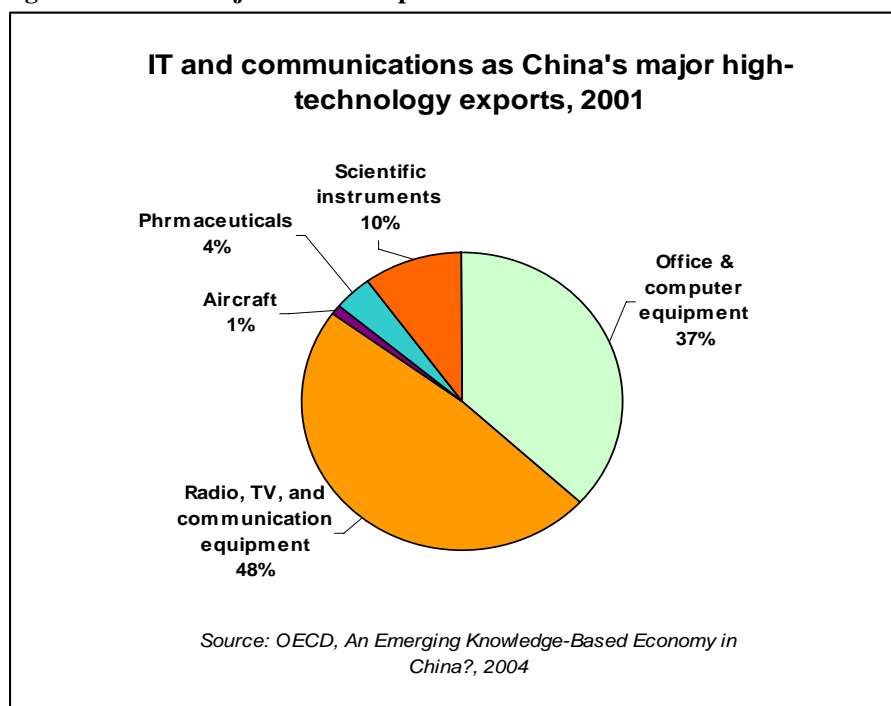


III China: ‘Opening Up’ to the Possibilities of the Knowledge Economy

China’s ability to maintain its current rates of growth will depend on investments in the KE. At almost 1.3 billion, China’s population is estimated to be 1.6 times the size of the population of the United States, EU and Japan combined. With such a large population and despite even greater economic disparities, the country has been able to enjoy long periods of stellar growth (averaging 9 percent per annum for decades). In order for China to maintain high growth rates and raise the living standards of its population the country will need to invest in new KE techniques and sectors that will make it more competitive.

China’s astronomical growth advances have been the result of the country’s ability to provide low cost, assembly line manufacturing. By the beginning of the next decade, China could become the largest exporter in the world, accounting for an estimated 10 percent of global trade. This rapid growth in China’s trade can primarily be attributed to its ability to provide cheap goods for export. The country has been able to successfully and efficiently provide assembly line services for the production of ICT goods, in particular. They now account for the largest portion of China’s export trade, approximately 30 percent in 2005, up from just over 12 percent of total trade in 1996. In 2004, China ranked as the world’s largest exporter of IT products, outstripping the EU, Japan and US, with its major IT exports being computer and communications equipment (Figure 45).

Figure 45: ICT a major Chinese export hub



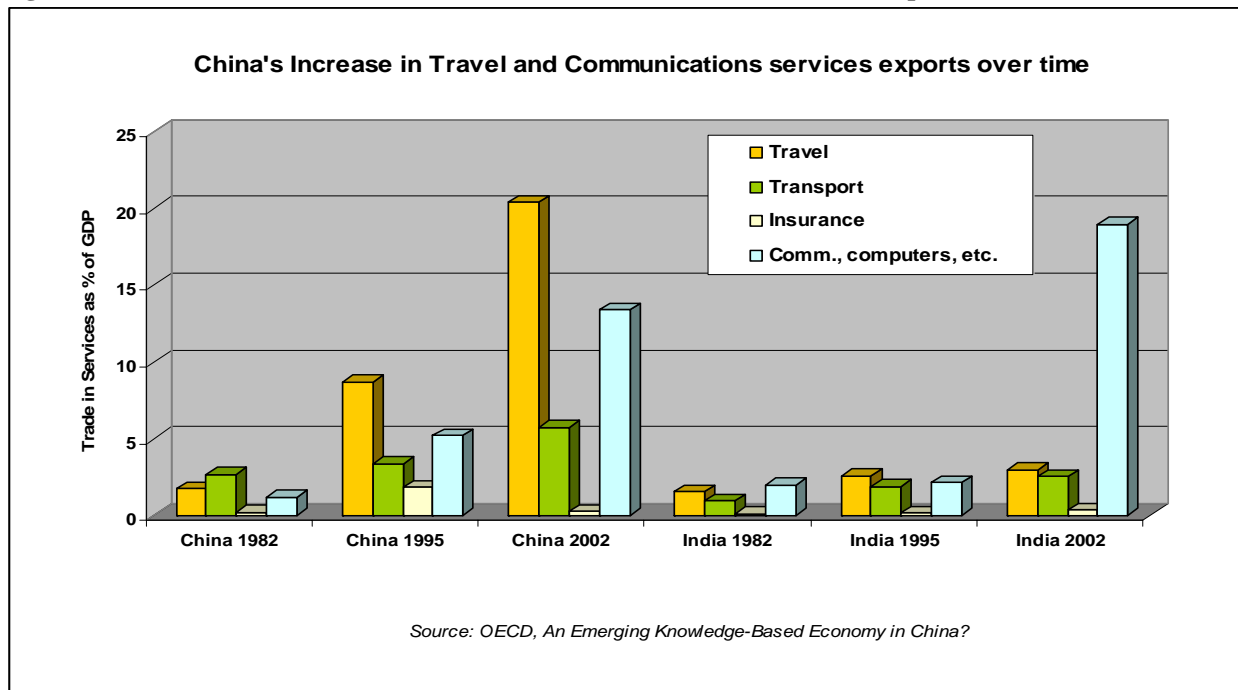
China is currently facing major challenges in its transition towards a knowledge and services based economy. In 2005, the country produced 303 million mobile phones and 81 million computers, taking second place as the world’s largest PC market, and it also became the world’s third largest producer of

semiconductors.¹⁰⁰ China's pace of IT manufacturing has drastically brought down IT costs globally. Although the country's advances in manufacturing have been impressive, China has only recently begun to confront the limitations of the sources of its growth: low cost manufacturing, imported and assimilated technology, significant flows of foreign investment, and an extremely high savings rate. China is making a rapid transition to a services based economy, with travel and communications service becoming the country's largest exports (Figure 46).

China has opened itself up to competition with its recent accession to the WTO. China's agreement with the WTO entails that it will be opening itself up to total competition, signifying that the country will need to find a comparative advantage in order to remain competitive in the global economy. The conditions of economic competition in China remain poor and strongly infused by monopolies, obscure procurement policies, protected markets, and interprovincial barriers to trade.¹⁰¹ By joining the WTO, China has agreed to undertake a series of important commitments to liberalize its regulatory framework in order to integrate in the world economy and provide a more predictable environment for trade and foreign investment in accordance with WTO rules (Box 10).

Existing tariff and non tariff barriers to internal trade diminish the potential of China's large internal market for realizing economies of scale and scope, and the removal of these barriers will allow the country to take full advantage of its large market.¹⁰² With competition coming from all sectors of the world, it will no longer be enough to import or copy high end technologies from the US and Europe. If China is to find a place in the world economy, it needs to shift to producing higher value added goods in order to support future waves of economic growth.

Figure 46: China increases travel services as India increases communications exports



¹⁰⁰ OECD Observer, 2006.

¹⁰¹ OECD, 2004

¹⁰² Ibid.

Box 10 : Accession to the WTO Entails Important Changes

The commitment of China to the World Trade Organization on a set of trade reforms that will have far-reaching impact on its economy:

- China will provide non-discriminatory treatment to all WTO Members. All foreign individuals and enterprises, including those not invested or registered in China, will be accorded treatment no less favourable than that accorded to enterprises in China with respect to the right to trade.
- China will eliminate dual pricing practices as well as differences in treatment accorded to goods produced for sale in China in comparison to those produced for export.
- Price controls will not be used for purposes of affording protection to domestic industries or services providers.
- The WTO Agreement will be implemented by China in an effective and uniform manner by revising its existing domestic laws and enacting new legislation fully in compliance with the WTO Agreement.
- Within three years of accession all enterprises will have the right to import and export all goods and trade them throughout the customs territory with limited exceptions.

Source: World Bank, China's Employment Challenges and Strategies after the WTO Accession and World Trade Organization.

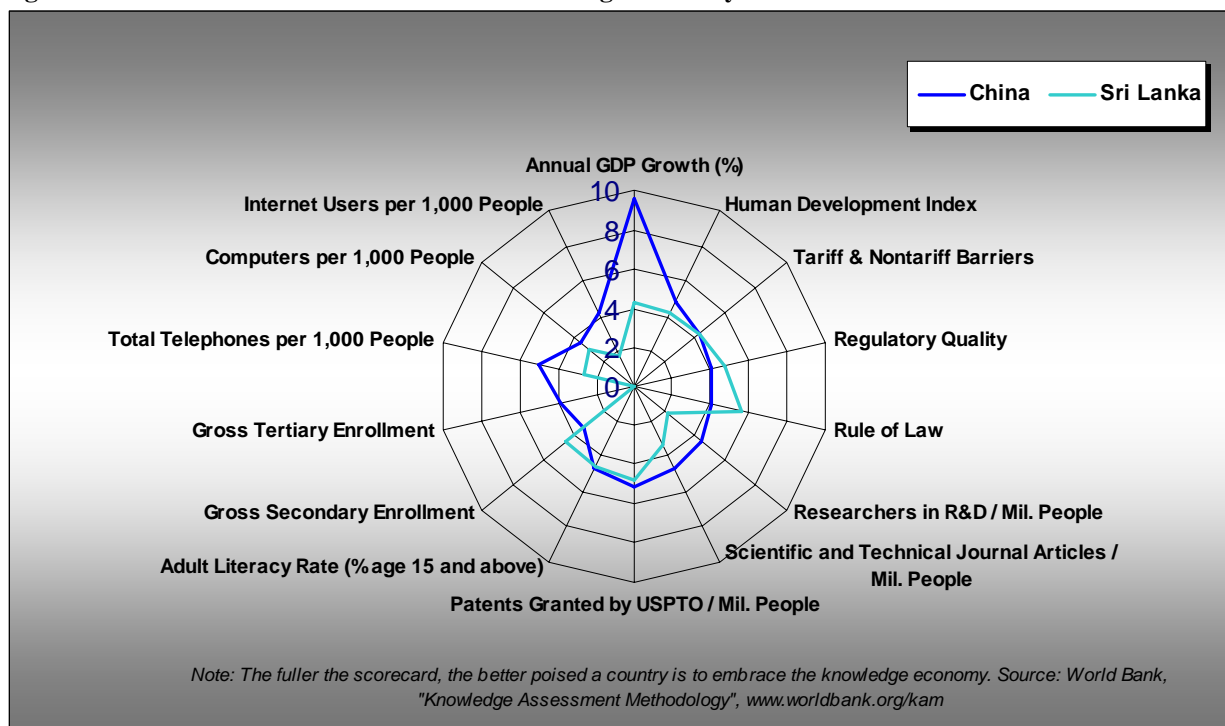
As China increasingly exposes itself to intense global competition, the country is accordingly looking to foster domestic innovation to carry it through the next stage of development. China differs from its neighbors in that China has long encouraged heavy inward investment. Of the 55 percent of China's total exports that are attributed to production and assembly-related activities, 58 percent of these are driven by foreign enterprises, of which 38 percent are entirely foreign owned. In fact, not one of the top ten high technology companies is Chinese.¹⁰³ Much of the IT assembly takes place in China, with components often imported from Japan, Taipei, the US and Europe. In response to the country's domestic innovation weaknesses, China has enacted a series of policies to transition from being a low cost manufacturer to being a global provider of high value added products, such as software, information security, and IT services. In its recent, eleventh five-year national plan for 2006-2011, the Chinese government announced its intent to foster domestic innovation in all high tech sectors through greater investment and domestically owned patents, and to reduce its dependence on foreign technology.

China's ability to embrace the knowledge economy is currently hindered by its poor rule of law, constrained markets, and low tertiary education enrolments (Figure 47). China has large and diverse provinces that differ greatly in natural and human resource endowments and in economic performance and welfare indicators. Prosperous areas include Beijing, Shanghai, and Tianjin. Parts of the poorest provinces appear to be several centuries behind in their technology and living standards. Beijing and Shanghai, the most knowledge intensive areas in China, have knowledge intensities 6.1 and 5.3 times the national average.¹⁰⁴

¹⁰³ OECD Observer, 2006.

¹⁰⁴ OECD, 2004.

Figure 47: China's Current Position in the Knowledge Economy



Overall, China has experienced impressive economic performance, reaching a high-level of human development and exceptional growth rates. The scorecard demonstrates that China's economy is still relatively protected from international competition as it scores low on tariff and non tariff barriers. Its market's lack of international exposure has resulted in a lack of competitive pressure by the global community, an environment that is not conducive to stimulating innovation and growth. China is average in its use of FDI as a way of obtaining global knowledge, but it does poorly in its domestic R&D and in the technological intensity of its exports. It also scores poorly in the indicators for the rule of law and control of corruption. The country does fairly well on adult literacy, but less well on secondary enrolment rates, and even worse on tertiary enrolment rates. The absolute number of enrolments in, and graduates from tertiary education in China match the numbers in the United States and the EU. Although large in absolute numbers, only a small portion of the population in China has a tertiary education degree. China's level of enrolments in and graduation from advanced research programmes, such as PhDs, is also significantly lower compared to other economies.

Recent Issues and Continuing Challenges facing China's Knowledge Economy

Economic and institutional Regime Issues

A considerable amount of China's economic growth has been fuelled by significant changes in government economic policy that have progressively given market forces greater autonomy. China is now in the middle of a significant transformation from a command economy to a market driven society. The momentum towards a freer economy has continued with membership of the WTO leading to the reform of a large number of China's laws and regulations and the prospect of further tariff reductions. In 2005, regulations that prevented privately owned companies from entering a number of sectors in the economy, such as infrastructure, public utilities and financial services were abolished, permitting the emergence of a powerful private sector in China's economy. The government has also introduced reforms into the state owned sector that dominated the economy in the early 1990s. State-owned enterprises have

fairly recently been transformed into corporations and, as a result, the number of state controlled industrial enterprises fell by over one half in the following five years. This transformation was supported and facilitated by the introduction of more flexible employment contracts and the creation of unemployment and welfare programs.¹⁰⁵

However, China's incentives and institutions, despite considerable progress, still constrain the economy from taking full advantage of rapid advances in global knowledge. China's institutions remain legacies of the command economy and of the Chinese traditional conceptions of the state and society, which encourage the allocation of resources based on privilege and familiarity rather than viability and productivity, causing inefficiencies in business and innovation. China's legal system, in particular, has been regarded as being extraordinarily complex and unclear, due to many uncoordinated legal initiatives of the different levels of government. Corruption, weak enforcement mechanisms, inadequately trained and underpaid judges are all staples within China's rule of law. Tax collection in China is also underdeveloped; the tax revenue of the central and provincial governments is just 14 percent of GNP, which is less than half the average for OECD countries. As a result, the government is forced to finance its spending through off budget funds, from banks.

China's financial system remains underdeveloped and is dominated by the banking sector, which is more than three times larger than the stock market. In the past, the bulk of lending went to SOEs, with the rest distributed as policy loans. But many distressed SOEs have begun to stop payment on their loans, creating a high level of non performing loans in the banking system. These forced loans constrain the emerging private sector's access to sufficient credit from the formal banking system, as banks are allocating all of their capital to projects which are less productive than some private sector projects. Thus, most of the financing for the private sector comes from re-invested earnings and informal financing, which limit the speed with which it can expand and provide productive employment.¹⁰⁶

China's government will have to reduce its direct influence on the economy and simply guide the market to promote a self-regulating, knowledge-based, socialist market system. In order to improve upon the country's political weaknesses, the government will need to create agencies for consumer protection, guard against anti-competitive practices, remove barriers to private development and foreign participation in services, where excessive regulation have constrained growth; strengthen the financial sector by increasing the autonomy of Chinese banks, permitting them to allocate capital more efficiently by instituting risk based, rather than policy based lending practices, and further develop the stock and insurance markets.

Innovation System Issues

The reform of the 1980's focused on pushing enterprises to be the driving force of S&T and R&D activities. Since the beginning of the reforms of China's national innovation system in the 1980's which sought to change the country's soviet style R&D system, the government has implemented two large scale national S&T programs that aim to foster high quality fundamental research and to facilitate the commercialization of technology. In China, the ICT industry is the most dynamic sector of the economy and there is evidence of a fast improvement of domestic firms' technological capability. The rapid evolution of the ICT infrastructure, (telephone mainlines, mobile phones, PCs, and internet) has contributed to knowledge creation, codification, and diffusion and forged a linkage between China's knowledge network and the global knowledge network.

China's new Science and Technology Program seeks to foster domestic innovation on all levels in a way that the reforms were not able to. In January 2006, China's Science and Technology Congress met

¹⁰⁵ OECD, 2004

¹⁰⁶ World Bank, 2001.

for 3 days to approve a medium and long term Science and technology program. The program identified priorities for the next 15 years and confirmed the aim of boosting investment to 2 percent of GDP by 2010 and 2.5 percent by 2020. In 2006, China for the first time spent more on research and development at just over USD 136 billion on R&D than Japan and so became the world's second highest investor in R&D after the United States. Reaching these targets will require investment in 2020 to be six times what it is today.¹⁰⁷

The Medium to Long-term plan determines 68 priority goals spread across 11 key areas of importance to China's economy and development including energy, environment, agriculture, manufacturing, transport, and public health. The plan also seeks to embark on 16 special research projects focused on core electronic devices, extremely large scale integrated circuit manufacturing technologies, wideband wireless mobile communications technology, breed new transgenic biological varieties, large scale advanced pressured water reactor, prevention of infectious diseases such as AIDS and hepatitis, R&D of giant planes, and manned space flights. Eight cutting edge technology areas and four major new research programs in protein research, nanoscience, growth and reproduction and quantum modulation research will also be implemented in upcoming years.

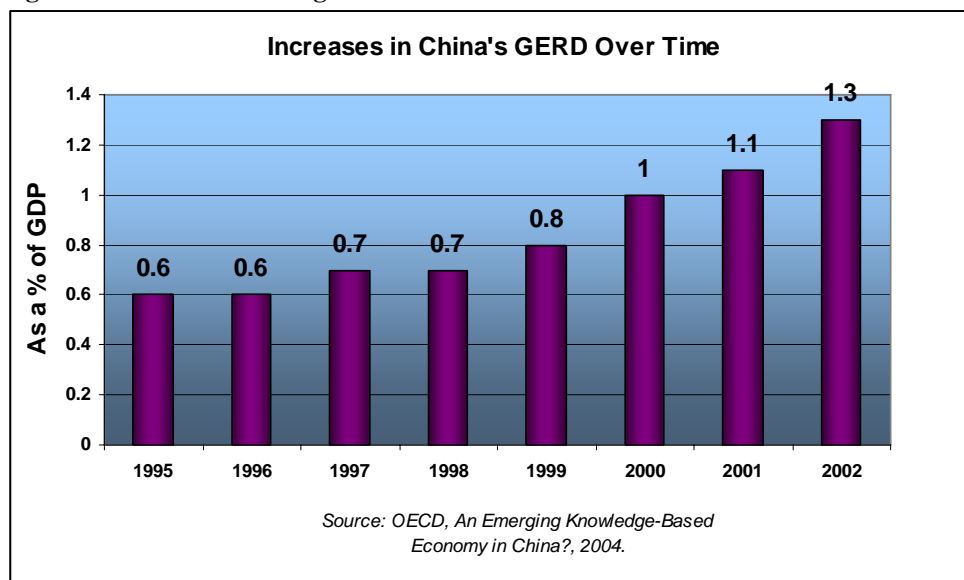
China's Innovation Strengths

Chinese policy is becoming more outward facing, as the government starts to think in terms of an integrated national system of innovation in order to meet the goals of its S&T program. China has a great chance of meeting the aforementioned goals as the government maintains the ability to mobilize resources, the world's largest scientific workforce, a high output of scientific papers and a successful strategy to attract overseas talent back to the country. Second, traditional forms of state planning and control are being replaced by lighter touch, enabling frameworks, including new funding structures and performance measures, and a far greater role of enterprise and private sector R&D. Third, there has been a marked improvement in the university sector, both in terms of the quantity of graduates, with around 350,000 IT graduates in 2004, and also in the quality of degrees and PhDs. China counts now more researchers than Japan, and is on its way to potentially overtake the EU as well. Finally, China has stepped up in the internationalization of its research system, with extensive networks of collaboration across Europe, Japan and the US, and a more visible presence in international journals and conferences. China's spending on R&D as a percentage of GDP, known as R&D intensity, has more than doubled from 0.6 percent of GDP in 1995 to just over 1.2 percent in 2004 (Figure 48). In 2004, the expenditure on research and development activities for the whole country was 184.3 billion Yuan, up 19.7percent over 2003, accounting for 1.35 percent of national GDP.¹⁰⁸

¹⁰⁷ Hepeng, Jia and Fu Jing, 2007.

¹⁰⁸ OECD Observer, 2005.

Figure 48: China increasing R&D overtime



Weaknesses in China's Innovation System

China needs to improve its dissemination of technology and facilitate a greater transfer of knowledge from the most efficient producers to the least efficient. Technology diffusion is fundamentally important for technological upgrading, but Chinese industries devoted very limited efforts and resources to technological diffusion in the past, preferring the import of technology. The absence of technology transfer channels to diffuse research results from public-funded research institutes to industry is another major impediment to the Chinese innovation system. Furthermore, as industries, universities, and R&D institutions belong to different administrative systems in China, it prevents the free flow of resources and knowledge between them.

Market institutions are still underdeveloped and ineffectively regulated. A better functioning market economy is a prerequisite for efficient knowledge and technology dissemination. Through joint funding between local and provincial governments, the central government should give higher priority and greater resources to technology dissemination schemes: engineering, research and productivity centers, renovated programs for rural industries, extension services in agriculture, and regional technical centers to support small and medium size enterprises. There is a lack of incentive for Chinese enterprises to devote their resources to R&D, since returns on investment in other activities tend to be higher and more immediate. This market environment has discouraged Chinese enterprises from undertaking R&D and other efforts to improve their product qualities and technical standing.¹⁰⁹

Private sector participation in R&D

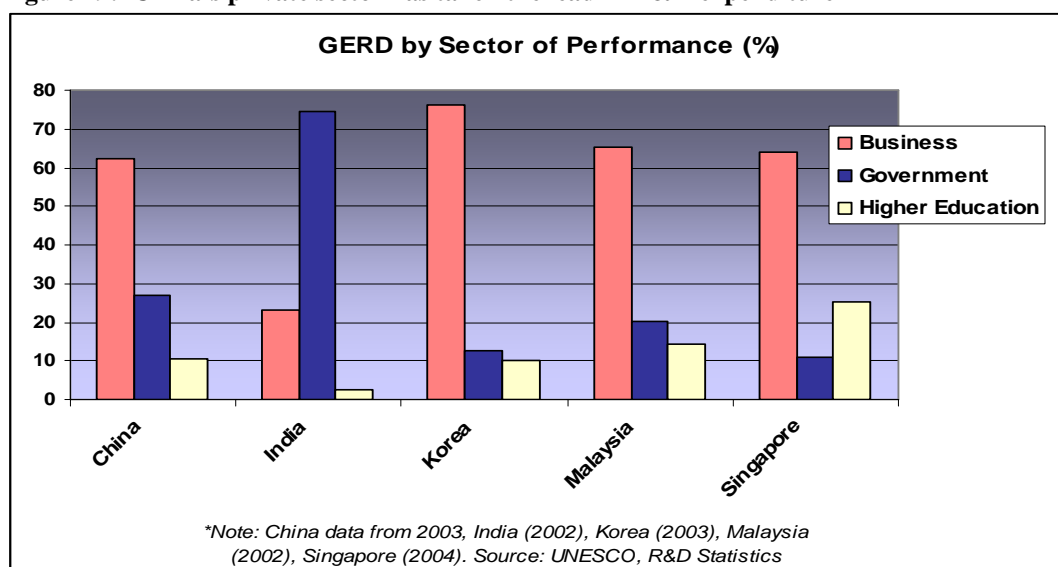
Chinese enterprises, particularly SOEs, do not invest sufficiently in R&D. A significant amount of China's growth and development has relied on imported technologies, demonstrated by the low 0.03 percent of Chinese firms that own the intellectual property rights of the core of technologies they use. This acts as a serious constraint on profitability. In terms of R&D intensity and patenting Chinese enterprises are spending on average only 0.56 percent of turnover on R&D expenditure while larger firms are spending a low 0.71 percent. China's business R&D has increased slowly from 40 percent to 45 percent of total GERD between 1991 and 1998, after which it shot up sharply to 61 percent in 2002. The

¹⁰⁹ OECD, 2004.

current level is not far behind that of the developed economies, and thus quite high for a developing economy (Figure 49).

The greatest challenge is to get Chinese companies to be more innovative, particularly in state owned enterprises, where management is still appointed by their superior administrative agencies and careers are not determined, or significantly influenced, by the performance of the enterprises that they manage. Since many of these managers' posts are of a political nature, and they are likely to be reassigned to a new post in a few years time, managers tend to be more interested in working on short-term, low-risk issues. However, since investment in R&D often carries high risk and may take a long time to deliver economic returns, R&D tends to be treated as a low priority by SOE managers. Because of this low priority, management of technological innovation is, consequently, weak in Chinese enterprises. Regardless, under a planned economy, state-owned enterprises (SOEs) are connected to state development plans, and are therefore in a favourable position to receive state allocations of various funds for innovation and technological upgrading. Therefore, they enjoy better access to the capital market for financing. China's R&D resources have therefore been channeled to SOEs, which lack the incentive to undertake R&D, while the smaller and non-state enterprises, which are more motivated to innovate, cannot get the resources they need. A greater percentage of finance needs to be distributed to the non state enterprises.¹¹⁰

Figure 49: China's private sector has taken the lead in R&D expenditure



Plagiarism and Misconduct

Protection policies must be strengthened in order to encourage people and enterprises to innovate and generate publications and patents. Since there are substantial benefits associated with scientific findings, a large number of people tend to plagiarize results, making research collaboration difficult. As a result, most researchers are said to work with the door closed. This resulting practice is inefficient and bad for innovation as it blocks technology dissemination. China's share in patent grants or applications at the US Patent and Trademark Office and the European Patent Office is still very small. However, the level of international co-operation in science and technology, measured by patent applications owned or co-owned by foreign residents and patents with foreign co-inventors, is actually higher for China than for most large economies. Chinese enterprises are adversely affected by the poor protection of intellectual property rights (IPR) in two specific way; enterprises find little incentive to invest in their own R&D and

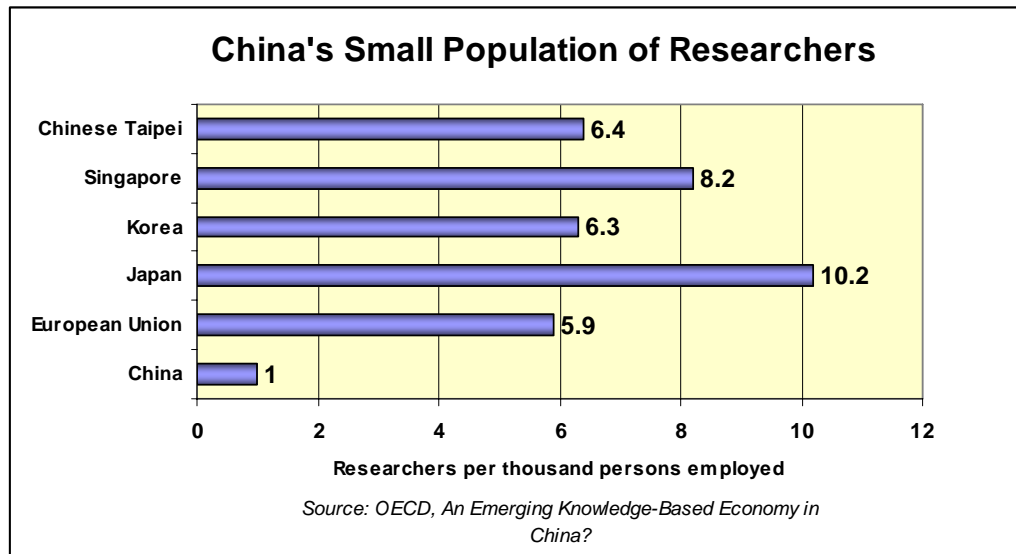
¹¹⁰ OECD, 2004.

innovation as many enterprises simply rely on copying and imitating others' production technology and product designs and in enterprises that do put resources into R&D, their investment interest is hampered by the fact that their R&D results cannot be effectively protected in the market.¹¹¹

Inadequate R&D Personnel

China's supply of R&D personnel is currently inadequate to meet the needs of the ambitious science and technology development program. The quality of the Chinese R&D personnel is generally low and unsatisfactory and the problem starts from the Chinese education system, which emphasizes theoretical and exam oriented learning at the expense of lifelong learning and problem solving skills. This is further worsened by the lack of investment in personnel training in the enterprise sector, which limits the knowledge upgrading of technical personnel. Furthermore, China has experienced a major brain drain in the last two decades, with a large number of educated Chinese going abroad to study, and the majority having not yet returned to China.

Figure 50: More researchers needed in China



Education Issues

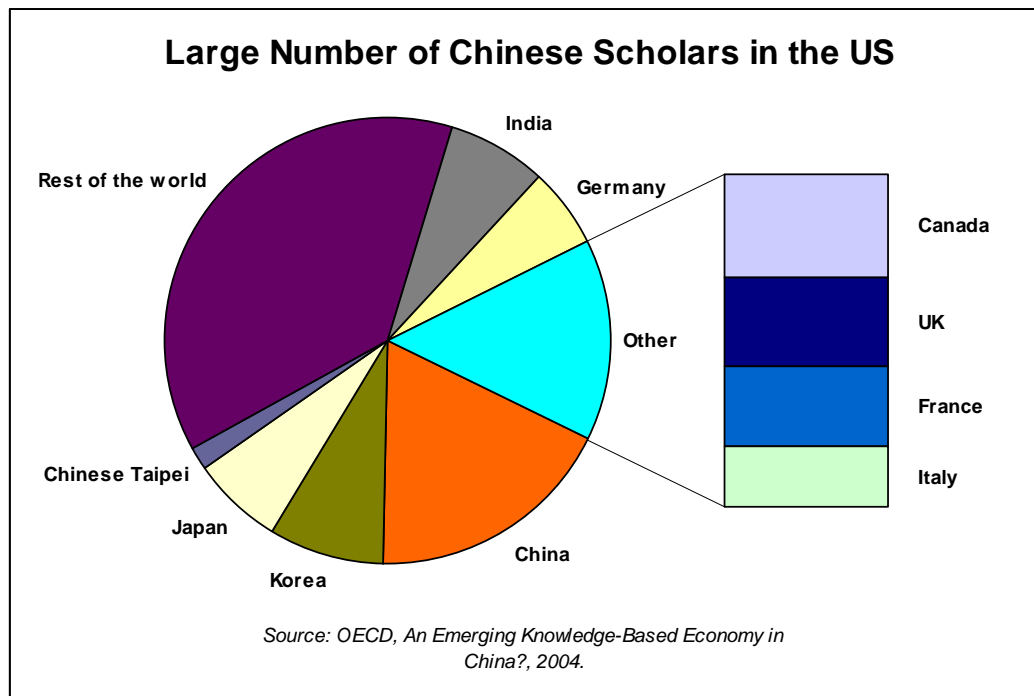
China has been able to provide students who are not able to get into universities with an effective alternative in privately funded tertiary institutions. In higher education, the government deserves credit for encouraging the mergers of small, single discipline institutions to broaden the education of students and lower the unit costs. The authorities of the public higher education system have a very selective recruitment, creating intense competition for these seats. In addition to China's public higher education system, and an independent military higher education system, there is a large informal private system of higher education which has grown rapidly since the early 1980's. Privately funded tertiary institutions are non profit entities that derive revenues from tuition and boarding fees. They offer a limited range of professional and practical courses and programs and attract second chance students unable to get into public universities. Because of the limited access to institutions of higher education, self study for the state administered higher education qualification examination has become an alternative.¹¹²

¹¹¹ World Bank, 2001.

¹¹² OECD, 2004

A large number of Chinese students go abroad in order to receive educations that are well rounded. China should develop more high quality teaching universities domestically to educate its students, reduce the need to finance education abroad, and even attract more foreign students to China. Other countries, particularly the US are benefiting from Chinese scholars that enroll in the country's universities in order to receive education that focus on soft skills as well as the hard skills (Figure 51). China's higher education institutions have limited autonomy in managerial, financial, and pedagogical matters. They lack choice in determining academic offerings, the number of students they can admit, and the tuition they charge.

Figure 51 An influx of Chinese Scholars in the US



China needs to pay more attention to soft skills to develop its private sector. The country needs to pay more attention to finance, law, accounting, design, marketing, education, technology and consulting, management, human resource development, foreign language fluency, and the ability to work in teams. These soft skills have been underdeveloped because of the traditional emphasis on mastering the hard skills. In order to attract back Chinese students from abroad and bring more foreign students to Chinese universities, the country will need to update its education system with a more modern curriculum that focuses on these soft skills that will be significant for the knowledge economy.

Vocational education

China needs to lower the enrolment in vocational schools and subsequently improve the quality. Vocational schools make up a large part (60 percent) of China's secondary education system. The qualifications from vocational schools are too narrow, due mainly to the numerous, over detailed specifications from the planned economy. The vocational and training system should put more emphasis on general competencies that promote adaptability and lifelong learning, and less on job specific skills. The economy needs skills in technology, software, management, and services. It also needs core skills that people can transfer across occupations and industry like entrepreneurship, language, social, and

teamwork.¹¹³ Most observers agree that China should encourage more students to go through a standard secondary education.

Updating Curricula

Increases in funding should be distributed towards quality inputs and modernizing the curriculum in all areas of the country. Although modern techniques are being increasingly incorporated into Chinese curricula, more emphasis needs to be placed on problem solving. Use of advanced information technologies are already leading to substantial changes in the Chinese education system. Innovative methods are being developed and used to deliver better education, in service training for primary and secondary school teachers, and training in communications and agriculture including cable television, satellite television, and online training. However, the curriculum needs to focus more on problem solving and practical skills.

More resources need to go to the rural areas. More than 60 percent of education spending goes to the primary and junior secondary segment, but poor areas lack resources for investments, a gap widened by private resources in more affluent regions. In order to combat this regional divide, China should expand compulsory education from 9 to 12 years. New methods of training, new learning materials (books) and more well trained teachers are needed. Public schools lack the resources and flexibility to adjust to the needs of the rapidly changing economy and society, while private schools, which possess greater resources and autonomy, have a competitive edge in developing new curricula and teaching methods.¹¹⁴

Information Infrastructure

Most of China still has limited and poor quality access to information infrastructure, but the digital divide is decreasing. China still lags behind most East Asian countries in telephones, computers, and internet connections per capita (Figure 52). Telephone subscriptions are increasing at a fast rate, with mobile phone subscribers overtaking fixed line subscribers in October 2003. Even though the absolute size of internet subscribers is large, the size is small in relation to the whole population. At the end of 2005, China had 111 million Internet users, amounting to just 8 percent of the population, compared with 50 percent in OECD countries. The number of broadband users stood at 64.3 million. In terms of internet users, there is a trend toward resolving the regional digital divide, with a decrease in the share of internet users in the municipalities of Beijing and Shanghai as well as the Eastern Coastal Province of Guangdong, with an increase in the share of the Western Region.

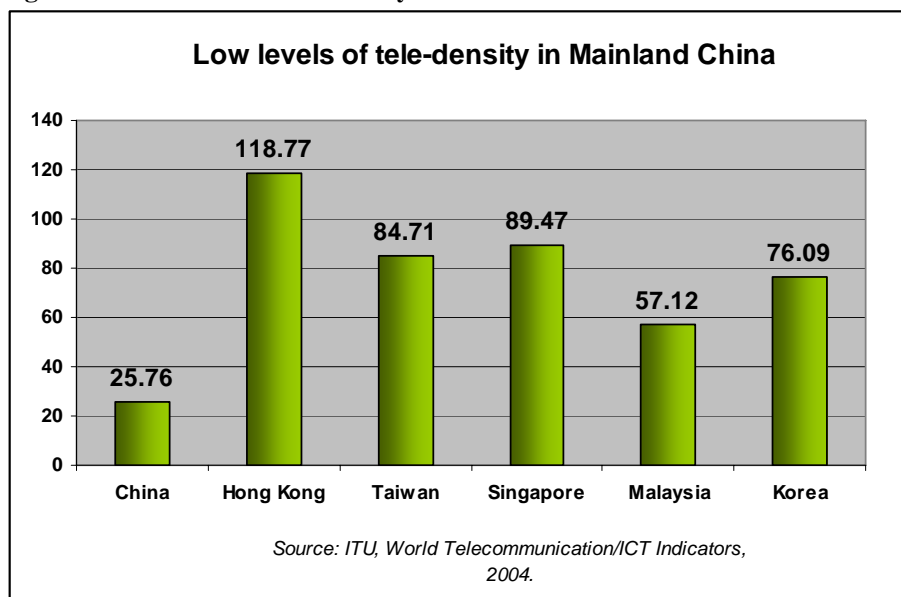
While low IT costs brought by China's competitive supply has helped OECD based firms upgrade, reorganize and boost productivity, the actual uptake of IT within Chinese firms is lagging behind. Notions like supply chain management, resource planning or knowledge management software that are standard currency in OECD firms are still undeveloped in China. Access to IT by the Chinese population is variable with a wide digital divide between urban and rural areas.¹¹⁵ China will need to decrease the digital divide within its country and find efficient way of bringing about connectivity to a larger share of its population.

¹¹³ World Bank, 2001.

¹¹⁴ OECD, 2004.

¹¹⁵ OECD Observer, 2006.

Figure 52: Low levels of tele-density in mainland China



As with most telecom industries, a greater level of competition will result in a larger share of the population having access to ICT services. China will need to promote greater competition by further opening markets dominated by China Telecom and other SOEs, create an independent regulatory body, and open more to foreign investment as a source of capital and technical expertise for information technology services. The country should promote greater use of information and communication technologies throughout the economy, such as; giving technical support to small and medium size enterprises; improving the efficiency of the banking system, including electronic banking, payment systems, and a national credit rating system; delivering internet based education and health services, promote electronic commerce-business to consumer and business to business.¹¹⁶ China has made big strides, but telephone penetration, computer use and internet access, especially in rural and urban areas are still lagging and desperately need to be improved in order to create a knowledge enabling society.

What can Sri Lanka learn from China's efforts in making a transition to the knowledge economy?

Sri Lanka needs to begin fostering domestic innovation in order to remain competitive in the knowledge economy. China is beginning to recognize the need to reform its economy and promote the development of domestic innovation. However, China is facing great challenges in moving towards a more knowledge based economy because it maintains a relatively stringent political regime. Sri Lanka, having one of the most liberal economies in South Asia, will not have so many challenges in developing a domestic innovation system. The main issue for Sri Lanka will be developing an innovative culture, which has proved to be a significant challenge in recent years. China is still in its early stages of making a transition to the knowledge economy, but what Sri Lanka can learn from China is that a history of having a closed economy is difficult to overcome, and integrating into the global community will take much more time. Since Sri Lanka is also in its beginning stages of knowledge development, the country should put great effort into strengthening innovation enabling factors such as IPRs and other protection policies. This will allow the country to innovate in an effective and efficient manner when it begins to develop a stronger and more powerful research and development base.

¹¹⁶ World Bank, 2001.