China In The 21st Century: Will ICT Sustain Economic Growth?

James W. Gabberty, (E-mail: jgabberty@pace.edu), Pace University
Linda Jo Calloway, (E-mail: lcalloway@pace.edu), Pace University

Abstract

The purpose of this paper is to stimulate critical thinking about China's ability to consistently grow its economy by leveraging its information and communication (ICT) infrastructure in such as way as to prolong the competitive advantage it now enjoys from its ability to attract multinational corporations (MNCs) attention. The success of China's transition towards economic and societal advancement is underpinned, to a large extent, by its total ICT investment. A competitive ICT profile is an antecedent to innovation, making China's intention to become a significant force in the global knowledge economy more viable. This paper interprets current evaluations of China's innovation circumstances in light of factual and perceptual data that represents the nation's ICT capabilities in the context of its standings with other nations.

Introduction

In the popular book, "Globalization and Its Discontents", author and 2001 Nobel Laureate in Economics Science Joseph Stiglitz outlined many of the reasons why globalization has become so controversial. He concludes, among other well-cited positations, that countries that embrace international trade improve their economies more than they would otherwise and that export-led growth is the centerpiece of the industrial policy that enriched Asia and "left millions of people there far better off" (Stiglitz, 2002). The recent rise to prominence by China, characterized by massive foreign-funded investments in manufacturing capacity and information & communication technologies (ICT), linking Chinese production centers with Japanese and Western multinational corporations (MNCs), appears to illustrate his central thesis.

The question that remains for China, for the purposes of this study, is whether Chinese manufacturers can continue to weave their firms (and the nation's pool of educated workers) into the global supply chain, achieving sustainable competitive advantage. Once accomplished, additional value added opportunities leading toward further innovation within China may occur. A parallel can be drawn between the point in time where China is today and where Mexico was just prior to joining NAFTA. Approximately 10 years ago, the framework laid out by the NAFTA terms made it possible for Mexico to achieve a similar weaving of its workers into the (mostly U.S.) value chain. The Mexican economy, as expected, improved greatly during the late 1990s and despite having achieved some competitive advantage, this advantage was nonetheless lost when China opened its doors wide to (mostly U.S. and European) foreign manufacturing activity. Currently, Mexico is mired in economic morass, nostalgically looking backward into its recent past for insight as to what could have been done to prevent losing its competitive advantage. China, on the other hand, is at a point in its upward-spiraling economic development (when comparisons to the Mexican example may be made) as that country strives to nurture its nascent economic development to escape repeating the fate that befell Mexico.

This is a difficult task for China to achieve, since it is straddled with concurrent burdens of steering its economy in the right direction, educating and training its workers, and rolling out an advanced ICT infrastructure that will achieve an economic payoff in future business opportunities with the rest of Asia and the West. The resulting challenge of coping with related issues that strain this development are many and include (1) the danger of creating an overheated economy (numerous signs of which have become manifest), (2) addressing internal infrastructural problems created by the vast streams of workers leaving the hinterland in pursuit of the developed coastal cities, and (3) carefully approaching monetarist policies to deal with calls by foreign leaders for the nation to

devalue its currency in preparation for a floating Yuan, which, at least in the short-term, is sure to slow economic activity.

This paper assesses China's predictability in achieving a sustained competitive advantage made possible, in part, by leveraging the capabilities inherent in its ICT profile. Relying on ICT infrastructure factors compiled by the World Bank and survey data from a report by the World Economic Forum, China's standings relative to similar, competing export-driven nations will be assessed.

China's Position in the Global Knowledge Economy

As part of the plan to move the nation forward as a significant player in the emerging integrated knowledge economies characterizing the 21st century, China's declared strategy of expanding its manufacturing capacity depends upon its ability to (a) update economic and institutional regimes, (b) upgrade education and learning, and (c) create and deploy a sound information infrastructure.

So far, China's growth is unprecedented for an Asian economy. Its economic development has mushroomed from an insular economy, leading the nation away from successive failing five-year plans to a level of national advancement characterized by the moniker "socialist market economy". By not repeating the "big bang" approach adopted by Eastern European countries (e.g., Russia) when they attempted to achieve the same goal, China is not in a rush to privatize its industries but instead bent on opening itself to foreign investment and export-led growth strategies. This feat of sustained economic development was made possible by building out its ICT infrastructure to enable MNCs to interlink Chinese manufacturers into their manufacturing value chain.

The Pace of Change

By leveraging the nation's low labor costs and the inherent knowledge gains made possible by building an ICT infrastructure promoting shared and collaborative production capabilities, China gained competitive advantage over other similar developing nations (Stiglitz, 2002). Further, the pace at which nations such as China open themselves up to the international economy is quickening (*globalization* is the catchphrase for this manifestation) and is accelerating as other nations try to catch up, despite the allegations that free trade, the free flow of capital, and rapid economic growth widen the income gaps in society (Larsson, 2001). This rate of change is so startling to industry and government leaders that recent protectionist calls by top executives in the public and private sector (notably the United States) cite that this fast pace of globalization wreaks havoc on national economies because they are unable to respond quickly enough to handle the impact that China has on their local economies. Because of this frenzied pace of leveraging ICT assets to gain superior production and marketing capabilities (Gabberty, 2004), improvements in telecommunications, interoperability among disparate computing platforms, the "commoditization" of the Internet, and advances in automated manufacturing and CRM software result in quickening the tempo of the beat toward globalization, further simplifying the ease with which manufacturing and service sector processing may be moved to offshore facilities in foreign locales.

Geographic Challenges

For the most part, China's economic miracle is taking place in the coastal cities, more or less following Porter's work on clustering manufacturing centers (Porter, 1990). As such, China's endogenous formation and internal sharing of knowledge made possible by network clusters results in spatially-clustered firms that sustain technological innovation. (Hicks & Niven, 2000). Accordingly, then, the challenge is to create technology innovation centers throughout China's urban areas. There is some justification to considering Coastal China as a developed economy, albeit currently one of manufacturing. Based on the work of Dewan and Kraemer (2000), an innovation policy that limited IT capital investments to developed coastal areas could be implemented. Using this scenario, China's development blueprint would be based on treating rural China as a developing economy and coastal China as developed. These authors found evidence that, for the developed countries between 1985 and 1983 there was a clear positive and significant structure of returns for IT capital investment that is commensurate with the relative factor share. In the developing countries, the opposite results were found.

The Lowest Labor Cost Supplier

While low labor cost nations such as China enjoy the recent economic stimulus made possible by weaving itself into the production supply chains of (mostly) Japanese and Western MNCs, it remains to be seen how long their ability to respond to changes in product demands will last. After all, the global workforce expansion unfolding over the past twenty years has made it possible for new entrants to gain access to this supply chain through comparatively lower labor costs. Foreign MNCs, driven by a never ending pursuit of lowered production costs and higher profit margins do not necessarily owe any particular allegiance to its suppliers but instead owe allegiance only to shareholders.

Eventually, the increased economic growth in China will lead to an appreciating currency, triggering reflexive monetarist intervention policies that mimic Japan's pattern of continually devaluing their currency in order to keep exports attractive and promote the manufacturing centers. For example, recent calls by U.S. Treasury Secretary Andrew Snow to Chinese counterparts to let the Yuan float on international currency markets will eventually lead to its appreciation and cause a rise in the costs of doing business in China.

When this devaluation occurs, several questions become apparent:

1. How will China be able to sustain its competitive posture in the global economy?
2. Will it be able to leverage its ICT infrastructure in new and innovative ways to continue attracting inflows of foreign investment?
3. Will it instead continue to rely on its current competitive advantage - that of being the lowest-priced labor source (following the Mexican example)?

The answers to these questions prove elusive at best. However, finding solutions to them before they become problematic will help divert China away from what noted U.S. Business and Industry Council research fellow Alan Tonelson refers to as the "race to the bottom", led by uncontrolled free trade and sinking American (and, ultimately Chinese) living standards? (Tonelson, 2002).

Avoiding Export Dependency

Hence, China needs to innovate, as did the U.S. in the last half of 20th century, specializing in information and communication technologies. The unquestioned ICT supremacy that the U.S. enjoys allows it to distribute its production and manufacturing centers throughout the world, driven by various factors that offer competitive advantage. From this perspective, China's factories are merely remote nodes of this international grid; Chinese leaders seem content in having established the nation as one of the world's most prominent workshops. However, the infrastructural components that comprise these manufacturing linkages may have unforeseen consequences (Spencer, 2003).

Also, since MNCs intrinsically have the ability to extend their competitive advantage beyond borders, they offer China the opportunity to tap into a wealth of technological know-how via knowledge transfer agreements that will serve them in the future. Specifically, infrastructural technologies in particular can be viewed as a critical component of competitive advantage because of the higher implicit value they offer compared to components used in isolation (Carr, 2003).

Innovation requires an innovative infrastructure, and in today's world, in the context of China's plans, the substrate of innovation is ICT capability. From a national perspective, China's need to innovate resonates with the basic tenets of competitiveness espoused by Michael Porter, co-chair of the Global Competitiveness Report (GCR), an annual ranking produced by the World Economic Forum (WEF) of the competitiveness and growth prospects of 80 countries. As international trade flourishes, competitiveness increases and innovation becomes paramount. Porter believes that innovation is what drives and sustains competitiveness (Porter, 1990). Moreover, he posits that there is no sustainable growth possible without technological improvements, because other potential determinants of growth

eventually suffer diminishing returns. As put aptly by the WEF GCR for 2001 – 2002, there are no diminishing returns on ideas.

Evaluating China's ICT Capabilities Relative to Competing Nations

China realizes the need to keep its ICT sophistication on an upward trajectory; however, this upward path may be dampened by the capabilities and perceived capacity of other countries that compete with China in international trade. From this perspective, China's continued economic expansion is not guaranteed.

A recent study by Gabberty and Calloway (2004) analyzed the relative rankings of China compared with various nations to elicit those ICT-related metrics that may impede China in its drive toward manufacturing innovation. In this research, this paper extends the analysis of these ICT readiness component measures to further illuminate the effects of these data on China's readiness to innovate and interleaves analyses of quantitative indicator components from the World Bank. The specific countries included in this study were selected for comparison from two country groupings: The National Asia Pacific Economic and Scientific Database (NAPES, 2001) and the Global Competitiveness Index (GCI) from the WEF. The NAPES database is a comprehensive repository of long-term economic indicators for the Asia-Pacific region covering bilateral trade, economic and industrial research and development, and patents. In this study, the authors analyzed China's rankings among the 41 export-oriented countries from NAPES database in relation to the executive perceptual data from the GCI report. The country selection criteria for those nations included in the NAPES database are simply those nations that have embarked on a path of economic development through trade; they are listed in *table I*. Since this study principally examines China's ICT capabilities with respect to its export-driven economic expansion goals, the inclusion of the NAPES country set is appropriate.

The study isolated forty-eight metrics that specifically characterize various aspects of ICT capability in China as observed by key executives surveyed in the GCR. Faced with the problem of devising a set of metrics to measure ICT development of China from multiple dimensions, the study parallels the method used by other authors; e.g., (Bui et al., 2002). Also, to mitigate the challenges presented by multiple data sources (each with their own measurement criteria and inherent shortcomings), the study instead took the approach of using a singular data source, namely, the metrics available from the WEF GCR. Thus, this approach eliminated inconsistent and overlapping measurements.

A second challenge of the study dealt with the problem of selecting which individual measures should be included. For example, three of the broader categories (namely, Macroeconomic Environment, Public Institutions [Corruption], and Environmental) are not significantly tied to ICT capabilities. To distill the remaining category components (specifically, Technology Innovation & Diffusion, Information and Communications Technology, General Infrastructure, Public Institutions [Contracts and Law], Domestic Competition, Cluster Development, Company Operations & Strategy), the relevance of each sub-component was determined, and those deemed most suitable were selected. The selected components are in *Appendix A*.

Table I

SELECT NAPES COUNTRIES			
Australia	*Germany*	*Korea*	*Spain*
Austria	*Greece*	*Malaysia*	*Sri Lanka*
Bangladesh	*Hong Kong*	*Mexico*	*Sweden*
Belgium-Luxembourg	*Hungary*	*Netherlands*	*Switzerland*
Canada	*Iceland*	*New Zealand*	*Thailand*
Chile	*India*	*Norway*	*Taiwan*
China	*Indonesia*	*Philippines*	*Turkey*
Denmark	*Ireland*	*Poland*	*UK*
Finland	*Italy*	*Portugal*	*US*
France	*Japan*	*Singapore*	*Vietnam*

Source: ***Adapted from National Asia Pacific Economic and Scientific Database, http://napes.anu.edu.au/***

Since survey data is inherently ordinal and differences in the minds of the respondents are expected to exist among different Likert scale values, rating scores were normalized using the following method, based on the number of standard deviations that the rating score was away from the mean.

The means and standard deviations for every component relative to each country set was computed, resulting in a data set whose coarser granularity is more likely to reflect actual differences among the various country rating scores. The standard deviation for the country sets was added to or subtracted from each rating score. If this modified score was greater than the mean value of the set plus one standard deviation, it was assigned a score of '3'. If it was less than the average value minus one standard deviation, it was assigned a score of '1'. Otherwise, it was assigned a default score of '2' (see *table II*).

Table II

METHODLOGY FOR RATING ASSIGNMENT
If Component Mean + Standard Deviation > = rating score, assign a '3'
If Component Mean – Standard Deviation < = rating score, assign a '1'
Otherwise, assign a '2'.

Although the data reported in the WEF survey are perceptual, responses based on perception are assumed to reflect an individual's state of mind (Frake, 1966). An individual's intentions have been shown to be the antecedents for behavior (Ajzen, 2002; Fishbein and Ajzen, 1975). It is probable therefore to assume that these executive perceptions will contribute toward intentions to behave similarly. Thus, these perceptions are likely indicators of whether or not China is on a path toward ICT optimization.

According the Icek Ajzen (2002), one of the originators of the Theory of Planned Behavior, "As a general rule, the more favorable the attitude and subjective norm, and the greater the perceived control, the stronger should be the person's intention to perform the behavior in question" (p 1). The formants of intention are described in relation to technology acceptance by Venkatesh & Davis (2000) in the expanded Technology Acceptance Model version 2.

The comparative study by Gabberty and Calloway (2004) identified twelve ICT components that may put China at a greater risk than previously identified in the nation's efforts to move from an export-driven manufacturing economy into a knowledge-based economy (see ***table V Appendix B***). For example, the component factors in their study had rating scores of '2' for the WEF set and '1' for the NAPES set; a value of '1' indicates that the score is more than one standard deviation below the mean. For these twelve components, China ranked lower within the set of export-driven economies competing against it in international trade.

The same twelve components emerge as critical factors that should be included in policy formulation by top Chinese executives. These components also generally ranked China in the lowest 15th percentile, ranking below 35 out of 41 nations. More importantly, the extent of these disadvantages was hidden in the context of the larger, more diverse WEF country set.

As a validation procedure, the same ranking computations for the set of 10 countries in the Asia Pacific Economic Cooperation (APEC) group used by Bui, Sebastian, Jones and Naklada (2002) to rate e-commerce readiness in East Asian economies was performed. This study, similar in intent to the WEF study, found that China ranked 8th among the 10 countries for overall e-readiness. China's average rank using the WEF/NAPES method employed here on the APEC country set also put China in the lowest 20th percentile.

Implications of the Extracted Perceptual Factors: The Lower-rated Factors

In comparison with the NAPES countries, China's rankings with respect to executive perceptions are low. Of the 48 components measured, China ranks in the lowest 20 percent against most of the NAPES export-driven nations. Twelve of the selected components, however, are remarkably low. Juxtaposed to the highly-acclaimed growth of China's GDP, its first place ranking in Asia for foreign direct investment (FDI) and the nation's concurrent growth in per capita income, these ratings are strikingly glum.

Deterioration of the strength of public institutions is indicated by a total of five components (out of twelve) used as barometers of the overall ICT capability in the Gabberty and Calloway report. The Global Competitiveness Index (GCI) report noted that China dropped in rankings from 38th to 44th within their 80-country dataset (as opposed to the 75 countries in the WEF GCR), most of the drop was attributed to a lower perception of the quality of public institutions. These five factors are shown below in *table III*.

Table III

EXTRACTED FACTORS REFLECTING PERCEPTIONS OF PUBLIC INSTITUTIONS	
ICT Component	**Executive Perception (Percentile)**
Laws relating to ICT use in electronic commerce, digital signatures, & consumer protection	Low 20th
Intellectual property protection	Low 20th
The Quality of free public schools	Low 20th
The Quality of management schools	Low 10th
The Availability of scientists and engineers	Low 5th

Three of the twelve measures in the lowest 10th percentile pertain to overall Internet measures. Internet access in China is slow and expensive; the extent that the Internet has improved domestic firms' ability to coordinate with [domestic & international] customers and suppliers to reduce inventory costs is practically non - existent. Lastly, competition in the telecommunications sector is not sufficient to ensure high quality of service (QoS) levels, a low mean-time-between-failure (MTBF) of critical system components that would lead to infrequent interruptions, and or low internet prices for businesses and consumers.

Some of the more dismal perceptions of executives seem to fly against the heavy FDI penetration into the manufacturing sector. Production process sophistication placed in the lowest 25th percentile, IT Training and Education Programs were rated in the lowest 5th percentile and the assessment of the executives' companies' extent of staff training fell to the bottom-most 10th percentile, along with Buyer Sophistication.

Of the 48 components selected from the WEF GCR report to represent perceived ICT capabilities in China, seven components ranked above the mean for the NAPES country set. Significantly, all of these seven component ratings represent China's positive capacity for innovation (see *Table IV*). Given that China is well on its way to establishing itself as the world's default light-manufacturing center, its ability to consistently lower production costs through innovation remains paramount for the nations continued success. Because these seven factors where China ranks above the mean are areas that gauge innovation, china's ability to continue and indeed flourish in its pursuit of serving as the world's primary manufacturing center is entirely plausible.

Executive expert opinion is used in these and similar rankings to assess the relative capabilities of countries to compete in global markets and as previously noted, the opinions are considered as harbingers for executive action. This suggests that these components are important in that they foretell a brighter possible future driven by innovation.

Implications of the Extracted Perceptual Factors: The Higher-rated Factors

Table IV

EXTRACTED FACTORS REFLECTING INNOVATION CAPABILITY
Government procurement of Advanced Technology Products are made to encourage innovation
Prioritization of ICT is perceived as Government a priority
Government Programs promoting the use of ICT are successful
In most industries competition in the local markets is perceived as good
Competition in the local market comes from local firms or local competitors
Entry of new competitors occurs in the local market
Companies do obtain technology by pioneering their own new products or processes

Implication of the World Bank Indicators

Following the concept of ranking china against other countries in relation to ICT component measures, data collected by the World Bank for the NAPES countries was used to extract factors where China ranked either in the top ten countries or the bottom ten countries. Six of the hard data measures illustrate China's objective position against the export-driven countries of the NAPES database.

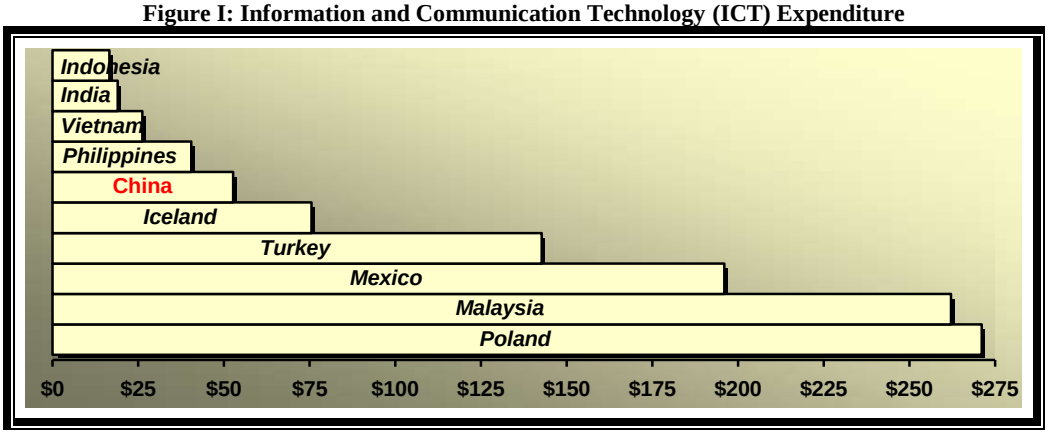
Implications of Lagging World Bank indicators

In some ICT categories, data from the World Bank places China among the lowest 25%, or among the lowest 10 ranking of the 41 countries listed in the NAPES database of exporting nations.

China's preoccupation with massive infrastructure projects (such as the Three Gorges Dam project and the 2008 Beijing Olympic Games) are tapping investment dollars that might otherwise have been put to use in extending the nation's ICT architecture. The nation's ravenous appetite for imported raw materials serves as a reminder of the enormity of the money being spent building up non-ICT infrastructure; for example, oil imports rose 30% in 2003, second only to the U.S., China's consumption of 50% of the world's production of cement, 30% of its coal, and 36% of its steel (Economist, February 1, 2004).

It is not surprising that China's ICT expenditures as a percentage of GDP do not necessarily reflective of a nation bent on ICT mastery. From a per capita perspective, China's ICT spending does not bode any better (*figure I*). The nation's rank in the context of the NAPES countries is in between the Philippines and Thailand; China's besting of its three subordinate countries (Vietnam, India, and Indonesia) also does not signal that a brighter Chinese future supported by ICT is likely.

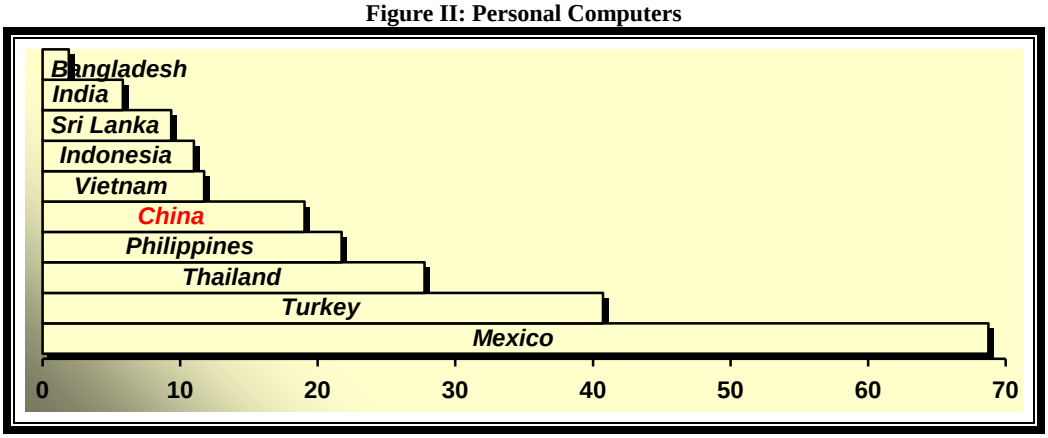
Figure I: Information and Communication Technology (ICT) Expenditure



(Per capita, US$)
Source: *Table IE.ICT.PCAP.CD, World Development Indicators 2003, World Bank*

Figure II shows that the number of personal computers per thousand people places China ahead of Bangladesh, India, Sri Lanka, Indonesia, and Vietnam. This is surprising for a nation whose miraculous growth and massive foreign investment did not necessarily translate into higher levels of personal computing availability for its populous to leverage in an increasingly knowledge-based global economy. Considering that according to World Bank statistics, China's foreign direct investment for 2001 stood at $44.2 billion, thirteen times that of India's $3.4 billion, it is disappointing that China's PC usage is only four times that of India's. Nevertheless, the low penetration of personal computers resonates with China's executives' evaluation of slow and expensive internet access and deficient competition in the telecommunications sector.

Figure II: Personal Computers

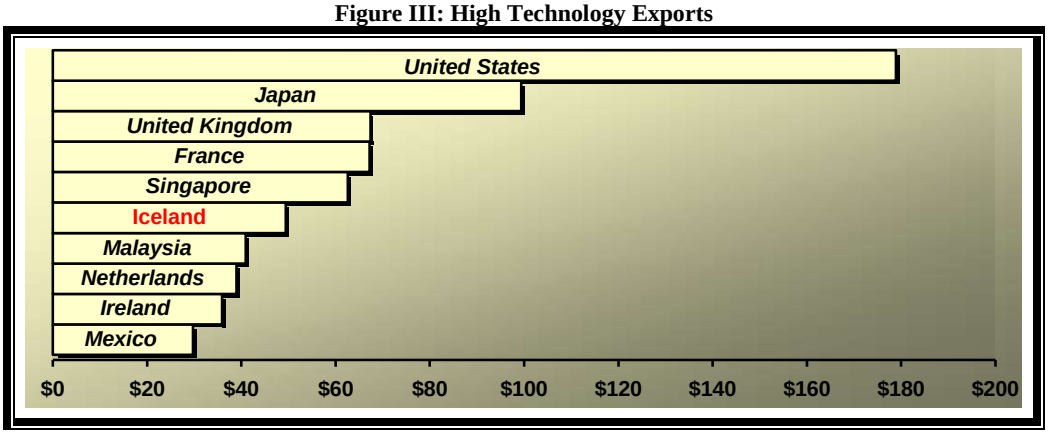


(Per 1,000 people)
Source: *Table IT.CMP.PCMP.P3, World Development Indicators 2003, World Bank*

Discussion of Ascendant World Bank indicators

Placing in the top quartile of the NAPES database countries, China's ability to export high technology products (*figure III*) is a wonderful indicator of the nation's ability to tap into its large, educated workforce and collect revenues exceeding competitor nations such as the Netherlands, Malaysia, Ireland, and Mexico, approaching high technology export levels of Singapore, France, and the United Kingdom.

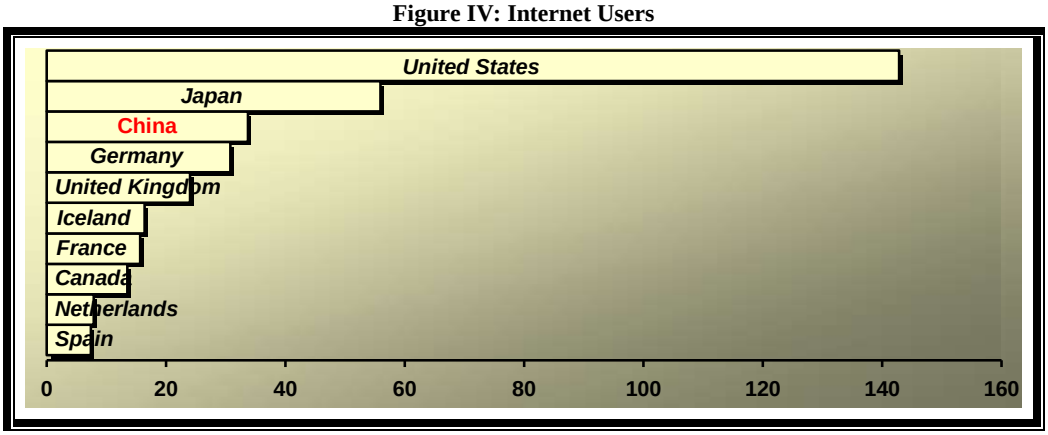
Figure III: High Technology Exports



(Current Dollars, Billions US$)
Source: *Table TX.VAL.TECH.CD, World Development Indicators 2003, World Bank*

China's 'online' population (*figure IV*) is illustrative of a nation whose inhabitants are ready to take on the challenges posed by the "new economy".

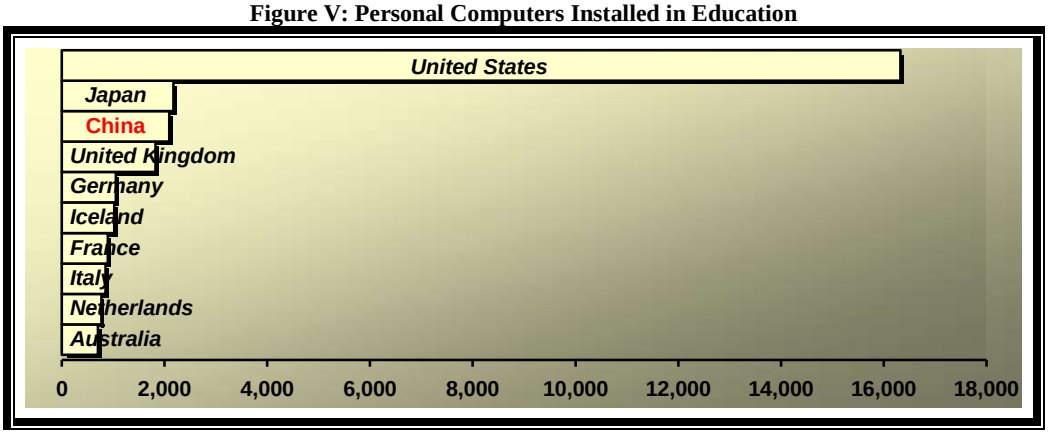
Figure IV: Internet Users



(Millions)
Source: *Table IT.NET.USER, World Development Indicators 2003, World Bank*

From the perspective that China is likely to take a lead role in the global economy, perhaps one of the most significant indicators to gauge is the number of personal computers installed in education (*figure V*). Approaching parity with Japan, albeit having a population five times that of Japan, China is at least investing in technology that is currently deployed in business the world over, especially the U.S. Assuming that the U.S. number of PCs in the classroom is a barometer of how critically important this type of technology is to prepare future business leaders,. China appears to be mimicking the notion that personal computing is essential. Exceeding the installed base of each European nation, China's impressive PC initiative will likely provide a benefit to the country in the near future.

Figure V: Personal Computers Installed in Education



(Thousands)

Source: *Table IT.CMP.PCMP.ED, World Development Indicators 2003, World Bank*

Concluding Comments

Since the mid 1990's, China's economy has soared. Emerging from a third world developing nation to an export-driven country offering access to a substantial low cost manufacturing base for many of the world's premiere multinationals. The MNCs, in pursuit of leveraging the investments made in ICT and other infrastructural programs, have driven the volume of international trade and inflows of foreign direct investment to astonishing levels. Japan, the former longstanding U.S. trade antagonist with huge trade surpluses with the U.S., has been supplanted by a burgeoning China.

This research begins to assess whether or not China can continue to weave its manufacturing firms into the global supply chain and to sustain their competitive position based on an innovation infrastructure that leverages ICT by making possible vast international trade to occur. Extensive research has and continues to be done to track China's economic meteoric trajectory and this research shows that sustained economic growth is predicated on continuance of fostering innovation, largely based on ICT transfer and absorption. For China to avoid repeating the mistakes of Mexico, another nation with a seemingly meteoric ascent to impressive trade output only to be outdone by China, it must sustain its capacity to innovate by upgrading its education, learning and information infrastructure

The responses of key executives surveyed by the WEF GCR portray China's competitive position as substantially below other nations with whom it competes. In fact, a previous analysis of China's rankings among export-driven nations by Gabberty and Calloway isolated 12 components where the China rank fell in the lowest 20th percentile, or below 30 of 41 countries. Several of these components represented confidence in public institutions such as the quality of public education and protection of intellectual property rights and consumer protection, while other components represented cost, quality and competition in the Internet sector. It is useful to note that the poorly perceived or actual quality of public institutions in a communist state may hamper endogenous innovation. Further, if gaps in ICT support left by poor public institutional performance are closed by yet more involvement by wholly-owned foreign enterprises, ICT absorption and innovation may be compromised if this technology transfer is not fully absorbed.

Although the mean perceptions of China's executives are remarkably low, the seven components with measures above the mean all represented China's positive capacity to innovate. These perceptions are in accord with World Bank data illustrating that although personal computers (using per capita figures) places China in 37th out of 41 countries, the number of personal computers installed in education puts China in third, below only Japan and the United States. This is substantial.

The positive implications for innovation drawn from these indicators is hopeful, and belies the notion that China, along with its hosted MNCs are deriving benefit from China's low-cost labor and high manufacturing capacity at the expense of the nation's deteriorating infrastructure and its power to sustain innovation.

Future Research Suggestions

China is poised at a crossroads: one path leads the nation to enlarging its infrastructure – fueled by inflows of foreign capital and the other path advises cautionary containment of this continued growth. From the MNC perspective, continue expansion of its manufacturing centers and (similar to India) development of a thriving service sector are imperatives that will lead to increased profit streams for shareholders. From the consumer perspective (both in China and elsewhere), China's continued expansion will lead to lower-priced goods and (ultimately) higher energy costs as fossil and coal fuel supplies dwindle. Finally, continued economic cooperation between China and the rest of the world will lead to intensification of multilateral obligations and, in the long term, reduce the likelihood of political friction between a nation that is attempting to become a successful Communist-led market economy following the tenets of a capitalism.

Subsequent research, fostering development of expressive thought and insight into the viability of bridging these two opposing ideologies, is warranted, perhaps using as a starting points the speculation of noted Asian author James Fallows (1994), illustrated in *Appendix C*.

Appendix A

SELECT ICT COMPONENTS THAT INFLUENCE NATIONAL EXPORT COMPETITIVENESS		
Category	**Title**	**Description**
Technological innovation and diffusion	Technological Sophistication	Your country's position in technology (1=generally lags behind most countries, 7= is among the world's leaders)
	Firm-Level Innovation	In your business, continuous innovation plays a major role in generating revenue (1=not true, 7=true)
	Firm-Level Technology Absorption	Companies in your country are (1=not interested in absorbing new technology, 7=aggressive in absorbing new technology)
	FDI and Technology Transfer	Foreign direct investment in your country (1=brings little new technology, 7=is an important source of new technology)
	Company Spending on Research and Development	Companies' spending on research and development in your country (1=is non-existent, 7=is heavy relative to international peers)
	Subsidies for Firm-Level Research and Development	Direct government subsidies for firms conducting research and development in your country (1=never occur, 7=are widespread and large)
	Tax Credits for Firm-Level Research and Development	Government tax credits for firms conducting research and development in your country (1=never occur, 7=are widespread and large)
	University/Industry Research Collaboration	In its R&D activity, business collaboration with local universities is (1=minimal or non-existent, 7=intensive and ongoing)
	Government Procurement of Advanced Technology Products	Government decisions on the procurement of advanced technology products are based on (1=price alone, 7=technology and encouraging innovation)
	Availability of Scientists and Engineers	Scientists and engineers in your country are (1=non-existent or rare, 7=widely available)
	Brain Drain	Scientists and engineers in your country (1=normally leave to pursue opportunities elsewhere, 7=almost always remain in the country)
Information and communications technology	Speed and Cost of Internet Access	Lease-line or dial-up access to the Internet in your country is (1=slow and expensive, 7=as fast and cheap as anywhere in the world)
	Public Access to Internet	Public access to the Internet through libraries, post offices etc is (1=very limited, 7=pervasive -- most people have frequent access)
	Internet Access in Schools	Internet access in schools is (1=very limited, 7=pervasive -- most children have frequent access)
	Quality of Competition in Telecommunication Sector	Is competition in your country's telecommunications sector sufficient to ensure high quality, infrequent interruptions and low prices? (1=no, 7=yes, equal to world's best)
	High Skilled IT Job Market	Highly skilled information technology workers in your industry (1=must leave the country to find good jobs, 7=have their pick of well-paid, desirable jobs within the country)
	IT Training and Education	Your country's IT training and educational programs (1=lag far behind most countries, 7=are among the world's best)
	Quality of Competition in ISP Sector	Is competition among your country's Internet Service Providers sufficient to ensure high quality, infrequent interruptions and low prices? (1=no, 7=yes, equal to world's best)
	Government Prioritization of ICT	Information and communications technologies are an overall government priority (1=strongly disagree, 7=strongly agree)
	Government Success in ICT Promotion	Government programs promoting the use of ICT are (1=not very successful, 7=highly successful)
	Government On-line Services	On-line government services -- e.g. downloadable permit applications, tax payments -- in your country are (1=not available, 7=commonly available)
	Laws Relating to ICT Use	Laws relating to electronic commerce, digital signatures, and consumer protection are (1=non-existent, 7=well-developed and enforced)
	Legal Framework for ICT Development	The legal framework in your country supports the development of IT businesses (1=no, strongly impedes, 7=yes, significantly promotes)
General infrastructure	Overall Infrastructure Quality	General infrastructure in your country is (1=poorly developed and inefficient, 7=among the best in the world)
	Quality of Public Schools	Public (free) schools in your country are (1=of poor quality, 7=equal to the best in the world)

	Telephone/Fax Infrastructure Quality	New telephone lines for your business are (1=scarce and difficult to obtain, 7=widely available and highly reliable)
	Electricity Prices	The price of electricity per kilowatt-hour in your country compared to international standards is (1=much higher, 7=among the world's lowest)
Public institutions: contracts and law	Intellectual Property Protection	Intellectual property protection in your country is (1=weak or non-existent, 7=equal to the world's most stringent)
	Burden of Regulation	Administrative regulations in your country are (1=burdensome, 7=not burdensome)
Domestic competition	Intensity of Local Competition	In most industries, competition in the local market is (1=limited and price-cutting is rare, 7=intense and market leadership changes over time)
	Extent of Locally Based Competitors	Competition in the local market comes primarily from (1=imports, 7=local firms or local subsidiaries of multinationals)
	Entry into Local Markets	Entry of new competitors (1=almost never occurs in the local market, 7=is common in the local market)
Cluster development	Buyer Sophistication	Buyers in your country are (1=unsophisticated and choose based on the lowest price, 7=knowledgeable and demanding and buy innovative products)
	Local Supplier Quantity	Local suppliers in your country are (1=largely non-existent, 7=numerous and include the most important materials, components, equipment and services)
	State of Cluster Development	How common are clusters in your country? (1=clusters are limited and shallow, 7=clusters are common and deep)
	Extent of Product and Process Collaboration	Product and process development in your country is conducted (1=within companies or with foreign suppliers, 7=in collaboration with local suppliers, customers & research institutions)
	Local Availability of Components and Parts	In your industry, components and parts are (1=almost always imported, 7=almost always sourced locally)
	Local Availability of Process Machinery	In your industry, process machinery is (1=almost always imported, 7=almost always sourced locally.
	Local Availability of Specialized Research and Training Services	In your industry, specialized research and training services are (1=not available in the country, 7=available from world-class local institutions)
	Local Availability of Information Technology Services	In your industry, specialized IT services are (1=not available in the country, 7=available from world-class local institutions)
Company operations and strategy	Value Chain Presence	Exporting companies in your country (1=are involved primarily in production, 7=conduct not just in production but also product development, distribution and marketing)
	Capacity for Innovation	Companies obtain technology (1=exclusively from foreign companies, 7=by pioneering their own new products or processes)
	Uniqueness of Product Designs	Product designs are (1=copied or licensed from abroad, 7=developed locally)
	Production Process Sophistication	Production processes generally (1=use obsolete technology, 7=employ the world's best and most efficient technology)
	Extent of Staff Training	In your country, companies general approach to human resources is to invest (1=little in training and development, 7=heavily to attract, train and retain staff)
	Quality of Management Schools	Management schools in your country are (1=limited and of poor quality, 7=among the world's best)
	Breadth of International Markets	Exporting companies from your country sell (1=primarily in a few foreign markets, 7= in virtually all international markets)
	Internet Effects on Business	To what extent has the Internet improved your firm's ability to coordinate with customers and suppliers to reduce inventory costs (1=no change, 7=huge improvement)

Appendix B: Table V

EXTANT COMPONENTS WITH RATING SCORES & RELATIVE RANKINGS								
Category	**Title**	**Difference in rank: WEF & NAPES**	**WEF category**	**WEF % rank of 75**	**NAPES category**	**NAPES % rank of 41**	**APEC % rank of 10**	**Description**
Technological innovation and diffusion	Availability of Scientists & and Engineers	16%	2	79	1	95	80 +-10	Scientists and engineers in your country are (1=non-existent or rare, 7=widely available)
Information and communications technology	Speed and Cost of Internet Access	13%	2	77	1	90	80 +-10	Lease-line or dial-up access to the Internet in your country is (1=slow and expensive, 7=as fast and cheap as anywhere in the world)
	Competition Quality in Telecomm Sector	16%	2	77	1	93	90	Is competition in your country's telecommunications sector sufficient to ensure high quality, infrequent interruptions and low prices? (1=no, 7=yes, equal to world's best)
	IT Training and Education	11%	2	84	1	95	90	Your country's IT training and educational programs (1=lag far behind most countries, 7=are among the world's best)
	Laws Relating to ICT Use	12%	2	71	1	83	80	Laws relating to electronic commerce, digital signatures, and consumer protection are (1=non-existent, 7=well-developed and enforced)
	Quality of Public Schools	14%	2	66	1	80	70 +-10	Public (free) schools in your country are (1=of poor quality, 7=equal to the best in the world)
Public institutions: contracts and law	Intellectual Property Protection	10%	2	80	1	90	70 +-20	Intellectual property protection in your country is (1=weak or non-existent, 7=equal to the world's most stringent)
Cluster development	Buyer Sophistication	23%	2	65	1	88	90	
Company Ops & Strategy	Production Process Sophistication	19%	2	56	1	75	70 +-10	Production processes generally (1=use obsolete technology, 7=employ the world's best and most efficient technology)
	Extent of Staff Training	12%	2	78	1	90	90	In your country, companies general approach to human resources is to invest (1=little in training and development, 7=heavily to attract, train and retain staff)
	Quality of Mgmt Schools	18%	2	72	1	90	90	Management schools in your country are (1=limited and of poor quality, 7=among the world's best)
	Internet Effects on Business	10%	2	80	1	90	90	How has the Internet improved your firm's ability to coordinate w/ customers & suppliers to lower inventory costs (1=no change, 7=huge improvement)

Appendix C

There are many reasons why China is attempting to link itself to the free market democracies which are providing the necessary capital, knowledge, and expertise necessary to become a serious link in the chain of globalization. When assessing these reasons however, a modicum of restraint is advised, since China inherently is an Asian nation, not a Western one. Here are four frames of reference to frame one's thinking about China from James Fallows.[i]

1. The *purpose* of economic life in the American-style model is to raise the consumer's standard of living. In the Asian model it is to increase the collective national strength. Ideally, the goal is to make the nation independent and self-sufficient, so that it does not rely on outsiders for its survival. As such, China may not be in a hurry to tie its destiny via ICT interlinks to Western (or even Japanese) counterparts. The American-style goal is materialistic; the Asian-style goal is political.
2. The view of *power* in setting economic policies is starkly different: the Anglo-American ideology views concentrated power as an evil whereas the Asian-style model views concentrated power as a fact of life. It has developed elaborate systems for ensuring that the power is used for the long-term national good. So while the central locus of control in China is collectively good and can be viewed as an asset in terms of moving quickly on consensus for national projects like Internet access for its people, the geopolitical mindset of China does not stop there but extends further in actually deciding what content gets filtered and what gets through to Chinese citizens surfing the World Wide Web.
3. The view of *surprise* and unpredictability in the Anglo-American model are the keys to economic life because markets are fluid and unpredictable; the Asian-style system deeply mistrusts markets and sees competition as a useful tool for keeping companies on their toes, but not as a way to resolve how a society should be run and in what direction its economy should progress. As there are no guarantees that China's approach (indeed, the approach taken by highly successful users of ICT) would be successful, it is not surprising that China might put too much emphasis on emerging technologies.

The view of *national borders* and an "us-versus-them" concept of the world; people everywhere are xenophobic and exclusive, but in the Anglo-American model this is thought to be a lamentable, surmountable failing. The Asian-style model assumes that it is a natural and permanent condition. Since the Asian mentality might be that no one will look for their interest, the likelihood for them to pin their hopes on uncertain futures (through technological investment) is unlikely. Whereas exports produce immediate results, innovation does not and therefore, takes a back seat.

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