued profession. These people get trained to the latest degree in university, getting updated on their skills, an entirely different attitude and an entirely different ethos, and that's part of the issue here.

One of my goals is that my members will say to their children

“you've got to go into science and technology, it's exciting, and it's going to offer you a great career.”

HEARING COCHAIR MULLOY: Yes. One last point, and then I'll turn it. Yes, Dr. Appelbaum.

DR. APPELBAUM: China has been described by Demos, a European think tank, as the world's largest technocracy. Just to build on what you said, science and engineering are highly valued there, and they're seen as keys to economic success, and they're valued in terms of prestige.

I think the fact that our colleges and universities are populated by Chinese and Indians is not a problem of China and India; I think it's our problem. Our students aren't doing that. They see other opportunities and that's what has to change.

In October 1957, when Russia launched Sputnik, we changed: we developed a generation of scientists and engineers, and we got into the space race. We saw it as a national competitiveness thing within the context of the Cold War. We have to change the culture.

Our kids aren't going into these disciplines, and it's not the fault of China and India. I think this provides an opportunity for us, but we have to have a cultural change, and I'm not exactly sure about how to do that. My own kids certainly didn't go in that direction.

CHAIRMAN BARTHOLOMEW: It's interesting, this cultural change, because I'm not sure when I went into college that I made any economic rational decisions, but--in terms of what I was studying, but the reality is at the same time that we have new government programs to emphasize STEM teaching and STEM education, we have people who are looking and seeing that there isn't an economic future for themselves in those industries.

And so it becomes very circular, doesn't it?

HEARING COCHAIR MULLOY: Yes.

CHAIRMAN BARTHOLOMEW: What should a young person embark on a career path if they think that there's not going to be any opportunity, and if they see all the R&D, the interesting, exciting things that they want to be working on taking place in another country?

A lot of our young people do think more globally, and so they could see a future where they would spend time in another country, but I think how we create it so that there is a reason for them to believe that there's an economic future is going to be a really important piece of how we convince them to make the investment of their time and their parents' money often in their educations.

HEARING COCHAIR MULLOY: Thank you, Commissioner Bartholomew.

One last point and then I'll turn it to Commissioner Slane. Commissioner Slane talked about the Apple. I want to make sure I understood what that was about. The Apple--say it was \$84 and Apple is getting \$80, and the people there in China who make the thing are getting \$4.

HEARING COCHAIR SLANE: Getting four--yes.

HEARING COCHAIR MULLOY: And you said that's this generation. The next generation could be different because the innovation will be taking place there rather than here. Was that a point you were making?

HEARING COCHAIR SLANE: That's what Dr. Lebbly--

HEARING COCHAIR MULLOY: Is that what you were saying, Dr. Lebbly?

DR. LEBBY: In the optoelectronics industry, yes. If the R&D of optoelectronic devices and systems goes to Asia or goes to China, then the value goes with it.

HEARING COCHAIR MULLOY: And you're saying that's what's happening?

DR. LEBBY: Yes.

HEARING COCHAIR MULLOY: Okay. I thought that.

DR. ARTHURS: I'm not clear about the numbers. The Chinese might be getting--it's actually made by Hon Hai Precision, a \$54 billion company, Taiwan based, that had until the downturn almost half a million employees in China, in mainland China.

The assembly is done in China from components from Japan, I think Korea, possibly Taiwan. I'm not sure. So I'm not sure that the total manufacturing--the total parts cost and so on plus assembly--is only \$4 and Apple is getting \$80. I'm not sure if that's the reality.

But certainly, the Apple iPod and the iPhone, I'd say, are designed in the U.S., assembled in China, and I think it might be Mike's point, how long are they going to be able to say that?

HEARING COCHAIR MULLOY: Yes.

DR. LEBBY: Well, actually I'd add one thing. If you look at the iPhone, I think about 30 percent of the building materials are photonics components. You really don't think about photonics in--but there's LEDs to light up the keypad and there's a display light. There's LEDs behind the LCD display, and if you add all these parts up, there's an image sensor, that's the camera, and that's basically array of silicon photo detectors.

And so if you add up the photonics components in one of these products, there's actually quite a bit. It's sort of surprising. You don't realize, I think one of the messages I'm trying to give is the optoelectronics enables many different products that you really on the

surface you don't think about, but they're actually there working, sort of the plumbing, as it were.

DR. APPELBAUM: I wonder if I could give briefly a lower-tech example of what you're talking about. Athletic shoes. One out of every six branded athletic shoes in the world is made in a Yuyuan factory owned by the Pao Chen Company based in Taiwan.

I visited a factory in Dongguan that employs 110,000 workers; 21,000 in the Nike sector; 12,000 in the Adidas sector; and so forth, for nearly all major brands of athletic shoes. They have factories throughout China as well as in Vietnam.

Now, so far they're a supplier, although a profitable one. How long will it be before they take the knowledge that they've gained making athletic shoes to start marketing to the three billion new consumers that Clyde Prestowitz talks about? And we haven't really talked about the internal market. But a high priority in China now is to begin producing for their own internal market, and that is going to drive their technology very fast.

I wonder if we'll have an opportunity then to market to China?

CHAIRMAN BARTHOLOMEW: Because part of the reason that the companies have taken their production and their R&D over there--

DR. APPELBAUM: To help them get a foot in the door.

CHAIRMAN BARTHOLOMEW: --was the vision of being able to sell. So the whole trade structure that was created that was sold up here to the Congress was about increasing U.S. exports to China. So what is there left to export? That, to me is the question. If you all are not even able to sustain or to grow your innovation into a point that we can export product around the world, we're--

DR. APPELBAUM: But what is an export? If a company designs a product, and then sells it in China, and it's made in China, if it's an American company, is that an American export or is that a Chinese product? Who profits from that?

CHAIRMAN BARTHOLOMEW: Well, I'm concerned about the American workforce as well as--

DR. APPELBAUM: Right.

CHAIRMAN BARTHOLOMEW: --everything else.

So are there economic opportunities that arise for American workers whose well-being we need to be thinking about? But whose generosity has also funded much of the good that has been done in other places in the world? Somebody needs to be keeping an eye on what's happening with them. And I think, Dr. Arthurs, that's some of what you're talking about, the economics of all of this.

DR. ARTHURS: Exactly. My members would probably kill me, but as a taxpayer, I have to ask why are my tax dollars going to R&D

that is not benefiting, turning around and benefiting essentially me the taxpayer? That used to be the model here. It's no longer the model.

HEARING COCHAIR MULLOY: Commissioner Slane.

HEARING COCHAIR SLANE: Real quickly, when you look at optoelectronics, it's moved to China because China incentivized them to come over and subsidize many of their manufacturing components.

My question, and I'm brainstorming with you here, what if the U.S. government or the state government, started to build pilot plants, and started to do the same thing that the Chinese were doing, to keep the next generation of optoelectronics here?

To me the role of the government in economic development is infrastructure, and the federal government has designated areas as federal empowerment zones, depressed areas. Youngstown, Flint, Gary, all over. And what if we built pilot plants in these areas?

DR. LEBBY: I'll give you an example. I mean there's one in the statement. Take high brightness LEDs. We do have a couple of companies here. We have Philips Lumileds in California, and we have Cree in North Carolina that actually make the devices.

But if you look at most of the production lines for these LEDs, it's not like silicon. Silicon is eight inch or even 300 millimeter, 12 inch wafers. And LEDs are two inch wafers. And some companies are moving to three. And so let's say you wanted to set something up in the U.S. You say, let's really do the job properly, do it on six or eight-inch wafers. Let's really make the wafers big. Instead of getting 10,000 LEDs on a wafer, let's make it 100,000. Let's really work the yield issues and bring the cost down, because one wafer going through with a good yield brings the cost down.

So then you can make an argument, it's not really a labor issue anymore. So if you're creative about how you do the manufacturing, I think you can win.

This is my message: don't just bring back what's over there because they have two inch fabs that are fully depreciated capital equipment. That's not going to work. What we have to bring back, if you want to bring something back, is to do the next step, take it to the next level.

DR. ARTHURS: I think besides the volume, as I said, there's a large number of companies who do low volume here in optoelectronics including the defense sector. And I think we should look at how we're going to keep that here. That is something else we should be looking at in addition to the very high volume consumer products.

HEARING COCHAIR SLANE: From a national security point of view?

DR. ARTHURS: Not just from a national security point of view, from a jobs point of view.

HEARING COCHAIR SLANE: Great.

HEARING COCHAIR MULLOY: Does anybody have anything else they want to add? I think it's the Book of Proverbs, the quote, "Without a vision, the people will perish." I don't think we have a vision that we're offering our people of what is happening to us, what a globalized economy means, and what we have to do.

And so your help today in getting this down on the record, which we put up on the Web site, and in our report to the Congress later on, so that others able to read and understand the concepts that we've discussed today.

So I can't thank you all enough for coming and spending your time with us today.

CHAIRMAN BARTHOLOMEW: Gentlemen, thank you.

HEARING COCHAIR SLANE: You have been great. Thank you very much.

DR. APPELBAUM: Thank you very much.

HEARING COCHAIR MULLOY: Thank you.

[Whereupon, at 5:15 p.m., the hearing was adjourned.]

ADDITIONAL MATERIAL SUPPLIED FOR THE RECORD

Stewart Testimony Appendix I: China's Trade by Type of Enterprise

[Stewart Supplemental: Annual Capital Expenditures](#)

[Stewart Supplemental: RD Data for Manufacturing](#)

[Stewart Supplemental: QFR Capital Expenditures Data](#)

China's Trade by Type of Enterprise

| <i>Millions of US\$</i> | 2006 | 2007 | 2008 |
|--|----------------------|------------------|------------------|
| | Trade Balance | | |
| State-owned enterprise | -33,898 | -44,301 | -96,274 |
| Sino-foreign contractual joint venture | 7,782 | 9,237 | 9,518 |
| Sino-foreign equity joint venture | 28,107 | 43,950 | 45,084 |
| Foreign-invested enterprise | 55,345 | 81,783 | 115,999 |
| Collective enterprise | 21,148 | 23,700 | 25,971 |
| Private enterprise | 97,940 | 147,238 | 199,223 |
| Private firm | 1,827 | 1,815 | 1,686 |
| Other, including foreign embassy, foreign company's office in China, etc. | -722 | -1,529 | -3,807 |
| TOTAL | 177,530 | 261,894 | 297,401 |
| | Exports | | |
| State-owned enterprise | 191,382 | 225,376 | 257,229 |
| Sino-foreign contractual joint venture | 17,714 | 18,116 | 18,349 |
| Sino-foreign equity joint venture | 163,801 | 198,972 | 227,006 |
| Foreign-invested enterprise | 382,497 | 478,834 | 545,477 |
| Collective enterprise | 41,098 | 46,920 | 54,679 |
| Private enterprise | 170,764 | 247,551 | 323,985 |
| Private firm | 1,878 | 1,913 | 1,860 |
| Other, including foreign embassy, foreign company's office in China, etc. | 190 | 473 | 284 |
| TOTAL | 969,324 | 1,218,155 | 1,428,869 |
| | Imports | | |
| State-owned enterprise | 225,281 | 269,677 | 353,503 |
| Sino-foreign contractual joint venture | 9,932 | 8,879 | 8,831 |
| Sino-foreign equity joint venture | 135,693 | 155,021 | 181,922 |
| Foreign-invested enterprise | 327,152 | 397,051 | 429,478 |
| Collective enterprise | 19,949 | 23,220 | 28,709 |
| Private enterprise | 72,824 | 100,313 | 124,762 |
| Private firm | 51 | 98 | 174 |
| Other, including foreign embassy, foreign company's office in China, etc. | 912 | 2,002 | 4,091 |
| TOTAL | 791,794 | 956,261 | 1,131,469 |

Source: China Customs

China's Trade with the World in Selected Commodities
By Type of Enterprise

Autos

| | | EXPORTS in US\$ | | |
|---|---|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 2,142,825,551 | 3,281,684,654 | 3,445,293,828 |
| 2 | Sino-foreign contractual joint venture | 161,084,137 | 140,336,254 | 98,415,677 |
| 3 | Sino-foreign equity joint venture | 2,438,064,500 | 3,584,454,758 | 4,154,361,609 |
| 4 | Foreign-invested enterprise | 2,826,164,208 | 3,801,957,888 | 4,596,214,298 |
| 5 | Collective enterprise | 413,489,240 | 499,443,666 | 533,958,483 |
| 6 | Private enterprise | 2,468,874,705 | 3,851,365,751 | 5,159,475,586 |
| 7 | Private firm | 5,290,293 | 9,115,720 | 16,070,205 |
| 9 | Other, including foreign embassy, foreign company's office in China, etc. | 18,798,023 | 50,381,653 | 5,836,602 |
| | SOE Share | 20.5% | 21.6% | 19.1% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|---------------|----------------|
| | | 2006 | 2007 | 2008 |
| | | 2,859,398,357 | 3,033,505,524 | 4,093,104,015 |
| | | 11,750,854 | 9,102,131 | 9,865,292 |
| | | 6,664,867,124 | 7,896,778,669 | 7,670,079,444 |
| | | 4,321,049,438 | 7,692,935,710 | 10,888,226,363 |
| | | 238,990,840 | 144,156,363 | 151,721,807 |
| | | 1,719,634,354 | 1,590,561,628 | 2,166,318,558 |
| | | 66,353 | 109,482 | 109,110 |
| | | 166,974,424 | 126,474,613 | 190,689,903 |
| | | 17.9% | 14.8% | 16.3% |

Chemicals

| | | EXPORTS in US\$ | | |
|---|---|-----------------|----------------|----------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 12,617,834,976 | 15,575,213,697 | 18,785,464,751 |
| 2 | Sino-foreign contractual joint venture | 489,581,539 | 605,791,737 | 830,480,637 |
| 3 | Sino-foreign equity joint venture | 6,084,730,683 | 7,668,352,615 | 10,480,273,480 |
| 4 | Foreign-invested enterprise | 5,647,150,617 | 8,454,094,757 | 11,891,525,556 |
| 5 | Collective enterprise | 2,942,004,393 | 4,097,430,797 | 4,969,817,645 |
| 6 | Private enterprise | 9,931,128,529 | 14,669,139,816 | 21,861,701,564 |
| 7 | Private firm | 27,053,418 | 52,419,819 | 62,901,029 |
| 9 | Other, including foreign embassy, foreign company's office in China, etc. | 19,255,301 | 11,795,409 | 23,555,474 |
| | SOE Share | 33.4% | 30.5% | 27.3% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|----------------|----------------|
| | | 2006 | 2007 | 2008 |
| | | 14,005,282,574 | 14,766,126,374 | 14,386,585,096 |
| | | 626,616,191 | 761,360,741 | 892,845,209 |
| | | 12,986,061,713 | 15,822,988,445 | 17,881,982,001 |
| | | 14,549,504,399 | 19,972,156,856 | 25,544,243,369 |
| | | 4,032,730,944 | 3,746,773,893 | 3,123,870,193 |
| | | 9,963,066,184 | 13,385,294,703 | 15,042,965,338 |
| | | 7,585,221 | 4,153,390 | 15,996,194 |
| | | 48,182,814 | 48,281,094 | 72,093,859 |
| | | 24.9% | 21.6% | 18.7% |

China's Trade with the World in Selected Commodities
By Type of Enterprise

Civil Aviation

| | | EXPORTS in US\$ | | |
|---|---|-----------------|-------------|-------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 349,579,504 | 430,947,878 | 781,739,960 |
| 2 | Sino-foreign contractual joint venture | 60,297 | 18,706 | 15,894 |
| 3 | Sino-foreign equity joint venture | 735,632,605 | 865,004,877 | 735,374,680 |
| 4 | Foreign-invested enterprise | 43,184,201 | 75,649,540 | 98,918,490 |
| 5 | Collective enterprise | 151,794,556 | 1,000,251 | 1,050,329 |
| 6 | Private enterprise | 2,180,114 | 4,835,863 | 13,077,163 |
| 7 | Private firm | 5,590 | 11,400 | . |
| 9 | Other, including foreign embassy, foreign company's office in China, etc. | 10,000 | 6,981,811 | 4,362,754 |
| | SOE Share | 27.3% | 31.1% | 47.8% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| | | 8,739,336,280 | 6,930,087,984 | 7,017,497,177 |
| | | 142,621 | 45,802 | 3,674 |
| | | 1,399,312,725 | 2,512,144,653 | 2,267,391,501 |
| | | 16,885,562 | 25,322,049 | 25,801,672 |
| | | 150,063,304 | 101,793,157 | 229,979,829 |
| | | 476,489,485 | 800,211,124 | 447,225,642 |
| | | | | |
| | | 106,228,799 | 3,811,790 | 5,515,531 |
| | | 80.3% | 66.8% | 70.2% |

Communications Equipment

| | | EXPORTS in US\$ | | |
|---|---|-----------------|----------------|----------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 4,780,618,458 | 7,931,816,533 | 9,437,937,885 |
| 2 | Sino-foreign contractual joint venture | 374,401,622 | 472,684,930 | 543,759,433 |
| 3 | Sino-foreign equity joint venture | 27,892,202,694 | 33,756,777,778 | 36,402,417,078 |
| 4 | Foreign-invested enterprise | 44,286,314,799 | 50,795,519,076 | 56,364,179,713 |
| 5 | Collective enterprise | 3,270,556,645 | 4,896,213,905 | 6,527,495,817 |
| 6 | Private enterprise | 2,316,164,052 | 4,157,853,193 | 5,633,431,367 |
| 7 | Private firm | 19,657,212 | 15,509,591 | 13,153,468 |
| 9 | Other, including foreign embassy, foreign company's office in China, etc. | 146,995 | 1,920,229 | 1,741,926 |
| | SOE Share | 5.8% | 7.8% | 8.2% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|----------------|----------------|
| | | 2006 | 2007 | 2008 |
| | | 3,512,922,891 | 4,217,003,908 | 3,633,826,554 |
| | | 211,716,018 | 211,568,783 | 130,670,047 |
| | | 9,637,091,444 | 9,385,408,378 | 9,068,703,729 |
| | | 15,630,941,888 | 15,157,119,740 | 16,252,704,388 |
| | | 203,629,120 | 343,531,340 | 485,602,327 |
| | | 901,877,259 | 1,307,263,595 | 1,724,410,997 |
| | | 49,856 | 1,840,611 | 1,810,143 |
| | | | | |
| | | 11,937,847 | 21,837,223 | 34,624,643 |
| | | 11.7% | 13.8% | 11.6% |

China's Trade with the World in Selected Commodities
By Type of Enterprise

Consumer Electronics

| | | EXPORTS in US\$ | | |
|---|---|-----------------|----------------|----------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 4,594,992,042 | 8,361,066,673 | 7,353,603,070 |
| 2 | Sino-foreign contractual joint venture | 608,907,102 | 581,108,579 | 600,105,522 |
| 3 | Sino-foreign equity joint venture | 9,699,875,861 | 12,025,805,816 | 11,595,900,799 |
| 4 | Foreign-invested enterprise | 21,953,274,685 | 36,291,891,747 | 38,198,121,626 |
| 5 | Collective enterprise | 680,843,170 | 754,860,034 | 821,840,775 |
| 6 | Private enterprise | 3,716,938,548 | 4,563,900,806 | 5,251,095,751 |
| 7 | Private firm | 68,363,093 | 68,842,506 | 23,085,843 |
| 9 | Other, including foreign embassy, foreign company's office in China, etc. | 154,309 | 439,298 | 664,122 |
| | SOE Share | 11.1% | 13.3% | 11.5% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| | | 974,488,620 | 807,942,495 | 599,950,511 |
| | | 88,627,375 | 59,229,622 | 42,828,648 |
| | | 1,619,622,359 | 1,284,251,922 | 1,302,100,706 |
| | | 3,642,964,337 | 3,937,156,210 | 4,450,136,080 |
| | | 59,351,486 | 26,468,997 | 31,226,501 |
| | | 499,558,882 | 447,093,318 | 612,385,160 |
| | | 193,247 | 218,207 | 118,439 |
| | | 2,641,462 | 760,347 | 1,706,964 |
| | | 14.1% | 12.3% | 8.5% |

Electronic Components

| | | EXPORTS in US\$ | | |
|---|---|-----------------|----------------|----------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 2,622,146,846 | 3,208,209,396 | 3,596,193,441 |
| 2 | Sino-foreign contractual joint venture | 964,241,001 | 1,059,499,561 | 1,048,304,704 |
| 3 | Sino-foreign equity joint venture | 4,076,577,745 | 4,361,208,852 | 5,179,998,573 |
| 4 | Foreign-invested enterprise | 17,723,682,232 | 22,685,554,582 | 24,882,031,398 |
| 5 | Collective enterprise | 485,116,781 | 568,412,104 | 687,380,166 |
| 6 | Private enterprise | 2,158,404,656 | 2,960,985,253 | 3,890,224,898 |
| 7 | Private firm | 18,407,769 | 17,219,007 | 10,681,515 |
| 9 | Other, including foreign embassy, foreign company's office in China, etc. | 141,397 | 427,890 | 634,685 |
| | SOE Share | 9.3% | 9.2% | 9.2% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|----------------|----------------|
| | | 2006 | 2007 | 2008 |
| | | 3,032,949,426 | 3,801,652,105 | 3,689,476,641 |
| | | 546,026,903 | 306,406,098 | 297,479,376 |
| | | 4,990,822,071 | 5,536,161,460 | 5,969,505,472 |
| | | 20,585,004,263 | 24,965,526,638 | 25,845,134,722 |
| | | 580,046,706 | 667,497,945 | 625,194,716 |
| | | 2,034,111,766 | 2,677,034,524 | 2,756,942,615 |
| | | 5,456,596 | 1,610,577 | 963,028 |
| | | 45,566,094 | 24,339,000 | 3,635,013 |
| | | 9.5% | 10.0% | 9.4% |

China's Trade with the World in Selected Commodities
By Type of Enterprise

Equipment Manufacturing

| | | EXPORTS in US\$ | | |
|---|---|-----------------|-----------------|-----------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 20,299,298,578 | 22,316,806,403 | 28,921,186,421 |
| 2 | Sino-foreign contractual joint venture | 3,960,914,850 | 3,673,779,770 | 4,018,143,821 |
| 3 | Sino-foreign equity joint venture | 21,655,287,962 | 27,160,466,245 | 31,975,720,904 |
| 4 | Foreign-invested enterprise | 122,869,923,276 | 148,983,445,554 | 167,110,511,331 |
| 5 | Collective enterprise | 4,256,946,819 | 4,939,808,729 | 5,488,526,442 |
| 6 | Private enterprise | 13,548,854,559 | 21,497,986,809 | 31,098,817,862 |
| 7 | Private firm | 60,733,737 | 77,969,011 | 107,002,675 |
| 9 | Other, including foreign embassy, foreign company's office in China, etc. | 4,260,980 | 13,548,980 | 20,121,335 |
| | SOE Share | 10.9% | 9.8% | 10.8% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|----------------|----------------|
| | | 2006 | 2007 | 2008 |
| | | 23,621,246,707 | 25,452,398,396 | 27,636,861,913 |
| | | 1,090,116,156 | 700,346,671 | 733,490,517 |
| | | 19,897,202,793 | 21,628,540,705 | 27,172,304,784 |
| | | 54,147,167,913 | 63,011,653,576 | 66,308,169,216 |
| | | 1,690,170,566 | 1,590,029,477 | 1,728,381,015 |
| | | 8,921,120,789 | 11,959,363,970 | 14,986,725,562 |
| | | 5,351,589 | 10,275,814 | 9,579,743 |
| | | 94,117,521 | 87,738,360 | 131,899,203 |
| | | 21.6% | 20.5% | 19.9% |

Industrial Electronics

| | | EXPORTS in US\$ | | |
|---|---|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 966,842,594 | 1,299,995,536 | 1,706,371,677 |
| 2 | Sino-foreign contractual joint venture | 134,552,057 | 197,895,383 | 219,771,840 |
| 3 | Sino-foreign equity joint venture | 842,463,431 | 1,081,359,370 | 1,370,934,665 |
| 4 | Foreign-invested enterprise | 4,339,427,346 | 6,971,874,271 | 8,505,343,527 |
| 5 | Collective enterprise | 134,080,874 | 149,369,033 | 160,169,401 |
| 6 | Private enterprise | 643,808,973 | 1,015,408,262 | 1,553,875,689 |
| 7 | Private firm | 8,417,519 | 8,041,666 | 5,980,110 |
| 9 | Other, including foreign embassy, foreign company's office in China, etc. | 1,390,315 | 2,645,152 | 7,457,977 |
| | SOE Share | 13.7% | 12.1% | 12.6% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| | | 3,305,261,275 | 3,872,297,248 | 4,853,429,103 |
| | | 159,618,740 | 159,034,728 | 138,029,617 |
| | | 2,491,620,747 | 2,569,866,007 | 3,412,348,655 |
| | | 5,803,382,808 | 6,303,395,325 | 6,644,556,974 |
| | | 175,981,148 | 213,336,119 | 220,030,957 |
| | | 1,298,617,858 | 1,772,996,695 | 2,516,401,395 |
| | | 269,700 | 1,180,596 | 883,237 |
| | | 10,742,901 | 5,025,504 | 17,395,987 |
| | | 25.0% | 26.0% | 27.3% |

China's Trade with the World in Selected Commodities
By Type of Enterprise

Iron and Steel

| | EXPORTS in US\$ | | |
|---|-----------------|----------------|----------------|
| | 2006 | 2007 | 2008 |
| 1 State-owned enterprise | 22,960,447,693 | 32,365,328,485 | 41,102,789,927 |
| 2 Sino-foreign contractual joint venture | 410,666,347 | 490,727,561 | 517,202,030 |
| 3 Sino-foreign equity joint venture | 7,813,806,295 | 10,390,483,959 | 13,436,138,906 |
| 4 Foreign-invested enterprise | 6,499,309,350 | 9,591,256,673 | 12,381,891,497 |
| 5 Collective enterprise | 2,560,670,443 | 3,381,698,734 | 5,719,674,703 |
| 6 Private enterprise | 11,574,635,714 | 20,103,893,708 | 28,378,345,016 |
| 7 Private firm | 56,400,896 | 155,693,729 | 236,348,345 |
| 9 Other, including foreign embassy, foreign company's office in China, etc. | 75,827,061 | 189,598,248 | 65,687,210 |
| SOE Share | 44.2% | 42.2% | 40.4% |

| | IMPORTS in US\$ | | |
|--|-----------------|----------------|----------------|
| | 2006 | 2007 | 2008 |
| | 8,310,245,005 | 9,084,018,632 | 10,310,087,697 |
| | 477,937,859 | 515,003,916 | 507,496,925 |
| | 6,541,804,501 | 6,536,501,385 | 6,854,948,158 |
| | 9,247,715,158 | 11,635,362,999 | 13,491,892,282 |
| | 320,880,358 | 322,751,824 | 380,996,820 |
| | 2,012,929,264 | 2,726,705,052 | 3,459,601,218 |
| | 808,218 | 1,366,874 | 8,470,765 |
| | 83,368,202 | 227,259,409 | 62,811,748 |
| | 30.8% | 29.3% | 29.4% |

Non-ferrous Metals

| | EXPORTS in US\$ | | |
|---|-----------------|----------------|----------------|
| | 2006 | 2007 | 2008 |
| 1 State-owned enterprise | 10,620,056,580 | 9,786,867,385 | 8,435,468,906 |
| 2 Sino-foreign contractual joint venture | 1,084,789,275 | 954,423,330 | 927,267,621 |
| 3 Sino-foreign equity joint venture | 5,158,786,768 | 5,732,374,537 | 5,912,278,039 |
| 4 Foreign-invested enterprise | 6,445,339,282 | 8,387,337,874 | 8,982,268,184 |
| 5 Collective enterprise | 2,311,313,478 | 2,560,478,136 | 2,466,383,306 |
| 6 Private enterprise | 7,706,768,456 | 11,389,763,211 | 15,138,254,379 |
| 7 Private firm | 58,676,076 | 91,888,507 | 107,119,230 |
| 9 Other, including foreign embassy, foreign company's office in China, etc. | 11,624,662 | 13,274,065 | 675,003 |
| SOE Share | 31.8% | 25.1% | 20.1% |

| | IMPORTS in US\$ | | |
|--|-----------------|----------------|----------------|
| | 2006 | 2007 | 2008 |
| | 8,965,729,260 | 14,055,861,465 | 11,955,940,381 |
| | 767,959,301 | 605,808,995 | 727,474,572 |
| | 5,870,259,240 | 7,649,445,108 | 7,112,786,087 |
| | 12,142,885,477 | 15,679,467,620 | 15,604,800,276 |
| | 1,051,618,969 | 1,332,812,781 | 1,138,855,086 |
| | 3,950,190,782 | 7,109,493,871 | 7,623,052,219 |
| | 1,901,775 | 38,760,130 | 84,781,840 |
| | 54,930,934 | 125,586,945 | 307,440,984 |
| | 27.3% | 30.2% | 26.8% |

China's Trade with the World in Selected Commodities
By Type of Enterprise

Petrochemicals

| | | EXPORTS in US\$ | | |
|---|---|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 2,027,978,224 | 2,718,039,619 | 4,835,396,123 |
| 2 | Sino-foreign contractual joint venture | 220,446,059 | 207,566,973 | 302,450,381 |
| 3 | Sino-foreign equity joint venture | 914,847,949 | 1,143,730,165 | 1,352,625,940 |
| 4 | Foreign-invested enterprise | 58,286,190 | 177,021,898 | 382,715,728 |
| 5 | Collective enterprise | 272,927,859 | 323,267,818 | 606,164,906 |
| 6 | Private enterprise | 814,407,583 | 1,243,167,910 | 2,275,677,291 |
| 7 | Private firm | 33,760 | 107,193 | 688,343 |
| 9 | Other, including foreign embassy, foreign | 72,432 | 41,944 | . |
| | SOE Share | 47.1% | 46.8% | 49.6% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| | | 2,080,380,030 | 2,129,237,185 | 1,861,628,439 |
| | | 13,701,122 | 9,069,182 | 7,331,311 |
| | | 2,039,141,894 | 2,166,282,522 | 1,848,914,129 |
| | | 488,715,610 | 857,441,385 | 1,211,472,892 |
| | | 94,725,944 | 108,412,384 | 108,199,810 |
| | | 780,420,773 | 960,337,428 | 1,134,422,823 |
| | | 30418 | 7,556 | 6,984 |
| | | 3,826,528 | 1,727,413 | 1 |
| | | 37.8% | 34.2% | 30.2% |

Petroleum

| | | EXPORTS in US\$ | | |
|---|---|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 4,808,094,497 | 6,742,934,305 | 9,597,384,602 |
| 2 | Sino-foreign contractual joint venture | 6,484 | 18,818 | 145 |
| 3 | Sino-foreign equity joint venture | 2,708,888,030 | 3,113,467,043 | 4,977,991,412 |
| 4 | Foreign-invested enterprise | 2,206,629,408 | 866,546,251 | 1,666,764,520 |
| 5 | Collective enterprise | 7,153,853 | 10,096,784 | 22,362,235 |
| 6 | Private enterprise | 68,562,537 | 65,825,246 | 112,481,298 |
| 7 | Private firm | . | 2,488 | 7,800 |
| 9 | Other, including foreign embassy, foreign | 3,155,326 | 4,945,265 | 31,732,486 |
| | SOE Share | 49.0% | 62.4% | 58.5% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|----------------|-----------------|
| | | 2006 | 2007 | 2008 |
| | | 71,843,193,466 | 84,449,962,027 | 141,598,557,627 |
| | | 470,780,346 | 515,410,950 | 820,187,442 |
| | | 5,674,045,464 | 6,349,686,112 | 9,922,777,547 |
| | | 575,937,361 | 702,341,893 | 1,142,911,046 |
| | | 1,432,226,643 | 1,728,220,112 | 2,454,910,923 |
| | | 1,814,250,829 | 2,167,534,467 | 2,894,431,659 |
| | | 254519 | 2,463 | 14,720 |
| | | 144,770,489 | 107,878,888 | 93,760,348 |
| | | 87.7% | 87.9% | 89.1% |

China's Trade with the World in Selected Commodities
By Type of Enterprise

Photonics

| | EXPORTS in US\$ | | |
|---|-----------------|----------------|----------------|
| | 2006 | 2007 | 2008 |
| 1 State-owned enterprise | 2,158,814,264 | 1,791,235,688 | 1,967,286,244 |
| 2 Sino-foreign contractual joint venture | 266,043,680 | 223,519,320 | 159,421,248 |
| 3 Sino-foreign equity joint venture | 3,578,289,512 | 3,522,958,403 | 3,391,090,869 |
| 4 Foreign-invested enterprise | 16,147,790,315 | 17,727,474,904 | 20,933,305,654 |
| 5 Collective enterprise | 65,458,763 | 87,150,419 | 74,205,568 |
| 6 Private enterprise | 668,928,412 | 826,517,891 | 1,109,510,667 |
| 7 Private firm | 2,042,030 | 2,085,884 | 1,228,297 |
| 9 Other, including foreign embassy, foreign company's office in China, etc. | 174,811 | 44,593 | 720,120 |
| SOE Share | 9.4% | 7.4% | 7.1% |

| | IMPORTS in US\$ | | |
|--|-----------------|----------------|----------------|
| | 2006 | 2007 | 2008 |
| | 4,390,612,993 | 5,396,493,189 | 4,933,105,769 |
| | 179,134,333 | 125,500,231 | 124,687,689 |
| | 7,468,569,689 | 7,840,922,597 | 7,856,675,047 |
| | 30,320,356,959 | 36,714,039,928 | 41,104,999,292 |
| | 112,962,327 | 211,219,868 | 237,041,999 |
| | 1,232,907,195 | 1,842,673,976 | 2,463,992,383 |
| | . | 1,909,524 | 626,970 |
| | 515,947 | 1,553,806 | 40,010,326 |
| | 10.0% | 10.4% | 8.7% |

Semiconductors

| | EXPORTS in US\$ | | |
|---|-----------------|----------------|----------------|
| | 2006 | 2007 | 2008 |
| 1 State-owned enterprise | 1,523,099,941 | 1,686,329,192 | 2,209,484,742 |
| 2 Sino-foreign contractual joint venture | 553,323,450 | 945,517,497 | 781,544,081 |
| 3 Sino-foreign equity joint venture | 3,876,766,904 | 4,187,808,005 | 6,792,901,031 |
| 4 Foreign-invested enterprise | 20,868,372,004 | 25,815,183,639 | 29,103,300,404 |
| 5 Collective enterprise | 86,847,493 | 79,133,502 | 208,733,981 |
| 6 Private enterprise | 790,856,740 | 1,225,261,944 | 2,707,713,859 |
| 7 Private firm | 2,502,016 | 1,250,725 | 3,159,156 |
| 9 Other, including foreign embassy, foreign company's office in China, etc. | 68,085 | 97,735 | 480,375 |
| SOE Share | 5.5% | 5.0% | 5.3% |

| | IMPORTS in US\$ | | |
|--|-----------------|-----------------|-----------------|
| | 2006 | 2007 | 2008 |
| | 9,148,103,015 | 11,603,744,903 | 10,152,817,063 |
| | 1,877,020,685 | 1,668,562,548 | 1,473,961,427 |
| | 15,915,798,996 | 18,865,206,066 | 22,617,977,037 |
| | 86,392,231,643 | 102,785,380,121 | 101,323,241,950 |
| | 1,712,841,092 | 1,922,409,131 | 2,517,014,659 |
| | 5,254,312,005 | 8,187,213,983 | 9,179,736,839 |
| | 1,259,684 | 253,219 | 656,556 |
| | 52,618,794 | 50,565,692 | 74,862,347 |
| | 7.6% | 8.0% | 6.9% |

China's Trade with the World in Selected Commodities
By Type of Enterprise

Tires

| | | EXPORTS in US\$ | | |
|---|---|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 1,700,894,254 | 2,117,581,973 | 2,063,692,786 |
| 2 | Sino-foreign contractual joint venture | 26,000 | . | . |
| 3 | Sino-foreign equity joint venture | 1,618,752,150 | 2,241,634,852 | 2,628,484,717 |
| 4 | Foreign-invested enterprise | 1,165,092,415 | 1,669,921,229 | 2,006,469,644 |
| 5 | Collective enterprise | 267,662,709 | 379,899,569 | 516,578,673 |
| 6 | Private enterprise | 376,184,778 | 694,319,958 | 846,707,214 |
| 7 | Private firm | 19,442 | 184,489 | 15,185 |
| 9 | Other, including foreign embassy, foreign | 20,597 | 118,327 | 166,781 |
| | SOE Share | 33.2% | 29.8% | 25.6% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|-------------|-------------|
| | | 2006 | 2007 | 2008 |
| | | 41,037,022 | 41,521,479 | 59,996,150 |
| | | 7,478,866 | 1,000,983 | 55,447 |
| | | 54,639,229 | 42,233,842 | 63,011,034 |
| | | 69,046,883 | 154,958,792 | 222,792,158 |
| | | 256,748 | 1,038,370 | 598,554 |
| | | 71,153,489 | 34,578,289 | 38,401,718 |
| | | . | . | 1,410 |
| | | 101,201 | 142,626 | 292,636 |
| | | 16.8% | 15.1% | 15.6% |

Paper

| | | EXPORTS in US\$ | | |
|---|---|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| 1 | State-owned enterprise | 903,949,823 | 957,565,538 | 899,817,440 |
| 2 | Sino-foreign contractual joint venture | 104,905,912 | 109,749,187 | 96,544,874 |
| 3 | Sino-foreign equity joint venture | 1,294,602,098 | 2,024,858,081 | 2,194,264,892 |
| 4 | Foreign-invested enterprise | 1,824,191,328 | 2,148,639,354 | 2,400,356,922 |
| 5 | Collective enterprise | 290,064,596 | 377,187,462 | 287,811,021 |
| 6 | Private enterprise | 968,311,705 | 1,454,906,633 | 1,795,310,705 |
| 7 | Private firm | 18,719,545 | 28,971,544 | 26,019,571 |
| 9 | Other, including foreign embassy, foreign | 348,276 | 709,755 | 1,692,798 |
| | SOE Share | 16.7% | 13.5% | 11.7% |

| | | IMPORTS in US\$ | | |
|--|--|-----------------|---------------|---------------|
| | | 2006 | 2007 | 2008 |
| | | 974,598,970 | 875,984,910 | 830,414,018 |
| | | 108,739,063 | 84,443,483 | 68,489,766 |
| | | 639,534,087 | 643,981,939 | 646,370,208 |
| | | 1,805,682,596 | 1,953,051,390 | 2,045,732,482 |
| | | 91,354,712 | 86,129,513 | 81,438,709 |
| | | 584,122,195 | 634,428,019 | 679,106,243 |
| | | 564,356 | 1,071,494 | 578,590 |
| | | 11,722,888 | 13,171,198 | 15,150,812 |
| | | 23.1% | 20.4% | 19.0% |

China's Exports by State-Owned Enterprises

| Rank | | Millions of US\$ | SOE Exports | | | SOE as % Total Exports | | |
|------|------|--|-------------|-------|--------|------------------------|------|------|
| | | | 2006 | 2007 | 2008 | 2006 | 2007 | 2008 |
| 1 | 8901 | Vessels For The Transport Of Persons Or Goods | 5,698 | 7,941 | 10,590 | 80% | 75% | 61% |
| 2 | 7208 | FI-RI Iron & Na Steel Nun600Mm Wd Hot-RI, Not Clad | 4,869 | 7,495 | 9,527 | 81% | 77% | 71% |
| 3 | 2710 | Oil (Not Crude) From Petrol & Bitum Mineral Etc. | 4,561 | 6,365 | 8,938 | 65% | 70% | 65% |
| 4 | 8517 | Electric Apparatus For Line Telephony Etc, Parts | 1,160 | 5,577 | 6,645 | 10% | 7% | 7% |
| 5 | 2701 | Coal; Briquettes, Ovoids Etc. Mfr From Coal | 3,658 | 3,267 | 5,142 | 99% | 99% | 98% |
| 6 | 8528 | Tv Recvrs, Incl Video Monitors & Projectors | 1,391 | 5,189 | 4,060 | 11% | 14% | 12% |
| 7 | 6110 | Sweaters, Pullovers, Vests Etc, Knit Or Crocheted | 3,152 | 3,390 | 3,782 | 25% | 21% | 24% |
| 8 | 6204 | Women's Or Girls' Suits, Ensemb Etc, Not Knit Etc | 3,498 | 3,535 | 3,502 | 28% | 26% | 25% |
| 9 | 7304 | Tubes, Pipes Etc, Seamless, Iron Nesoi & Steel | 1,541 | 1,967 | 3,463 | 54% | 41% | 38% |
| 10 | 2704 | Coke Etc Of Coal, Lignite Or Peat; Retort Carbon | 1,213 | 1,812 | 3,384 | 60% | 59% | 58% |
| 11 | 7225 | FI-RI Alloy Steel Nesoi Nun 600Mm Wide | 130 | 514 | 2,957 | 72% | 86% | 83% |
| 12 | 7210 | FI-RI Iron & Na Steel Nun600Mm Wd, Clad Etc | 1,252 | 1,786 | 2,694 | 53% | 46% | 40% |
| 13 | 7202 | Ferroalloys | 1,061 | 2,015 | 2,687 | 42% | 49% | 45% |
| 14 | 7228 | Al Steel Nesoi Bars, Ang Etc; Hol Dr St Bars Etc | 253 | 755 | 2,630 | 43% | 41% | 44% |
| 15 | 7308 | Structures Nesoi & Parts Thereof, Of Iron Or Steel | 1,326 | 1,714 | 2,617 | 33% | 28% | 29% |
| 16 | 9503 | Toys Nesoi; Scale Models Etc; Puzzles; Parts Etc | 1,979 | 2,643 | 2,605 | 32% | 31% | 30% |
| 17 | 4202 | Travel Goods, Handbags, Wallets, Jewelry Cases Etc | 2,030 | 2,156 | 2,348 | 23% | 20% | 17% |
| 18 | 8473 | Parts Etc For Typewriters & Other Office Machines | 1,692 | 1,756 | 2,199 | 5% | 5% | 7% |
| 19 | 8504 | Elec Trans, Static Conv & Induct, Adp Pwr Supp, Pt | 1,368 | 1,824 | 2,158 | 12% | 13% | 13% |
| 20 | 8708 | Parts & Access For Motor Vehicles (Head 8701-8705) | 1,609 | 2,092 | 2,150 | 18% | 17% | 15% |
| 21 | 4011 | New Pneumatic Tires, Of Rubber | 1,701 | 2,118 | 2,064 | 33% | 30% | 26% |
| 22 | 8704 | Motor Vehicles For Transport Of Goods | 704 | 1,436 | 2,004 | 59% | 52% | 54% |
| 23 | 6203 | Men's Or Boys' Suits, Ensembles Etc, Not Knit Etc | 1,947 | 2,032 | 1,990 | 24% | 24% | 21% |
| 24 | 6109 | T-Shirts, Singlets, Tank Tops Etc, Knit Or Crochet | 1,872 | 1,970 | 1,916 | 25% | 23% | 24% |
| 25 | 7227 | Bars & Rods Alloy Steel Nesoi, H-R Irreg Coils | 98 | 161 | 1,890 | 91% | 56% | 58% |
| 26 | 6402 | Footwear, Outer Sole & Upper Rubber Or Plast Nesoi | 1,567 | 1,627 | 1,836 | 20% | 18% | 17% |
| 27 | 8471 | Automatic Data Process Machines; Magn Reader Etc | 4,847 | 1,645 | 1,711 | 5% | 2% | 2% |
| 28 | 9013 | Liquid Crystal Devices Nesoi; Lasers; Opt Appl; Pt | 1,016 | 1,571 | 1,703 | 7% | 8% | 7% |
| 29 | 8544 | Insulated Wire, Cable Etc; Opt Sheath Fib Cables | 984 | 1,387 | 1,647 | 14% | 14% | 14% |
| 30 | 6403 | Footwear, Outer Sole Rub, Plast Or Lea & Upper Lea | 1,530 | 1,590 | 1,638 | 18% | 17% | 17% |
| 31 | 7209 | FI-RI Iron & Na Steel Nun600Mm Wd Cold-RI, No Clad | 787 | 889 | 1,576 | 87% | 80% | 56% |
| 32 | 8516 | Elec Water, Space & Soil Heaters; Hair Etc Dry, Pt | 1,151 | 1,262 | 1,519 | 13% | 12% | 13% |
| 33 | 8431 | Parts For Machinery Of Headings 8425 To 8430 | 885 | 1,051 | 1,515 | 38% | 30% | 28% |
| 34 | 6104 | Women's Or Girls' Suits, Ensemb Etc, Knit Or Croch | 1,324 | 1,518 | 1,491 | 20% | 14% | 15% |
| 35 | 8402 | Steam Etc Generating Boilers Nesoi; Sup W Boilers | 209 | 442 | 1,487 | 64% | 68% | 76% |

China's Exports by State-Owned Enterprises

| Rank | Millions of US\$ | SOE Exports | | | SOE as % Total Exports | | | |
|------|------------------|--|-------|-------|------------------------|------|------|-----|
| | | 2006 | 2007 | 2008 | 2006 | 2007 | 2008 | |
| 36 | 9403 | Furniture Nesoi And Parts Thereof | 1,445 | 1,514 | 1,440 | 15% | 13% | 10% |
| 37 | 7106 | Silver (Incl Prec Plated), Unwr, Semimfr Or Powder | 1,132 | 1,349 | 1,407 | 69% | 67% | 66% |
| 38 | 7219 | FI-RI Stainless Steel Products, Not Und 600Mm Wide | 561 | 1,736 | 1,397 | 36% | 53% | 67% |
| 39 | 9405 | Lamps & Lighting Fittings & Parts Etc Nesoi | 1,290 | 1,392 | 1,349 | 20% | 18% | 15% |
| 40 | 8443 | Print Mach Incl Ink-Jet Mach Ancil T Prnt Pt Nesoi | 87 | 1,507 | 1,349 | 22% | 8% | 7% |
| 41 | 8415 | Air Conditioning Machines (Temp & Hum Change), Pts | 941 | 1,325 | 1,347 | 16% | 16% | 14% |
| 42 | 9401 | Seats (Except Barber, Dental, Etc), And Parts | 773 | 1,107 | 1,338 | 10% | 11% | 10% |
| 43 | 8501 | Electric Motors And Generators (No Sets) | 1,049 | 1,249 | 1,316 | 24% | 22% | 20% |
| 44 | 8525 | Trans Appar For Radiotele Etc; Tv Camera & Rec | 2,003 | 962 | 1,294 | 5% | 9% | 12% |
| 45 | 2931 | Organo-Inorganic Compounds Nesoi | 185 | 415 | 1,263 | 37% | 40% | 39% |
| 46 | 8429 | Self-Propelled Bulldozers, Graders, Scrapers Etc | 430 | 818 | 1,258 | 42% | 44% | 46% |
| 47 | 8430 | Mach Nesoi, Moving, Grad Etc; Pile-Dr; Snoplow Etc | 684 | 797 | 1,253 | 52% | 50% | 48% |
| 48 | 6302 | Bed Linen, Table Linen, Toilet Linen & Kitch Linen | 1,313 | 1,235 | 1,222 | 30% | 24% | 19% |
| 49 | 8529 | Parts For Television, Radio And Radar Apparatus | 1,289 | 1,074 | 1,206 | 5% | 10% | 10% |
| 50 | 6202 | Women's Or Girls' Overcoats Etc, Not Knit Or Croch | 1,193 | 1,264 | 1,187 | 32% | 29% | 23% |

Source: China Customs.

China's Imports by State-Owned Enterprises

| Rank | | Millions of US\$ | SOE Imports | | | SOE as % Total Imports | | |
|------|------|--|-------------|--------|---------|------------------------|------|------|
| | | | 2006 | 2007 | 2008 | 2006 | 2007 | 2008 |
| 1 | 2709 | Crude Oil From Petroleum And Bituminous Minerals | 60,600 | 73,310 | 119,869 | 91% | 92% | 93% |
| 2 | 2601 | Iron Ores & Concentrates, Including Roast Pyrites | 15,978 | 25,111 | 41,860 | 77% | 74% | 71% |
| 3 | 2710 | Oil (Not Crude) From Petrol & Bitum Mineral Etc. | 11,243 | 11,140 | 21,729 | 72% | 68% | 73% |
| 4 | 8542 | Electronic Integrated Circuits & Microassembl, Pts | 7,678 | 9,851 | 8,471 | 7% | 8% | 6% |
| 5 | 8802 | Aircraft, Powered; Spacecraft & Launch Vehicles | 8,428 | 6,612 | 6,471 | 86% | 71% | 74% |
| 6 | 1201 | Soybeans, Whether Or Not Broken | 1,829 | 2,106 | 5,737 | 24% | 18% | 26% |
| 7 | 9013 | Liquid Crystal Devices Nesoi; Lasers; Opt Appl; Pt | 3,759 | 4,842 | 4,255 | 10% | 11% | 9% |
| 8 | 2603 | Copper Ores And Concentrates | 3,284 | 4,895 | 4,249 | 55% | 56% | 41% |
| 9 | 7403 | Refined Copper & Alloys (No Mast Alloy), Unwrought | 2,001 | 4,139 | 3,943 | 36% | 39% | 38% |
| 10 | 8517 | Electric Apparatus For Line Telephony Etc, Parts | 975 | 3,031 | 2,630 | 27% | 16% | 14% |
| 11 | 8471 | Automatic Data Process Machines; Magn Reader Etc | 3,364 | 3,038 | 2,565 | 17% | 15% | 11% |
| 12 | 2503 | Sulfur Of All Kinds Nesoi | 310 | 632 | 2,334 | 44% | 49% | 61% |
| 13 | 8703 | Motor Cars & Vehicles For Transporting Persons | 1,469 | 1,457 | 2,301 | 21% | 15% | 16% |
| 14 | 7304 | Tubes, Pipes Etc, Seamless, Iron Nesoi & Steel | 1,793 | 1,628 | 2,046 | 75% | 67% | 65% |
| 15 | 7202 | Ferroalloys | 861 | 1,655 | 1,890 | 86% | 66% | 71% |
| 16 | 1507 | Soybean Oil & Its Fractions, Not Chemic Modified | 367 | 889 | 1,885 | 46% | 41% | 57% |
| 17 | 8708 | Parts & Access For Motor Vehicles (Head 8701-8705) | 1,389 | 1,569 | 1,771 | 15% | 15% | 16% |
| 18 | 8481 | Taps, Cocks, Valves Etc For Pipes, Tanks Etc, Pts | 1,211 | 1,185 | 1,751 | 35% | 32% | 34% |
| 19 | 2610 | Chromium Ores And Concentrates | 437 | 1,012 | 1,716 | 59% | 65% | 63% |
| 20 | 2602 | Manganese Ores A Concntrts Inc Ferr Mangn Iron Ore | 355 | 706 | 1,710 | 55% | 54% | 49% |
| 21 | 3104 | Mineral Or Chemical Fertilizers, Potassic | 648 | 1,308 | 1,692 | 42% | 56% | 58% |
| 22 | 8541 | Semiconductor Devices; Light-Emit Diodes Etc, Pts | 1,470 | 1,753 | 1,682 | 11% | 11% | 10% |
| 23 | 3901 | Polymers Of Ethylene, In Primary Forms | 1,849 | 1,680 | 1,583 | 29% | 24% | 20% |
| 24 | 8408 | Compression-Ignition Internal Comb Piston Engines | 669 | 999 | 1,552 | 45% | 41% | 37% |
| 25 | 2604 | Nickel Ores And Concentrates | 347 | 1,722 | 1,495 | 79% | 71% | 71% |
| 26 | 4403 | Wood In The Rough, Stripped Or Not Of Sapwood Etc | 1,094 | 1,346 | 1,373 | 28% | 25% | 27% |
| 27 | 8479 | Machines Etc Having Individual Functions Nesoi, Pt | 1,495 | 1,431 | 1,330 | 15% | 19% | 17% |
| 28 | 2905 | Acyclic Alcohols & Halogenat, Sulfonatd Etc Derivs | 1,223 | 1,364 | 1,297 | 23% | 19% | 16% |
| 29 | 4703 | Chemical Woodpulp, Soda Or Sulfate, Not Dissoly Gr | 842 | 1,074 | 1,293 | 24% | 25% | 24% |
| 30 | 7110 | Platinum, Unwrought, Semimfr Forms Or In Powder Fm | 680 | 897 | 1,242 | 52% | 41% | 43% |
| 31 | 1511 | Palm Oil & Its Fractions, Not Chemically Modified | 534 | 749 | 1,238 | 23% | 20% | 24% |
| 32 | 7502 | Nickel, Unwrought | 1,370 | 2,130 | 1,235 | 63% | 55% | 45% |
| 33 | 8414 | Air Or Vac Pumps, Compr & Fans; Hoods & Fans; Pts | 1,189 | 1,032 | 1,211 | 30% | 26% | 25% |
| 34 | 7501 | Nickel Mattes, Nickle Oxide Sinters, Oth Int Prod | 858 | 1,854 | 1,197 | 100% | 100% | 77% |

China's Imports by State-Owned Enterprises

| Rank | Millions of US\$ | SOE Imports | | | SOE as % Total Imports | | | |
|------|------------------|--|-------|-------|------------------------|------|------|-----|
| | | 2006 | 2007 | 2008 | 2006 | 2007 | 2008 | |
| 35 | 8504 | Elec Trans, Static Conv & Induct, Adp Pwr Supp, Pt | 1,069 | 1,238 | 1,162 | 16% | 15% | 13% |
| 36 | 2701 | Coal; Briquettes, Ovoids Etc. Mfr From Coal | 582 | 861 | 1,145 | 36% | 36% | 32% |
| 37 | 8413 | Pumps For Liquids; Liquid Elevators; Parts Thereof | 729 | 928 | 1,139 | 37% | 37% | 33% |
| 38 | 7225 | FI-RI Alloy Steel Nesoi Nun 600Mm Wide | 590 | 687 | 1,090 | 31% | 30% | 35% |
| 39 | 3903 | Polymers Of Styrene, In Primary Forms | 1,086 | 1,273 | 1,089 | 23% | 22% | 18% |
| 40 | 8483 | Transmission Shafts, Bearings, Gears Etc; Parts | 599 | 789 | 1,067 | 26% | 25% | 25% |
| 41 | 2917 | Polycarboxylic Acids & Anhyd Etc, Halog, Sulf Etc | 1,549 | 1,611 | 1,061 | 21% | 21% | 16% |
| 42 | 9027 | Inst Etc For Physical Etc Anal Etc; Microtome; Pts | 751 | 781 | 1,057 | 43% | 38% | 38% |
| 43 | 4001 | Natural Rubber, Balata, Chicle Etc, Prim Form Etc | 919 | 1,019 | 1,013 | 30% | 31% | 24% |
| 44 | 9801 | Expts Of Repaired Impts; Impts Of Returned Expts | 593 | 407 | 997 | 29% | 17% | 23% |
| 45 | 8607 | Parts Of Railway Or Tramway Locomotives Or R Stock | 732 | 851 | 988 | 89% | 85% | 84% |
| 46 | 8419 | Machinery Etc For Temp Chang Treat Mat; W Heat, Pt | 798 | 764 | 984 | 39% | 38% | 35% |
| 47 | 8411 | Turbojets, Turbopropellers & Oth Gas Turbines, Pts | 1,084 | 919 | 983 | 68% | 57% | 50% |
| 48 | 2607 | Lead Ores And Concentrates | 600 | 1,167 | 974 | 63% | 72% | 58% |
| 49 | 9032 | Automatic Regulating Or Control Instruments; Parts | 456 | 673 | 960 | 25% | 27% | 29% |
| 50 | 8455 | Metal-Rolling Mills And Rolls Therefor; Parts | 837 | 917 | 949 | 70% | 82% | 75% |

Source: China Customs.

Sector Identification

| Sector | HS Chapter of Individual 4-digit HS Subheading |
|--------------------------------|--|
| Coal | HS 2701 |
| Civil Aviation | HS 8802, 8803 |
| Equipment Manufacturing | HS Chapter 84 |
| | (note some of the categories for IT Products contain individual 4-digit HS categories from Chapter 84 as well) |
| Auto | HS 8703, 8706, 8707, and 8708 |
| Steel | HS Chapters 72 & 73 |
| Chemical | HS Chapters 28 to 38 |
| Non ferrous metal | HS Chapters 74 to 83 |
| New Pneumatic Tires, Of Rubber | HS 4011 |
| Paper and Paperboard | HS Chapter 48 |
| | |
| IT Products | This category is the aggregate of the categories listed below. |
| Consumer Electronics | HS 8518 to 8522, 8524, 8527 & 8528 |
| | |
| Communications Equipment | HS 8517, 8525, 8533 to 8536 & 8540 |
| | |
| Computer & Office Equipment | HS 8443, 8469 to 8473 |
| Semiconductors | HS 8541 & 8542 |
| Electrical Components | HS 8504, 8532 to 8536, and 8540 |
| | |
| Industrial Electronics | HS 8419, 8456, 8526, 8543, 8548, 9012, 9014, 9015, 9024, 9025, 9027 to 9032 |
| Photonics | HS 9001, 9002, 9007 to 9011 & 9013 |
| | |