Technology, globalization, and international competitiveness: Challenges for developing countries

Carl Dahlman*

1. Introduction

This paper traces the role of technology in economic growth and competitiveness, summarizes the strategies of the fastest growing economies over the last 50 years from the perspective of their technology strategy, summarizes some of the key global trends which are making it more difficult for developing countries to replicate the fast growth experience of the countries mentioned, and traces the impact of the rise of China on developing countries. The main argument of this paper is that technology is an increasingly important element of globalisation and of competitiveness and that the acceleration in the rate of technological change and the pre-requisites necessary to participate effectively in globalisation are making it more difficult for many developing countries to compete.

Section 2 gives a long-term perspective on technology and economic growth. Section 3 presents a global overview of changes in regional competitiveness as revealed by economic growth. Section 4 identifies some of the high performers in the last 50 years and reviews the strategies of the high performing East Asian economies comprising the well known "gang of four", plus three South East Asian countries. Section 5 reviews the strategies of the BRICM countries, the largest developing country economies (Brazil, Russia, India, China and Mexico). It also argues that it is harder for developing countries to replicate the success of the high performing East Asian countries for two main reasons. One relates to new elements in the global competitive environment. These are summarized in section 6. The other is the rapid rise of China (and to a lesser extent India). This is covered in Section 7, which also includes a preliminary analysis of the effects of the rapid rise of China on the rest of the world. Finally, Section 8 draws some conclusions. Developing countries must develop more technological capability and greater flexibility to succeed in the more demanding and asymmetric global environment. It is likely that the pressures of globalisation and greater international competition generate strong protectionist retrenchment in both developed and developing countries. These should be resisted. The world as a whole will be better off if developed countries focus on increasing their flexibility to adjust to changing comparative advantage resulting from rapid technical change, and developing countries focus on increasing their education, infrastructure, and technological capability. There remain however large asymmetries in the global system and greater efforts need to be made to provide some global balancing and transfer mechanisms.

* Georgetown University, Edmund A. Walsh School of Foreign Service.

2. Knowledge, technology, and growth in long-term perspective

2.1 Long-term trends

One of the best ways to see the role of knowledge in development, which is both sobering and enlightening, is to take a long historical perspective on both the growth of population and the increase in average per capita income (figure 1).[1] For the first 1,400 years of the past two millennia, the global population grew very slowly.[2] Although there were privileged elites with much higher income during this period, average per capita incomes hovered around $400 (in 1990 international US dollars). This figure is sobering in that it is roughly the same as that for today's poorest countries. Yet something remarkable began to happen around 1500. Both the global population and per capita income began to increase simultaneously. This shift was due to the convergence of many factors, in particular: better hygiene; the development of ingenious ways to harness wind and water power to augment human and animal energy; and advances in agricultural techniques such as irrigation, improved seeds, and multiple cropping. What is even more remarkable, when viewed from a long-term perspective, is how suddenly, even seemingly exponentially, both population and per capita incomes began to rise from the 1800s onward. This tremendous growth was in large part led by the development of the steam engine, whereby mankind was first able to harness fossil fuel energy for productive tasks. This augmentation of power enabled the industrial revolution with the corresponding proliferation of productive activity and expansion in the range of products and services brought to market.

As a compounding factor, further improvements in agriculture released a stream of labour into the recently arisen and relatively more productive industrial sectors. Simultaneous with these demographic changes and enhanced production technology, railroads and steamships supported scale economies and provided new opportunities for specialization and exchange. In the early nineteenth century, this broad social and economic transformation set the course toward the advanced standard of living which is today the hallmark of developed countries.

These first basic transformations were followed by successive radical inventions and corresponding institutional restructurings. Consider, for example, the advent of electricity. More or less suddenly, power could be distributed in discrete units including into the home for powering numerous labour saving devices. This technological change gradually released women into the workforce and increased output. Other examples include the following: gas and then electric lighting increased the length of the working day; the development of the gasoline engine untethered power from grids and led to more flexible transportation; the telegraph, and then the telephone reduced distance by making it possible to communicate and coordinate activities across space, enlarging markets and furthering opportunities for

specialization and exchange. Eventually, the development of the semiconductor spawned the current information technology revolution which ought to be viewed as one more epochal innovation wave that transforms the organization of economic and social activity.[3] As such, development strategy today must be based upon the evolving productive and developmental logic of information technology and knowledge economics.

Regrettably, the benefits of all these many historical advances have not been equally spread. From the 1700s onward, per capita incomes diverged across countries and regions (figure 2). The benefits of increased per capita income concentrated first in England which spawned the industrial revolution, then spread to Western Europe, and soon thereafter to the United States (US). By the end of the 1800s, the US began to overtake Europe in many areas of industrial production.

Looking at figure 2, it is natural to ask: what accounts for the dazzling performance of the US? To a great extent, US growth was supported by a large internal market that allowed broader exploitation of transportation and communications advances starting with the railroad. Embracing these technologies brought large cost reductions from extensive economies of scale and scope. The US was also a land rich in natural resources including navigable rivers, arable land, timber, and minerals. Yet, more important than these contributing factors, the foundation of American economic growth was a fabric of institutions and an economic incentive regime which supported entrepreneurship, experimentation, and risk-taking. A core expression of this orientation, the US may be said to have invented the process of invention itself— when Thomas Alva Edison created the first industrial research and development (R&D) laboratory. After Edison, the industrial R&D lab was quickly imitated by many large US companies. By 1900 there were more industrial research laboratories in the US than in Europe.

Citing R&D as the core element in US economic growth may lead some to think that the solution to unequal economic growth is to create more research capability in the developing world. While this orientation may help, the innovation needs of developing countries are both simpler and more complex: simpler because to a large extent developing countries can attain increases in productivity by making effective use of existing knowledge; more complex, because the key requirements of technology-driven development are not just new knowledge.[4] In addition, development requires education, packages of technical skills, and a whole series of institutions, networks and capabilities which enable the effective use of existing knowledge and must be part of, or even precede, any serious effort to create new knowledge. Because addressing these constraints is critical for developing countries, the following sections offer greater detail on different aspects of innovation in order to lay the groundwork for explaining the strategies of different countries over time.

2.2 Innovation in the context of developing countries

Innovation in the context of developing countries is not so much a matter of pushing back the frontier of global knowledge, but more the challenge of facilitating the first use of new technology in the domestic context. Innovations should be considered broadly as improved products, processes, and business or organizational models. Development strategists ought to think not only of R&D and the creation of knowledge, but also attend to the details of its acquisition, adaptation, dissemination, and use in diversified local settings. It is useful to review what is involved in each of these five activities as this taxonomy will help structure the analysis of the most appropriate policies, institutions and capabilities necessary to increase innovation in the broad sense suggested here.

2.3 The creation, acquisition, adaptation, dissemination, and use of knowledge in developing countries

The *creation* of knowledge is the process of inventive activity. It is usually the result of explicit research and development effort normally carried out by scientists and engineers. The key institutions involved in the creation of knowledge are public R&D laboratories, universities, and private R&D centres. However, not all creation of knowledge is the result of formal R&D effort. Sometimes inventions come from the experience of production, or through informal trial and error; sometimes they come from serendipitous insight. Notably, the multiple origination of knowledge raises a measurement problem because not all R&D activity results in an invention, and not all inventions come from formal R&D activity. Nonetheless, various proxies are available to track knowledge, R&D effort, and their interconnections. Accordingly, the most standard proxies will be applied as needed in the following discussion.

For countries behind the technological frontier, *acquisition* of existing knowledge may be expected to yield higher increases in productivity than would flow from a similar scale investment in R&D or other efforts to push back the technological frontier. There are many means of technology transfer for private goods. Direct foreign investment, licensing, technical assistance, importation of technology as embodied in capital goods, components or products, copying and reverse engineering, and foreign study are the key channels. Also, more generally, easy communication allows access to technical information in printed or electronic form, especially including what can be accessed through the internet. Proprietary technology is usually sold or transferred on a contractual basis. But even proprietary technology may leak out depending on the strength of the Intellectual Property Rights (IPR) regime and its enforcement, and the reverse engineering capacity of users. However, despite significant proprietary constraints, much of the most useful technology is in the public domain or is owned by governments who could potentially put it in the public domain. As such, the key challenges for

development strategy are less about the creation and acquisition process and more often related to the challenges of delivering technology and knowledge to those who need it.

Technologies often must undergo *adaptation* to be applicable in specific local conditions. This need is particularly clear in agriculture, where new technologies such as hybrid seeds are very sensitive to specific local conditions. To meet local needs, further research and experimentation is often required to adapt general agriculture solutions to specific temperature, soil, and water conditions as well as local pests. To a lesser extent, even industrial technologies have to be adapted to local conditions: access to raw materials, sources of power, labour traditions, various standards, and climate are just some of the local idiosyncrasies that leave their mark on industry. And yet, often the skills necessary to adapt technologies to local conditions are not too dissimilar from those necessary to create new technology. Similar to knowledge creation, adaptation also requires research and experimentation.

In the private sector, the *dissemination* of knowledge happens when enterprises expand, sell, or transfer their knowledge, or when other firms or organizations imitate or replicate the knowledge others have created. The efficient dissemination of knowledge requires appropriate mechanisms to educate potential users in the benefits of the related technology, often a process inclusive of broad educational advance, not just the provision of technical information.[5] Much dissemination also occurs through the sale of new machinery or other inputs that embody a new technology. There are also specialized institutions, such as agricultural research and extension systems, productivity organizations, and consulting firms that specialize in helping disseminate technologies. These efforts usually involve explicit training, demonstration projects, or technical assistance on how to use the technology.

To *use* new technologies usually requires literacy as well as specialized training. Also, beyond education, using new technology often requires access to complementary inputs and supporting industries, and access to finance for new equipment, inputs or purchase of the technology license. When it involves starting a new business, it is important to have a supportive regulatory environment, namely one without excessive red tape, but which at the same time has a strong rule of law, respects private property, and facilitates the enforcement of contracts. At the broadest level, knowledge use also requires macroeconomic stability and good governance. In short, it requires a well developed economic and institutional regime.

Countries have followed different strategies in how they created, acquired, adapted, disseminated or used knowledge for their development. Most countries that are behind the global technological frontier can take advantage of acquiring knowledge that already exists elsewhere in the world and adapting it for use in their local settings. This is most often done through trade and through formal technology transfer agreements. Foreign technology owners are not always willing to license their cutting edge technology.

Some countries explicitly try to attract foreign investors to bring their advanced foreign technology to their countries, while others do not. In addition, not all countries that have put in place foreign investment promotion policies have met with success. Countries have sometimes preferred to develop their own technology, rather than to rely (primarily) on foreign technology. Sections 4 and 5 of the paper will trace the strategies of the high performing countries and the largest developing countries. I will attempt to draw some conclusions on what works under what circumstances before considering some of the new elements of global competition (sections 6 and 7) which are affecting what may be feasible in the new, more demanding context.

3. Global overview of changing competitiveness

Before focusing on the strategies of the developing countries that have had the highest rates of growth in the last 50 years, it is useful to have a somewhat broader perspective of the relative performance of different regions. Figure 3 presents the shares of global GDP accounted for by the two largest single economies as well as the European Union (EU), plus the developing world divided into the six regions used by the World Bank.[6] This is done using two different sets of data. In Figure 3a, nominal exchange rates are used. In Figure 3b purchasing power parity (PPP) exchange rates are used.

As can be seen in Figure 3a, the share of the US in global value added declined during the seventies and eighties as Japan increased its share. The Japanese economy experienced very fast growth in the first half of the twentieth century based on copying and reverse engineering of technology developed in the West. This rapid growth was truncated during the World War II and its direct aftermath, but resumed soon thereafter, again, based on copying and reverse engineering of foreign technology. By the second half of the twentieth century, Japan innovated many elements of what came to be known as the Japanese production system, eventually becoming the fastest growing economy in the world. Japan has, however, not managed to recover fully from recession in the early 1990s.

The US, on the other hand, had faster growth in the second half of the nineties than the rest of the world and recovered most of its lost global GDP share by 2000. The rapid growth of the US in the last five years of the twentieth century, at an average annual rate of 5 per cent, was remarkable. Until then, it had been thought that countries at the frontier could not grow so fast. Its rapid growth was attributed to investments in information technology and organizational change which began to be made in the late 1980s and early 1990s when the country was trying to keep ahead of Japan. It is noteworthy that the EU also lost global GDP share, whether measured by the original EU 15 countries, or the expanded EU-25.[7]

In the developing world, the only region that continuously increased its share of global GDP was East Asia. All other regions lost global GDP share or at best barely maintained it. The remarkable growth of the East

Asian developing countries can be appreciated better when GDP is converted using PPP exchange rates as in Figure 3b. In that figure it can be seen that the share of the East Asian developing countries surpasses that of Japan and begins to approximate that of the US.

4. Countries with successful long-term growth

Only a handful of countries have made the transition from "developing" to "developed". Japan did it in the first half of the last century. The "gang of four" (Hong Kong, China; Republic of Korea, Singapore, and Taiwan, Province of China) did it in the second half of last century.

It is instructive to identify which countries have achieved high growth performance over the last 50 years and to compare their strategies and performance with that of the five largest developing countries (the BRICMs).[8] Table 1 presents the average annual rates of GDP growth for all countries that have grown at an average annual rate of 5 per cent or more between 1965 and 2004. It also includes the rates of growth for the last 14 years as well as the last 4 years to see how they have done in the more recent period.

On the high performer side, there are a couple of surprises. Pakistan has averaged annual growth above 5 per cent for both parts of the period, although its average growth rate has slowed over the last 14 years. It is now also a special case given the geopolitical developments since 9/11, and will not be covered here. Botswana is a special case due to its diamond trade and also will not be considered here. The other high performers are the familiar ones from East Asia. The original Asian "gang of four" (see above) make it to the group of high performers, in spite of the 1997 Asian crisis, which hit all of them hard. Hong Kong, Singapore, and Taiwan, however, experienced a somewhat slower average rate of growth for the last four years – a fact that may be related to the rapid rise of China. Three of what are sometimes called the next-tier Asian newly industrialized countries (NICs) – Indonesia, Malaysia and Thailand – also make it.[9] China, which did not receive much attention as a high performing country even at the beginning of the 1990s in spite of its track record, has been the best long-term performer of all and will be the central focus of section 6 of this paper.[10]

Among the other BRICMs, the two Latin American countries (Brazil and Mexico) grew at over 5 per cent annually in the first half of the period. In contrast, they grew at less than 3 per cent in the second half, slower than the global average, and have lost share in the global economy.[11] India, on the other hand, which grew at an average of only 3.3 per cent in the 1965-1980 period, grew at 5.8 per cent in the 1980-2004 period. Its growth has actually been accelerating, and for 2003-2005 it grew at 8 per cent annually. Russia went through a crisis and fragmentation with severe contraction of GDP during the transition, and even a significant drop of life expectancy. Since 1998, it has started to grow thanks to massive oil and gas exports, with an average growth of 6.8 per cent for 2000-2004.[12]

The high performing East Asian economies plus the BRICMs accounted in 2004 for 50 per cent of the world's population, 15 per cent of its gross national income (33 per cent in PPP terms), and 25 per cent of its merchandise exports (see table 7). Given that these 12 economies account for 60 per cent of the developing world's population, about 75 per cent of its GDP, and 93 per cent of its merchandise exports, it is quite instructive and relevant to examine in more detail the strategies of the Asians compared to the non-Asian BRICM countries that have not been performing as well.[13]

Table 2 maps their strategies in terms of the extent to which they have relied on foreign direct investment or their own R&D and the extent to which they are inward or outward oriented. All the successful Asian countries have been outward oriented in their trade strategy while the non-East Asian countries have been more inward oriented. An inward orientation means that they have tended to protect the domestic market from outside competition and have also generally tried to develop their own technology. An outward orientation does not necessarily mean low tariff and non-tariff barriers. It means that the countries have generally been open to outside ideas and have used exports as a way to put pressure on domestic firms to improve their capabilities even while there may have been some degree of protection. It is also useful to distinguish between countries that have been relatively passive in their openness to foreign direct investment (FDI) and those that have been more strategic in using industrial policy extensively to induce FDI to develop backward linkages and increase its contribution to the economy.[14]

This is just a rough characterization of the broad strategies of these countries. As will be seen in the summaries below, there have been some changes over time. Those changes are in themselves significant and will be picked up again after this section, for they have implications for what other countries will or will not be able to do. Tables 3, 4 and 5 provide some key indicators for the "gang of four", the other high performing Asian economies, and the BRICM countries respectively.[15]

4.1 The first wave of high performing East Asian economies[16]

Republic of Korea: Autonomous technological development

Korea's strategy is close to that of Japan. Like Japan, it relied very little on FDI. Instead, initially it acquired a lot of its technology through trade, copying, reverse engineering and technology licensing.[17] When it became a competitive threat to the countries that were licensing technology, its companies had to begin to invest in R&D to develop their own technology.[18] The government had a strong role in industrial policy. It used success in the export market as the yardstick by which to measure performance. This also led to the creation of large industrial conglomerates known as chaebols. These have been part of the Korean success story because they have had deep pockets to cross-subsidize risky ventures in new areas out of the profits of their more competitive "cash cows". In 1965 Korea spent only 0.5 per cent of its GDP

on R&D and 80 per cent of the effort was undertaken by the government. By the mid 1990s it was spending over 2 per cent of GDP, more than 70 per cent of which was accounted for by the private sector, primarily the chaebols, who were having trouble obtaining licenses from foreign competitors. It was only after the 1997 financial crisis that Korea opened up to foreign investment to get foreign exchange into the economy from the sale of failed companies, but also to get access to more advanced foreign technology and to put pressure on domestic firms to perform better.[19] Even so, as can be seen from Table 3, among the "gang of four" Korea has relied the least on FDI. On the other hand, Korea invests the most in R&D and in higher education. It has one of the highest tertiary enrolment rates in the world.

Hong Kong: Laissez-faire development

Hong Kong, at the other extreme, is a laissez-faire economy with complete integration into the global trading system. Along with Singapore, it is one of the countries most dependent on trade and FDI for access to knowledge. The share of trade to GDP is over 300 per cent in both, and the average share of FDI to GDP has been over 20 per cent also in both. One of the special aspects of Hong Kong is that it has served as the gateway for business with China. Besides being a critical entrepot for China trade, Hong Kong was quick to outsource labour-intensive manufacturing activity to mainland China. It also developed extensive links with foreign buyers and became a transportation and logistics centre for trade in the region.[20] Being the gateway to China also gave it a special and privileged position in becoming a financial and service centre. Among the "gang of four", Hong Kong also used to be the one with the weakest education base. Hong Kong had the additional constraint of some uncertainty when it reverted back to China in 1999. In addition, it has been facing competition from Shanghai as part of China's explicit strategy to support Shanghai after 1990. As a result, in the 1990s the local government began to engage in more pro-active policy-making, beginning to invest more in R&D, higher education and infrastructure (e.g. information and communications technology – ICT – infrastructure and the new airport). Nevertheless, Hong Kong still lags on these counts vis-à-vis the other three economies.

Singapore: Strategic use of foreign investment

Singapore also had an open trade regime and depended very much on FDI for its technology. It had however a much stronger and activist government role than Hong Kong. While generally working with market principles, the government was heavily involved in attracting the kind of foreign investment which it thought would contribute the most to economic development. The development story of Singapore is one of moving quickly from cheap unskilled labour to becoming a knowledge-based economy. In the mid 1960s, after independence from the UK, it briefly entered a federation with

Malaysia. When that failed, Prime Minister Lee Kwan Yew opted for attracting outward oriented foreign investment based on cheap and disciplined labour. Singapore attracted foreign investment when most other countries (like India) were shunning it. Wage rates rose rapidly as the foreign firms came in. The government therefore invested heavily in secondary and technical tertiary education and in upgrading the skills of Singaporean workers in order to remain competitive.

Furthermore, it invested very heavily in developing a port and airport in order to become an efficient transhipment point for trade between South East Asia, Europe and the US. In the 1990s, it invested heavily in ICT to improve trade logistics and further reduce transactions costs.[21] By the end of the 1990s, the government also began to invest more in R&D and to position Singapore as a major educational hub for Asia. It has now become an important regional hub for finance, education, and regional corporate headquarters for multinational corporations (MNCs), and for medicine – all knowledge-based services.[22]

Taiwan (Province of China): State-directed technological development

Taiwan was somewhat in between the strong industrial policy approach of Korea and the more open trade but still government-directed approach of Singapore. Three special characteristics of Taiwan that are important to understanding its success are the role of the state, the Chinese diaspora, and the structure of industry. First, the government has had a strong role in its economic development. In the 1950s the key development strategy was import substitution under high tariff walls. The 1960s saw a switch to export orientation. In the period up to 1990, the government had a very active role in the economy. It made extensive use of tariff and non-tariff barriers and selective credit to favour specific sectors and to develop new industries.[23] In addition, the government was very strategic toward the use of FDI and actively encouraged the development of backward linkages and technology transfer.[24] Furthermore, the government set up special industrial parks, including the Hsinchu Science Based Industrial Park in the vicinity of universities and a large public research institute to stimulate technology development and the creation of new high technology enterprises.

Second, Taiwan has drawn very successfully on the large Chinese diaspora working in the high-tech industry around the world. The government developed various mechanisms such as wise men councils and periodic meetings to draw on the advice of this diaspora. It has also actively sought to attract back some of its nationals with high tech experience. A good example of its strong industrial policy as well as the link to the diaspora was the development of the science based industrial park of Hsinchu and the Industrial Technology Research Institute. This involved a strong role of government in developing the electronics industry and in attracting nationals back to Taiwan.[25] This was very successful in moving its electronics industry

from simple assembly of electronic products, often for foreign companies, to developing its own chip making capability, and becoming an important own brand player in the global industry.

A third special characteristic of Taiwan is that, unlike Korea, its industrial sector has been made up primarily of small and medium-sized firms, rather than large chaebols with deep pockets to cross-subsidize risky ventures. The government has thus developed a strong supportive technological infrastructure such as technical information services and specialized public research institutes. It also developed special programs to create technological linkages between foreign firms and small domestic suppliers. As Taiwan's own wages rose, it offshored labour-intensive assembly industry to China, especially in Shenzhen and Guangdong. It kept its high-tech industry home. However, as China deepened its trade reforms and maintained rapid growth, and clearly became a dominant economy, Taiwanese investors started to transfer their high-tech manufacturing to the Chinese mainland. There are now "little Taipeis" all along the Chinese coast.

4.2 Strategies of the second wave of high performing East Asian economies

The second group of high performing East Asian economies (Indonesia, Malaysia, and Thailand) has been more similar in their industrial and technological strategy. Vietnam has been added to this group, although it only achieved annual growth rates above 5 per cent in the 1980-2004 period, because it is following in the footsteps of these other countries, albeit from a lower human capital and institutional base as a transition country to a market economy (see table 4). They have all been export oriented, although Malaysia, Thailand and Vietnam more so than Indonesia (the share of trade to GDP has been over 100 per cent for all but Indonesia). The first three also have had higher investment to GDP rates than Indonesia. In all of them FDI played a critical role in export growth, in Malaysia and Thailand more so than in the others. Malaysia and Thailand are also more advanced than Indonesia and Vietnam in investments in R&D and in education, particularly tertiary education. Malaysia is the most industrialized of the four and has the highest share of manufactured exports as well as the most technology-intensive manufactured exports. They were all negatively affected by the Asian financial crisis in 1997 (Vietnam least of all), but have recovered. Indonesia averaged growth of 4.8 per cent per annum from 1980 to 2004, and Malaysia and Thailand have grown above 6 per cent per annum. Vietnam, meanwhile, has been steadily increasing its average growth rate since the Asian financial crisis.

5. Strategies of the BRICM countries

Before summarizing the strategies of India and China, both of which merit more in-depth treatment, it is instructive to contrast the strategy or the East Asian NICs with those of the three BRICM countries that have not performed well—Brazil, Mexico, and Russia. On the face of it, these three countries should have been expected to perform better. All three are large economies, have a critical mass of trained professionals, and significant investments in R&D – though more so in Russia, and to some extent Brazil, than in Mexico. All have also achieved islands of technological excellence such as nuclear, space and aeronautics and deep oil exploration in Brazil; petroleum, glass, steel and cement in Mexico; and military and space technology in Russia. However, these islands of excellence have not permeated the economies but remain enclaves rather than the precursors of more general innovation capability.

5.1 Brazil: Still mostly a primary commodities exporter in spite of decades of government R&D effort

The Brazilian government has been focusing on science and technology for more than four decades. The military government of the 1960s saw technological capability as a strategic element and promoted investment in R&D and higher education institutions. Like India, it developed a large nuclear program. In addition, it has developed a strong space and aeronautics program. One island of excellence has been Embraer, now the world's third largest producer of aircraft, which was born as a spin-off of the aeronautics research institute. Brazil has also attracted FDI and has been second only to China in attracting the most volume among developing countries. However, Brazilian industry has not been very competitive in general. There are three key factors for this. One is that, along with India, Brazil is one of the most inward oriented of the large developing countries. It has thought of itself as a continental economy that could be nearly self-sufficient in almost everything. The share of trade in GDP is only 30 per cent and it also has high tariff and non-tariff barriers (Table 5).

Thus its domestic industry has not been subjected to pressures from international competition as much as the East Asian economies covered above. This has also meant that a lot of the foreign investment that came to Brazil has been oriented towards the protected internal market rather than towards using Brazil as an export platform as was the case for the Asian economies. As a result, together with India, Brazil has among the lowest ratios of manufactured exports to GDP and the lowest shares of high technology exports in manufactured exports. Second, Brazil has had much more macroeconomic instability. For firms, financial engineering has thus been more important than focusing on industrial engineering and developing a strong technological capability to export. Third, Brazil has very high costs of

capital, high direct and indirect taxes, and high indirect labour costs as a result of high taxes on labour and rigidities in the labour market. As a result, Brazil has a very large informal economy (estimated by some at 40 per cent) and is not very competitive in manufactured exports.

A bright spot for Brazil, however, has been agricultural and mineral exports. In cereal production Brazil has high productivity because of good land and climatic conditions as well as successful agricultural research and extension programs by the Federal and some of the state governments. Brazil is also rich in many mineral resources with strong Brazilian companies such as CVRD (minerals), Petrobras (petroleum), and Gerdau (steel).[26] Agricultural and mineral exports have been growing very rapidly, mainly to feed China's increased demand. These natural resource driven exports have been important in raising Brazil's overall rate of growth in spite of continued competitive problems in its industrial sector.

5.2 Mexico: Falling behind in spite of being next to the United States

Mexico's experience is similar to Brazil's in many respects. However, it has been much more integrated into the global market through trade. The share of trade in GDP is nearly double that of Brazil. Part of this used to be petroleum exports, but Mexico also diversified into manufactured exports. This occurred initially through foreign investment in the "maquila" border assembly industry. Special provisions in the US tariff code – which imposed import duty only on foreign value-added when certain types of good were exported for assembly and re-imported – stimulated the growth of electronics assembly plants in Mexico. When Mexico joined NAFTA (North American Free Trade Agreement) in 1994, however, much of the advantage of this special import regime disappeared. At the same time, many firms found it more attractive to move their labour-intensive industries to China. NAFTA did, however, bring in more FDI focused on the US market and manufactured exports have increased. The share of manufactured exports in merchandise exports increased from 43 per cent to 80 per cent between 1990 and 2004. Nevertheless, Mexico was overtaken by China two years ago as the second largest exporter to the US.

Mexico has been losing competitiveness because of high transportation costs, electricity and other infrastructure costs, as well as the relatively low level of education of its labour force. Unlike the Asian high performers, it was not able to develop strong backward linkages from most of the foreign firms, particularly those in the maquila sector.[27] Mexico has spawned some large competitive domestic companies such as América Móvil (cellular telephone service provider), CEMEX (cement), FEMSA and GRUMA (food and beverages), Modelo (beer), and Nemak (auto engine cylinder heads), but most of them are expanding more abroad than in Mexico because of the difficult domestic conditions.

Mexico has invested much less than Brazil in R&D, as can be seen by the very low expenditures on R&D as a share of GDP (just 0.4 per cent of GDP vs. 1.0 per cent in Brazil).

5.3 Russia: Becoming a petro-economy with poor industrial competitiveness

As is well known, Russia was a scientific and technological super-power. With the economic crisis that followed the collapse of the Soviet Union in 1991, however, the scientific and technological support infrastructure suffered significant contraction. Many of the former mechanisms for transferring research output to production collapsed. In addition, as Russian industry was very outmoded, if not obsolete, and not geared up for competitive industrial production, there was also a significant contraction of the industrial base. Furthermore, most firms turned to import of technology, capital goods, and components rather than to the domestic scientific community or research labs for technology. As a result, Russia produces much basic science but few commercial applications. Russia has not been able to attract much FDI except to its oil and gas sector. Part of the reason it has not been successful is foreign investors' frustrations with bureaucracy and corruption as well as with a perceived lack of security of property rights in light of recent experience, e.g., with the re-nationalization of Yukos.

Until recently Russia was also not very well integrated into global trade. With the high international prices for oil and gas, Russia is now growing by exploiting its large natural gas and petroleum reserves. This is a very unbalanced growth, however, and Russia is in effect de-industrializing as the large foreign exchange inflows are generating Dutch disease effects. Virtually everything other than natural resources (and armaments) is losing competitiveness. In 2004, only 23 per cent of its exports were manufactured products and the share of manufacturing in total output has been falling too.

The Russian economy is a cautionary tale of the importance of an effective economic and institutional regime. Having a highly educated population and a strong scientific and technological capability without an effective economic and institutional regime has meant that Russia's strong knowledge assets have not been well deployed to increase economic growth and competitiveness.

5.4 India: Cautiously beginning to integrate into the global trade system

After independence from Britain in 1947, India embarked on its own development strategy. As a reaction to what was considered an exploitative colonial experience, the government developed a very autarkic, inward oriented strategy. The main elements of that strategy were import substitution, a large public sector with central planning, strong intervention in labour and capi-

tal markets, and over-regulation of business, including the reservation of 1,500 items for production by small-scale industry.

There were also very strong restrictions on FDI and on the licensing of foreign technology. During this period, technology policy focused very much on self reliance.[28] The Indian economy grew very slowly between 1950 and 1980 at what became known derisively as the "Hindu rate of growth" of 2 per cent to 3 per cent per annum in contrast to rates of growth of 5 per cent to 10 per cent for many other Asian economies. However, one of the great successes of this period was the green revolution. The public agricultural research efforts of Indian institutions working with other public research institutions worldwide led to significant improvement in wheat varieties with higher productivity. The dissemination and use of these new improved varieties turned India from a grain importing country with periodic famines into a net agricultural exporter.

The 1980s saw the introduction of pro-business reforms initiated by Indira Gandhi and later carried out by Rajiv Gandhi. These included easing restrictions on capacity expansion by large firms, removal of many price controls, and the reduction of corporate taxes. These were followed in 1991 by a more significant liberalization of the economy as a result of severe balance of payments crisis. These reforms included liberalizing imports, reducing investment licensing, privatizing some state-owned enterprises, allowing automatic approval of FDI in some sectors, and reducing the number of products reserved for small-scale industry.[29]

The impact of this liberalization on the economy and on science and technology policy was significant. The average rate of growth for the economy jumped to 6.0 per cent for 1990-2000. Firms which had not had to worry much about efficiency in a protected and over-regulated domestic market suddenly woke up to the need to improve their products and services and to reduce their costs. Some parts of the public research infrastructure responded to the change in the overall incentive regime.[30] The impact of growing competitive pressure was also reflected in an increase in the number of private firms doing R&D and in the increase in their R&D relative to sales.

As part of the conditions for joining the WTO in 1995, India agreed to bring its intellectual property legislation into conformity with developed country standards. This was done through a series of amendments in 1999 and 2005. The opening up of foreign investment also brought stronger competitors into the domestic market.

Since 2000, India is showing greater participation in the global arena. Between 2000 and 2004 the Indian economy achieved an average annual growth rate of 6.2 per cent, and since 2003 it has actually been growing at 8 per cent. India's engineering talent began to be recognized globally thanks to the reputation its software engineers acquired in fixing the "Y2K bug". This launched its expansion into software services and business process outsourc-

ing (BPO) globally. In addition, in the last five years an increasing number of MNCs are not only producing in India, but setting up their own R&D centres in the country, attracted largely by the relatively low cost and high level of human capital available locally, as well as the possibility of working round the clock with their other research centres thanks to digital networks. The result of this increased R&D investment by MNCs in India as well as some increased R&D investment by domestic firms has led to an estimated increase in R&D from an average of about 0.8 per cent of GDP for the 20 years up to 2003 to as much as 1.1 per cent of GDP in 2005.[31]

5.5 China: Embracing globalisation

There have been many building blocks to China's innovation strategy.[32] The first was massive importation of turnkey plants, mostly in heavy industry, from the Soviet Union in the 1950s as part of its initial industrialization drive. This ended with the Great Leap forward in 1958 when China went on a more autarkic technological development strategy ("a furnace in every back yard") and the Cultural Revolution of the 1960s. This was a period of turmoil and relative stagnation. In the early 1970s, Zhou Enlai proposed the "four modernizations" (agriculture, industry, science and the military). This led again to massive importation of technology, primarily from the West and Japan. Deng Xiaoping's decision to give farmers more autonomy over their production – the rural household responsibility system – was another milestone in China's reforms. This led to a strong increase in agricultural productivity. These reforms were eventually applied to the industrial sector, freeing enterprises to make more of their own decisions and to enjoy the rewards of good ones. The effect of these changes was to create a strong incentive for finding better and more efficient ways to produce. A third initiative, very important for the rural sectors, was the Spark program which aimed to speed the dissemination of agricultural technology. This was subsequently reinforced with the Torch Program aimed at disseminating more advanced technologies throughout the economy. A fourth measure was to create enclaves open to FDI with a near free trade regime in special economic zones (SEZs). Initially only a few were set up as pilot experiments. These performed very well, so the government expanded them gradually. When China decided to join the WTO in 1997, these were effectively expanded to the whole economy. Besides the SEZs, explicit measures were undertaken during the 1980s and 1990s to liberalize FDI rules.

Thus, China has been very effective at both disseminating knowledge domestically and tapping into global knowledge through trade and FDI. Among the large economies, China is the most integrated through trade. The share of merchandise and services trade in GDP in 2004 was 67 per cent. In addition, China has become the second largest host to FDI. The share of FDI inflows to GDP increased to 7 per cent at its peak and has averaged 5.1 per cent for the last 10 years.

China is now engaged in a major strategy to strengthen its own innovation. In 1998 it was investing just 0.7 per cent of GDP in R&D. Around 2002-2003, however, it decided to put more emphasis on own innovation. Between 2003 and 2004, China increased its investments in R&D by 50 per cent and by 2005 it was investing 1.4 per cent of GDP. For the new five-year plan China announced in December 2005 that it would be increasing its R&D expenditures to 2.0 per cent of GDP by 2010 and to 2.5 per cent (the average for developed countries) by 2025.[33] To put this in a global context, figure 4 presents R&D expenditures of the largest spending countries in PPP terms. The circles correspond to the absolute value being spent, the horizontal axis gives its share of GDP, and the vertical axis shows the number of scientists and engineers in R&D per million people. According to the OECD's latest Science, Technology and Industry Outlook, in 2004 China was the third largest national spender on R&D, but given it rapidly increasing expenditures, it probably overtook Japan by the end of 2006. However, it is still not as efficient in R&D as developed countries.

Thus, China has followed a five pronged strategy. One prong was to import a massive number of turnkey plants, first from the Soviet Union, then turnkey plants and capital goods from the West. A second has been to copy, reverse engineer and otherwise borrow as much foreign technology as possible. Like Japan, and Korea earlier, this has been facilitated by investments in human capital. A third has been to disseminate knowledge internally. The fourth was to tap foreign knowledge through trade and through FDI. Now that it is catching up in many sectors and that it is being seen as a major competitor, the fifth prong consists in beginning to innovate on its own account by increasing investments in R&D.

5.6 Conclusion

This section has traced the strategies of the successful high performing economies and contrasted them with those of Brazil, Mexico, and Russia which have not been performing as well. From the comparisons it may be inferred that the key elements of the successful strategies of the Asian economies have been a strong outward orientation, heavy use of foreign knowledge (including copying and reverse engineering and otherwise appropriating foreign knowledge), macroeconomic stability, high investment rates, and an economic incentive and institutional regime that demands improved performance. All of them except Korea and India made extensive use of FDI as a way to acquire foreign knowledge and to penetrate export markets. Korea opted not to rely on FDI, but to acquire knowledge through trade, and reverse engineering, and to invest substantially in its own R&D. It also invested massively in secondary and then tertiary education. These high levels of education facilitated its assimilation of foreign technology and the development of its own technological capability, including its large investments in R&D. India, which also opted to limit FDI until the last 15 years,

followed a more autarkic strategy than Korea, as it did not rely much on acquiring foreign knowledge through trade. Unlike Korea, however it did not expand significantly its own R&D investments, nor did it invest much in expanding secondary and tertiary education. That is one of the reasons why its performance until the opening up in the 1990s was so poor. After 1991, as it drew more on foreign knowledge, its economic growth improved and eventually accelerated to over 8 per cent for the last three years.

Brazil and Mexico did get FDI, but much of it came for the protected domestic markets. Also, these countries did not make as massive investments in R&D and education as Korea. Russia did invest a lot in R&D, but most of it was focused on military objectives. Its commercial industrial technology was generally quite poor. Engagement with the global system through trade was limited, and this in turn limited knowledge acquisition and spillovers. It also had a poor economic and institutional regime which did not allocate resources to the most productive uses, leading to poor competitive performance. Its recent growth performance is based on natural resource rents rather than on technological capability.

Thus it appears that a common strategy for most of the high performers was to start with labour intensive exports and to gradually move up to more sophisticated products.

However, the simpler labour-intensive outward oriented strategies that worked in the past are no longer as easy to replicate for two reasons. One is that the global context has changed significantly. Some of these new trends and their implications for developing countries are developed in Section 6. The second is the speed, scale and scope of China's entry onto the global stage. It is pre-empting the simple labour-intensive growth strategy because its advantages are not only low cost but also very productive labour, as well as economies of scale in transportation and logistics. It is also moving up the technology ladder very quickly, and is fully plugged into international value chains and distribution systems. The implications of China's rise for other countries will be covered in Section 7.

6. Key global trends

The key global trends that are changing the global competitive context and therefore the possibilities for developing countries include: increasing speed in the creation and dissemination of knowledge; trade liberalization, globalisation, and physical disintegration of production; increased importance of integrated value chains; increased role of MNCs in production and distribution; and changing elements of competition.[34]

6.1 Increasing speed in creation and dissemination of knowledge

Advances in science, combined with the information revolution (itself a product of these advances), are driving an acceleration in the creation and

dissemination of knowledge. It is now possible to codify and digitize much of our understanding of science. This permits modelling and simulation, which in turn further speeds up the understanding of science and the creation of new goods and services. The time between basic scientific discovery and commercial application is decreasing. This is particularly evident in biotechnology. The product life cycle of most manufactured products is also shrinking. This is evident in the electronic products industry, ranging from computers and mobile phones to consumer electronics.[35]

The increased importance of new technology can be seen in the increasing variety of goods and services produced. This can be appreciated in the increasing importance of manufactured products and services in trade. For the world as whole, the share of manufactured products in trade has increased from 58 per cent in 1965 to 65 per cent in 1980, 73 per cent in 1990 and 77 per cent in 2004. This is partly because the demand for manufactured products is more income-elastic than for primary commodities. Developing countries that do not have the capability to move into production of manufactured products therefore lose out on the possibility of benefiting from the most dynamic part of merchandise trade. In addition, the technological intensity of trade in manufactured goods is increasing. This can be seen in trade among OECD countries, which accounts for approximately two-thirds of world trade. For their trade in manufactures, which accounts for the bulk of their exports, over the last ten years the share of medium and high technology manufactured exports has increased from 59.8 per cent in 1994 to 64 per cent in 2003 (figure 5).

The implication of the speed-up in the creation and dissemination of knowledge is that developing countries need to find effective ways of tapping into the very rapidly growing stock of global knowledge. Those that are more advanced also have to invest more in their own R&D in order to compete with new frontier technological advances.

6.2 Trade liberalization

Since the GATT there has been a trend towards increasing liberalization in trade policy among most countries. In developing countries, average tariff levels have fallen from 34.4 per cent in 1980-83 to 12.6 per cent in 2000-2001; in developed countries they have fallen from 8.2 per cent in 1989-92 to 4.0 per cent in 2000.[36] In addition, non-tariff barriers have fallen. There is also a movement towards greater openness in trade in services, including not only financial and business services, but also education.[37] We are moving closer to free trade in manufactured products, but the same does not apply to agriculture. While movement of capital is increasingly free, this is not generally the case for labour, where international mobility has been concentrated among the highly skilled, for which some advanced countries have created special temporary immigration visas, particularly for information technology specialists.

Many services areas that were once considered non-tradable have now become tradable to the extent that they can be digitized and provided remotely, across national boundaries, through the internet. Thus we are moving to a system of freer trade which is bringing increasing competitive pressure to domestic markets the world over.

At the same time, there has been a strengthening in the rules and regulations of the international trading system. Some protectionist trade and industrial policies used effectively by some of the current developed countries as well as some of the Asian high performers to promote their industries and services are now not allowed under WTO rules.[38] Moreover, stronger enforceable sanctions against piracy of intellectual property through the TRIPS mechanism of the WTO now exist. As a result, it is now much harder for developing countries to use some of the policies that helped some countries acquire more advanced technology as part of their development strategy.

The challenge for developing countries is therefore to determine how best to be open to international competition while at the same time nurturing the development of their own production capabilities. If they liberalize too early, they run the risk of having their domestic industries wiped out by well established and stronger foreign competitors.

6.3 Globalisation

The two trends just discussed have led to a dramatic expansion of globalisation – the greater integration of economic and social activity around the world. The reduction in communication and transportation costs combined with trade liberalization has led to a dramatic expansion of trade. Imports and exports as a share of global GDP have increased from 40 per cent in 1990 to 55 per cent in 2004. In addition, the reduction of communications cost and the spread of the mass media have virtually created a "real time world", where events that happen in one place are instantly known worldwide.

Moreover, as the formerly inward oriented economies of China, India, and the former Soviet Union have increased their participation in the international trading system, the net effect is that the global labour force has effectively doubled (Freeman, 2006). This has strong implications for developed as well as developing countries. Developed countries are now facing competition from much lower cost workers, which is putting pressure on labour-intensive industries. Freeman goes on to argue that the doubling of the global labour force has increased the marginal productivity of capital. As a result, that share of value added that is going to capital has increased, while that which is going to labour has decreased. The principal beneficiaries of this globalisation and rebalancing of relative wages are the multinational corporations which are the most effective agents at intermediating and taking advantage of differences in global factor prices.

The implication of this increased globalisation for developing countries is that they are more exposed to everything that is happening worldwide. It also means that everything happens faster, so in addition to facing more competition, they have to develop greater capability than before in order to respond rapidly and adequately to new threats and opportunities.

6.4 Physical disintegration of production and increased importance of integrated supply chains

The reduction in transportation and communication costs combined with the digitalization of information has led to the physical *disintegration* of production. Because of lower transactions costs, different components of a final product are now manufactured in several different countries.[39] The product may then be assembled in yet another country and then distributed worldwide. The same applies to some services. This means that, to get products or services to the market, it is now more important than in the past to tap into global supply chains. Even R&D is being commoditized to some extent as it is being outsourced to specialized centres in different countries, including India and China.[40]

This is what is being called the two great "unbundlings".[41] It is useful to distinguish them because they have different trajectories and implications. The first unbundling is the end of the necessity to produce goods close to consumers. This has been going on for centuries but has been accelerated by the rapid decline in transportation costs in the last four decades, particularly since the widespread use of containers and bulk carriers. The impact of this has been that much manufacturing production, especially of the more standard and labour-intensive goods, is being transferred to developing countries with lower labour costs.

The second unbundling is the end of the need to perform most manufacturing stages near each other. This has been made possible by the rapidly falling costs of telecommunications and the possibility of codifying and digitizing tasks. The impact of this has been that many service tasks supporting manufacturing as well as other services have been offshored to countries with lower labour costs.[42]

The implication of these developments is that there are increased opportunities for those countries that can position themselves to take advantage of the two unbundlings. The major developing country beneficiary of the first unbundling has been China, which is becoming the manufacturing workshop of the world. The major beneficiary of the second unbundling has been India, thanks to its critical mass of higher educated English speaking technicians, engineers, and scientists. Other economies such as the Philippines, Vietnam, former Soviet republics with critical mass of highly skilled manpower, and some Caribbean English speaking island economies are also benefiting from digital trade made possible by this second unbundling. Most other develop-

ing countries without critical mass in the skills base, English language or the advanced telecommunications and other physical infrastructure have not benefited as much and are having trouble competing on both fronts.

Developed countries are also being impacted by increased globalisation and the two unbundlings. The first is more in keeping with the expectations of traditional trade and product cycle theory, which postulated that labour-intensive manufacturing would move to labour abundant countries. Under this theory it was expected that developed countries would stay ahead by moving into more skill- and technology-intensive sectors. However, the second unbundling is a newer phenomenon not foreseen by traditional trade theory. It was not anticipated that services could be traded virtually thanks to advances in information technology.

Various economists, including Alan Blinder (2006) and Gene Grossman et al. (2006) are beginning to focus on this phenomenon. Blinder has even gone as far as to call offshoring the third industrial revolution. Its most significant idiosyncrasy is that the dividing line between jobs that can be outsourced versus those that cannot is not related to skills. Many highly skilled and knowledge-intensive jobs can now be outsourced. Blinder (2006) estimates that the total number of jobs susceptible to offshoring may be two to three times the total number of current manufacturing jobs in the US.[43] This is an important new element not anticipated by economic policy in developed economies. It is no longer sufficient for developed countries to invest in higher education to stay ahead. They will need to focus on exploiting advantages in non-tradable services, transform their educational systems to prepare workers for those jobs, strengthen innovation and creativity, and put in place adequate trade adjustment mechanisms (Blinder, 2006).

6.5 Increased role of MNCs in production and distribution

One of the key drivers of globalisation with significant implications for developing country strategies is the increased role of MNCs. They are the key producers and disseminators of applied knowledge. They are estimated to account for at least half of total global R&D and more than two-thirds of business R&D.[44] MNCs disseminate knowledge directly through their operations in foreign countries and through licensing agreements. In addition, they often are the first to introduce new products, processes, or business and management methods in many foreign countries, providing examples and ideas for imitation by domestic companies. They also train workers, managers and researchers who may disseminate some of the knowledge and experience acquired while working for the multinational when they leave to work for another company or set up their own.

It is estimated that the value added by MNCs in their home countries plus that in foreign affiliates represents 27 per cent of global GDP.[45] On the trade side, it is estimated that affiliates of foreign firms account for one-third

of world exports.[46] However, the influence of MNCs is greater than this. They affect a much larger share of GDP if one takes into account backward and forward linkages, as well as their role in demonstrating new technologies and putting pressure on domestic firms to upgrade production processes. Although there is no accurate estimate, probably more than half of the remaining trade is done through supply chains controlled by multinationals as part of vertical chains or through distribution chains.

In addition, MNCs are now operating much more as independent global agents.[47] Rather than responding to the needs of any country, even their original home country, their objective is to operate globally in the best way to increase returns to their investors, whoever they are and wherever they may be. This will increasingly put them at odds with the interests of their home countries (as they shift even high value, high skill jobs and functions, including research, out of their home base) as well as host countries (as one location is pit against another and resources are redeployed to wherever it is more profitable).

One of the implications of the increased role of MNCs in the generation of knowledge and in production and distribution of goods is that developing countries now need to pay more attention to how to attract and make the most effective use of foreign investment. Even Korea and Japan, which were the countries that made least use of FDI, have had to open up in the 1990s in order to get access to some cutting-edge technology that foreign firms are not willing to license. However, FDI to developing countries is very heavily concentrated in just a few of them. The top ten developing countries account for 65 per cent of the total FDI going to developing countries.[48] FDI goes to where it finds the most attractive profit opportunities, either to supply local markets, or to use those locations as export platforms for other markets. Most evidence shows that offering special tax and other incentives is usually not sufficient to offset major economic disadvantages perceived by foreign investors. Therefore, countries that cannot offer intrinsic advantages to attract FDI are going to have to find alternative ways of getting access to relevant foreign knowledge. These can include buying some of the technologies through arm's-length transactions, technical assistance, copying and reverse engineering, and own technological development, but these pose their own sets of challenges (as discussed above).

Another implication of this for developing countries is that they have to become integrated into global supply chains normally controlled by multinational producers or distributors (like Wal-Mart or other large retailers). Entry into supply chains is usually at the simpler levels such as making simple manufactured goods, producing simple components, or assembling subcomponents. Both getting into and moving to higher value added activities in vertical supply chains can be difficult. For the first, the supplier must demonstrate capability to produce to high standards of quality and timeliness in delivery; for the second, strengthened technological capabilities are required.[49]

Entering supply chains controlled by distributors such as Wal-Mart is also difficult. Usually production runs have to be large. Suppliers must also be able to maintain quality and timeliness. All three of these requirements make it difficult for smaller countries with smaller firms to enter these supply chains.[50] Their producers generally do not have the scale to produce the volumes required (Wal-Mart is sourcing over 25 billion dollars worth of goods from China, cuts out middlemen, and goes directly to the producers). In addition, a buyer like Wal-Mart exerts continued pressure on the suppliers to reduce costs and improve quality and speed of delivery.

It should be noted that there are only a few companies from developing countries which have managed to create and sell globally under their own brand names.[51] This indicates how difficult and expensive it is to develop own brand and distribution systems.

6.6 Changing elements of competition

Competitiveness used to be based (to a greater degree) on static comparative advantage. Today, competitiveness does not just depend on the cost of factors of production, or on a specific technological advantage. Rather, it depends on continuous innovation, high level skills and learning, an efficient communications and transport infrastructure, and a supportive enabling environment.[52] Each of these aspects is discussed below in greater detail.

Innovation becoming a critical component

In this context of rapid development and dissemination of new knowledge, innovation is becoming a more critical element of competitiveness. Firms have to be constantly innovating to avoid falling behind. This does not necessarily mean that they have to be moving the technological frontier forward. Only the most advanced firms do that. However, all firms need to be at least fast imitators and adopt, use and improve new technology in order not to fall behind. This puts a great deal of pressure on firms' technological capabilities. Moreover, innovation is not just a matter of new products or new processes and ways to produce them, but also better organization and management techniques, and better business models which facilitate doing business.[53] An example of what is essentially a very simple innovation is containerized cargo, which has greatly facilitated shipping manufactured products and dramatically cut down freight costs. An example of business innovation is the development of consumer product companies such as Dell, which subcontract production according to their design and specifications to third parties, eliminate distributors, and sell directly to the final consumer. Another example of a business innovation is Wal-Mart's monitoring of consumer demand from points of sale through electronic cash registers, linking that information to central ordering directly to producers all around the world, thereby eliminating intermediaries in production and distribution.

The implication of this for companies is that they have to make greater efforts to keep up with new technologies and new forms of business organization and production and distribution networks. This requires more investment in their technological capability to search for, acquire and adapt technology to their needs and in managing production and distribution systems. For those that are closer to the frontier, it means that they need to put more effort into real cutting edge innovations in technology and business.

Education and skills as fundamental enablers

Technological advance is very complementary with higher skills and more education.[54] As a result, education and skills are becoming more important in international competitiveness. MNCs make their location decisions partly based on the education and skills of the local workforces. This means that countries need to make more investments on increasing education and skills. Globally, there has been an increase in average educational attainment. There has been a strong increase in the number of persons with higher education. Because of the knowledge revolution, there is a need for people to learn a diverse range of new skills. This has given rise to what Peter Drucker termed the "knowledge worker" (Drucker, 1994). The knowledge worker is not just the PhD with very narrow and advanced education. S/he is the technician and the graduate of the junior college. In the United States, 35 per cent of students in tertiary education are older than the typical college age cohort of 18-24. Many are workers who are coming back to get their college degrees, or workers who already have college degrees but are coming back to obtain specialized training certificates or more advanced degrees. Thus there is a need to think in terms of systems of life-long learning.

This implies that developing countries need not only to expand primary education, but that they also need to expand the access and quality of secondary and tertiary education. This may be difficult given tight budgetary constraints, so many developing countries will have to rely more on tuitions and private provision of higher education. Increasing higher education may bring the risk of losing people to the brain drain if graduates cannot find good jobs locally. Thus developing country governments have to think through their higher education strategies more carefully. In addition, governments need to think of education and training as integrated systems for life-long learning and to start designing systems that will have multiple providers and multiple pathways to different levels of certification and qualification. They also have to make more effective use of distance education technologies, particularly the potential of internet based education and training services which can be delivered anywhere, anytime at any pace.[55]

Logistics, transportation, and distribution becoming more important

In this new context of increased globalisation, rapid technical change, and shorter product life cycles, modular production and outsourcing, and the

need to get components and products to the customer quickly, logistics (transportation, distribution channels, and warehousing), which connects manufacturing and retailing, is becoming another critical factor for competitiveness.[56] Therefore, transportation infrastructure – roads, railroads, airports, seaports and transportation companies, with coordination enabled by IT – is critical for countries to participate effectively in the global market.[57]

The implication of this for many developing countries is that, even if they can produce competitively, it may still be very difficult for them to get into global value chains because of high transport costs. Typically, developing countries have very poor transportation infrastructure. In addition, they frequently do not have the volume to warrant bulk transport systems nor the frequency of service required to make the transportation costs competitive. This works against small countries far from the main markets. Most countries in Africa have very poor shipping or air links with the rest of the world, and few of these have direct links with key markets. This means that there are usually many stops and several transhipments before products get to their final destination. This increases both transportation costs as well as the inventory costs for goods in transit.

Part of the cost advantage of China is not just low wages and that it has over 200 million underemployed workers in agriculture that can be brought into industrial production, but that it has developed large scale and low cost transportation infrastructure. Combined with frequent shipping and air service to major world markets, it can place its goods virtually anywhere, for a fraction of the costs of most other developing countries.

Efficient IT becoming new critical infrastructure

Information technology is becoming a fundamental enabling infrastructure of the new competitive regime. "Supply chain management requires speed across global space to accomplish what a factory accomplished internally with the assembly line. Information and communications technologies (ICT) are the tools that allow flexible accumulation to function."[58] ICT is a critical part of what enables the organization and coordination of global production networks and the integration of global supply chains. It is also an essential element for monitoring what the consumers are buying and what they want, and passing that information seamlessly along to producing units which often are not even owned by brand name manufacturers. This real-time information on the changing needs of the market, indeed even direct interaction with the consumer (as in the examples of made to order computers or automobiles), as well as internal electronic exchange and management between different departments and division within firms and among firms, their suppliers and distributors, are becoming essential new ingredients of the global economy.

There are several implications for developing countries. At the national level, there needs to be modern and low cost communication systems as well as good training in the skills necessary to use these networks. For the development of e-business, there need to be appropriate legal and regulatory sys-

tems including e-signature as well as secure digital communications and safe payment systems. At the level of the firm, investments in training and hardware as well as in restructuring business processes are also necessary in order to take advantage of the reduction in transactions costs and time that can be obtained through these technologies.[59]

The enabling environment as a still necessary factor

The enabling environment consists of the government regulations and institutions that facilitate the operation of business and the economy. It includes the basic institutions such as government, rule of law, efficiency of capital and labour markets, ease of setting up or shutting down business. It also includes the ability of the government to create consensus and the ability to help people who fall through the cracks in the system.

7. The China (and India) factor(s)[60]

Figure 6 presents the current and projected size through 2015 of the world's nine largest economies in terms of purchasing power parity (PPP) comparisons.[61] Using PPP exchange rates, China is already the second largest economy in the world and India the fourth largest. Moreover, using average growth rates for the period 1991-2003 to project future size, China will become the largest economy, surpassing the US by approximately 2013, and India will surpass Japan (currently the third largest economy), by the end of next year. While past performance is not necessarily a good predictor of future performance, these projections are helpful to emphasize that China and India are already large players in economic terms and that they are going to be even larger given that they are growing almost three times faster than the world average. It is therefore useful to take stock of their strengths and challenges and to explore the potential impact of their growth on other countries.

7.1 China's strengths and challenges

China's strengths are numerous and varied.[62] One strength is its very large size and rapid growth. It has critical mass and economies of scale. It also has a government that has a long-term strategic vision and is able to orchestrate and implement long-term plans. Part of why it has been able to upgrade its technology so fast is because it is well integrated into the global trade system. As noted, it has the largest traded sector among the world's large countries. It gets modern technology embodied in capital goods and components and its export firms are forced to compete with the best abroad. It has also used FDI to rapidly modernize its economy.[63] Through the lure of its very large internal market and the potential to serve as an export platform as well, it attracts MNCs willing to bring the most modern technology into the country. In addition, because of its rising supply of scientists and engineers, over 700 R&D centres have been set up by MNCs in China. Moreover, it has

been investing heavily in higher education. In 1997, its tertiary enrolment rate was 6.5 per cent. Since then it has been increasing new entrants by 50 per cent per year. Last year, its tertiary enrolment rate reached 21 per cent and the number of students enrolled at the tertiary level surpassed that in the US. Forty percent of them were in mathematics, science and engineering.

China also faces many challenges. One of them is increasing income inequality. Its Gini coefficient increased from 0.33 in 1990 to 0.47 in 2003. There are also very large regional income inequalities between the coastal provinces, where GDP has been growing at 15 per cent to 20 per cent per year, and the western provinces, where growth has been just 2 per cent to 5 per cent . As part of its rapid restructuring and transition to the market economy, for the past five years the state-owned enterprises have been shedding workers at the rate of 12 to 15 million workers a year. These lay-offs plus the increasing income inequality are potentially destabilizing. In addition, every year China absorbs 10 to 15 million rural migrants into the cities. Its financial sector is another weak area as there is a very large non-performing loan portfolio. Part of the problem is that the financial system still channels the bulk of the funds to the state enterprise sector. Since the social security system is still not well developed, state enterprises still act as an informal social security system and require support from the government. China also has a rapidly ageing population, and because of the one-child policy adopted some years ago, it will start to have a very high dependency ratio in 20 years.

China is also facing very severe environmental constraints. It is natural resource poor, particularly on a per capita basis. It relies on imports from the rest of the world for a large part of its raw materials. It turned from being an oil exporter until the 1990s to now being the second largest oil importer after the US. It has a water shortage. The Yellow River periodically dries up. The rate of desertification is increasing. The Gobi desert is moving toward Beijing and there are sand storms that blow red dust all the way to North America. Water and air pollution are serious problems. It is estimated that several million people die each year from air pollution. Air pollution is getting worse not only because of China's rapid industrialization, but also because it has opted for a very rapid expansion of cars as a basic means of transportation.

Finally, China also faces the challenge of how long a one party system can continue to function effectively as the country transitions rapidly to a private market economy. The number of demonstrations has been rising since the late 1990s to reach over 80,000 last year.

Thus, while China has been growing very fast, and the consensus expectation of most economists is that it can continue to grow at 7-8 per cent for another 10 to 20 years, it also has some severe structural problems.

7.2 India's strengths and challenges

India is a rising economic power, but one which has not yet integrated very much with the global economy and still has not achieved its potential as

much as China. It has many strengths, but it will also be facing many challenges in the increasingly competitive and fast changing global economy.[64]

India's key strengths are its large domestic market, its young and growing population, a strong private sector with experience in market institutions, and a well developed legal and financial system. In addition, from the perspective of the knowledge economy, another source of strength is a large critical mass of highly trained English speaking engineers, businessmen, scientists and other professionals, who have been the dynamo behind the growth of the service sector. In fact, Blinder (2006, p. 127) sees India as a greater challenge than China to developed countries in terms of future competition because it is currently stronger in terms of the second unbundling (see Singh, 2007, in this volume, for an analysis of the strengths and limitations of India's service-led industrialization).

The reality, however, is that the supply of highly trained knowledge workers such as scientists and engineers in India is much more limited than commonly thought. There is a highly bifurcated higher education system. The premier part consists of seven Indian Institutes of Technology, six Indian Institutes of Management, the Indian Institute of Sciences, the Indian Statistical Institute, and the All Indian Institute of Medical Sciences which are world class. However, they produce only ten thousand graduates per year. The bulk of the higher education system produces graduates of very low quality. A recent McKinsey study estimates that only 10 to 20 per cent of the graduates are properly trained to work for MNCs. There are also many political economy problems to increasing the supply of the premier institutes or to improving the quality of the broader system. These constraints on the ability to expand rapidly the supply of high level human capital will constrain India's ability to exploit the second unbundling.

More generally, one of India's key challenges is its rapidly growing and young population. India's population is expected to continue to grow at a rate of 1.7 per cent per year until 2020 and to overtake China's. An important part of the challenge is that India's population has low average educational attainment. The average years of schooling of the adult population is less than 5, compared to nearly 8 in China and 12 in developed countries. In addition, illiteracy is 52 per cent among women and 27 per cent among men.

Another challenge is poor infrastructure – in terms of power supply, roads, ports and airports. This increases the cost of doing business. In addition, India is noted for an excessively bureaucratic and regulated environment which also increases the cost of doing business.

All these factors constrain the ability of the Indian economy to react to changing opportunities. Low education reduces workforce flexibility. Poor infrastructure and high costs of doing business constrain domestic and foreign investment. The high costs of getting goods in and out of India constrain the country's ability to compete internationally and to attract export

oriented foreign investment except for business that can be done digitally rather than requiring physical shipments.

7.3 The impact of China's rise on the rest of the world

The speed, scale, and scope of China's economic growth is unprecedented in economic history. China's rapid integration into the global trading system has been spectacular and has implications for the rest of the world.[65] China's merchandise exports have surged from US$25 billion in 1984 to US$62 billion in 1990 and US$593 billion in 2004. Its share of world merchandise exports shot up from less than 0.5 per cent in 1980 to 6.5 per cent in 2004 (figure 7). Although China used to export some commodities and fuels, its exports are primarily manufactures and their share in the total has been increasing – from 72 per cent in 1990 to 91 per cent by 2004. Furthermore, as in the other Asian high performing economies, its manufactured exports started primarily as labour-intensive goods (particularly textiles and clothing), but the technology intensity of its exports has been increasing very rapidly. In 1998, the share of high technology exports in China's manufactured exports was 15 per cent. By 2004 it had doubled to 30 per cent.

Figure 8 projects the growth of merchandise exports of the eight largest economies in the world, using the average export growth rates from the past 5 years. According to these projections, China's merchandise exports surpass the US's by 2006 and those of Germany by about 2009. This is no longer based on PPP but on nominal exchange rates. Thus China already is a major force to be reckoned with and is likely to become even more important in the near future. India is still at a much earlier stage and will not be as important for some time to come, although it has the potential to increase its exports and have a more significant impact on world markets. The rest of this section will therefore focus on the impact of China's rising importance in global trade on the rest of the world.

To analyze the impact of China's trade on the global system, it is useful to distinguish direct effects from indirect effects. Direct effects include the direct impact of exports and imports on other countries. The indirect effects include the impact of exports and imports on third markets, as well as any secondary effects that China's growth may have on other international flows such as direct foreign investment and finance. These are hard to quantify but an attempt will be made to at least indicate what some of these may be for different countries.

First, it should be noted that while China is rapidly increasing its exports it is also increasing its imports. Thus, it is opening up the opportunity for many countries to export to China, or even to set up manufacturing facilities there. China's imports are primarily natural resources, and machinery and components. Therefore, developing country exporters of commodities are likely to benefit from increased exports and higher prices (indeed many

are already doing so). The same goes for exporters of capital goods and components. The main exporters of capital goods are likely to be developed countries. Component exporters include many countries in East and South East Asia, as China has become the final assembler and exporter of many finished goods based on components from neighbouring countries.[66 67]

It should also be noted that an important indirect impact of China's rapid expansion of manufactured exports is that they have helped to drive the price of many manufactured products down. That has meant an increase in welfare for consumers all over the world. The problem, of course, is that the direct competition from cheaper Chinese manufactured products has diminished markets and profits for producers of those goods from other countries, and some may even be driven out of business. This is already clear in the production of textiles and garments where China has a very clear comparative advantage that was being constrained until January 2005 by the quotas of the Multi-Fibre Agreement and its successor.

An important indirect impact of China's rapid growth on the rest of the world is its pressure on global environmental resources. The impact of China's voracious appetite for natural resources has already been seen in rapidly rising prices for many natural resources and commodities, particularly oil. There are also the negative externalities of increased transboundary air pollution and global warming.

Developed countries probably have the most to gain from the expansion of China's trade. They are the biggest importers of Chinese manufactures, so their consumers will get the advantage of lower prices. They will feel some competition in the medium technology level and many manufacturers may have to switch to production in or sourcing from China. However, they have higher educated workers and more capability to compete through innovation, so they should be able to redeploy workers to more competitive areas. Moreover, a very large share of Chinese manufactured exports are being produced or sourced there by MNCs headquartered in developed countries. Thus, these MNCs and their stockholders are benefiting. Also, developed countries are better placed to export the capital goods and consumer durables and services in demand by China as people reach higher incomes and want more sophisticated consumer goods and services. Nevertheless, there will be considerable adjustment pains as some industries face Chinese competition. These are likely to be more pronounced in the EU than in the US as the rate of unemployment is already higher in European countries and their economies are less flexible and less innovative than the US.

Developing countries in South East Asia have also been benefiting from China's growing trade. The poorer natural resource rich countries are supplying China with natural resources and primary commodities. The more advanced economies, including Japan, Korea, and Taiwan, are supplying it with capital goods and components for its expanding higher technology manufacturing in special high-tech export processing zones. However, there

is a risk that some suppliers will shift to producing directly in China, thus reducing exports and domestic jobs. Middle-income countries of South East Asia face perhaps the biggest competitive challenge from China in their export markets for manufactures, though they have also enjoyed increased demand for their components from Chinese assembly plants as well as increased demand for their natural resource based exports. The labour rich low-income countries (such as Vietnam, Cambodia and some South Asian countries, particularly India) may find that, as Chinese wages rise, some of the labour-intensive production that is still done in China will be transferred to them.[68]

Latin American countries are likely to experience two different effects. Mexico and some of the Central American textiles exporters which have had preferential arrangements with the US, such as the Dominican Republic and Nicaragua, are already feeling the pain of increased competition. On the other hand, many natural resource-rich countries in Latin American, including Brazil, are experiencing an export boom thanks to increased import demand from China. China is also sealing many long-term supply contracts. In addition, a significant inflow of Chinese FDI is emerging, mainly into natural resource sectors, but this may expand to manufacturing for domestic or regional markets. A few Latin American companies are also beginning to invest in the rapidly growing Chinese market. In the medium and long-run, Latin America is likely to find it difficult to keep up with the Chinese expansion of manufactured exports. Latin American exporters of manufactured goods are already facing increased competition from Chinese exporters not only in other Latin American markets, but also in the US and the EU, and this is likely to get more intense. As noted, even Brazil and Mexico, which are the most industrially advanced of the Latin American countries, are not investing enough in education or carrying out enough innovation efforts to become more effective competitors with China. Therefore, the Chinese competition is becoming more of a threat for their future manufacturing growth.[69]

African countries are likely to experience similar effects to Latin America but even more pronounced. Textiles and garments, which has been the most important manufactured export industry of Africa, is already facing very strong Chinese competition and many factories are closing down. On the other hand, many countries are benefiting from increased sales of minerals and commodities to China, and these exports are booming. In fact, they are growing so much that a problem for many African countries is going to be to manage the impact of increased export earnings in order to avoid Dutch disease effects caused by appreciation of exchange rates. In addition, there is rapidly growing Chinese foreign investment in Africa, particularly in mining and commodities and supporting infrastructure. A critical issue is whether this new Chinese investment will develop more linkages than that of preceding foreign investment from other countries.[70] Given past historical experi-

ence and the low education and institutional capability in most African countries, it is not clear that these positive linkages will develop very quickly, if at all.[71] Aid agencies will also have to consider how to adjust their policy advice given how China is pre-empting the usual one of labour-intensive export growth. Aid agencies will also have to factor in the implications of a much larger Chinese influence in Africa not just in the commercial and economic spheres, but also in terms of development assistance and policy advice.

8. Conclusions and implications

It is a challenge to draw together all the different strands covered in this paper, but this will be attempted here under various headings. Some are more tentative than others. Obviously much more could be done on any of these topics so they are listed here to provoke further discussion and more research.

The international environment is becoming more competitive, demanding and fast paced. The world has become more integrated through the expansion of trade, investment, and communications. The ICT revolution has also led to an explosion in the internationalization of all types of services that can be done digitally. Thus there is more international competitive pressure. Product life cycles have become shorter. Production, distribution, and supply chains have become more integrated globally even as production has become more fragmented across countries..

The global system depends on efficient communications and information system, plus excellent logistics to get goods and services in and out of countries and delivered to the customer in a matter of hours or days, rather than weeks or months. This has led to a speed-up in production and distribution systems. Suppliers have to respond immediately to customer demand.

Most developing countries do not have the pre-requisites to compete successfully in this more demanding global system. It is not just that they do not have the latest technologies or skills. They will have to put in place more agile procedures and ways of doing business. They also do not have the logistics and infrastructure. Even if they had the money to invest in the physical infrastructure, they do not have the economies of scale for bulk air or sea shipping via the most direct routes to key markets. This means that many developing countries are excluded from these fast paced markets.

China and India (if it can open up more, reduce bureaucracy and red tape, and invest more in infrastructure, education, and R&D) will do well in this new competitive system. They have the scale and critical mass of highly trained people and R&D, as well as large internal markets to play successfully in the global system. They are also large and strategic enough to be among the countries developing the rules of the global system. As such they can play an important leadership role for other developing countries.

Developing countries have to position themselves to try to benefit as much as possible from this demanding globalised world. This involves many things.

First, it means more investments in human capital. This is not just in basic education, but secondary, technical and higher education and a system of life-long learning. Second, it means more investment in two kinds of infrastructure. One is the traditional physical infrastructure needed to link to the global economy – roads, ports, airports. The other is the new ICT infrastructure which has already become so critical for competition in the new real-time world and for taking advantage of the second unbundling. Third, it means improvements in the economic and institutional regime – the rule of law, the efficiency of capital and labour markets. Fourth, it means improvement in governance – the ability of government to help its citizens respond successfully to the new challenges and to help people falling between the cracks.[72]

What countries can do will depend on their level of development and their specific economic, political, and social structure. They will need to examine carefully how to make best use of their resources and how to leverage them in this new competitive environment. They need to think and act more strategically. They can learn about creating consensus on longer term visions from some of the high performing East Asian economies. They have to learn how to make effective use of global knowledge, how to attract FDI than can contribute to their national development, and how to get positive externalities from that investment.

Because of very strong adjustment pressures and trend towards marginalization of many countries and even within countries, there has been an increase in the difference in incomes between the richest countries and the poorest. In 1980, the gap between the richest country and the poorest was about 170 times. Now it is 500 times.[73] Even within developed countries there is a trend toward increasing inequality. The gap in incomes between knowledge workers and those with high school education or less is increasing.

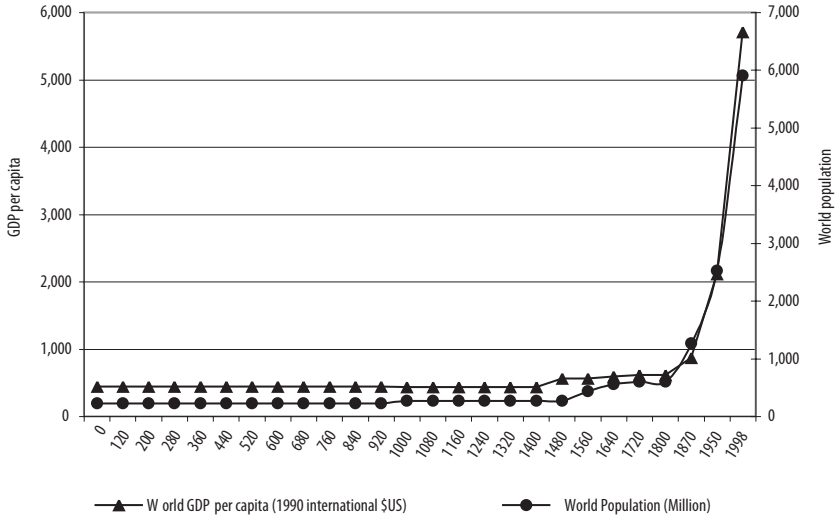
On a global level, part of what is going on is a massive integration of labour markets and rebalancing of relative incomes. With the entry of China, India and the former Soviet economies into the global market economy, the world's effective labour force has doubled. With reduction of transportation, communication and information processing costs there is increased trade in goods and services. Together with rapid technological change, the shifts in production locations and the redeployment of resources which globalisation is causing are resulting in large adjustment pressures.

There is the possibility of backlash against globalisation with a risk of moving back to protectionist trade regimes. If at all, this is likely to start in Western Europe because it is more rigid than the US, but it could spread to the US. Globalisation will also be a contentious issue for developing countries that are being left out. Note for example the movement towards the left in Latin America, seemingly largely from a feeling that the Washington Consensus reforms have failed. It will be important for the stability of the world for both developed and developing countries to resist the temptation to revert to pro-

tectionism. Developed countries in particular should focus instead on increasing the flexibility of their economies to adjust to changing comparative advantage, focusing on labour retraining, improving social safety nets, and fostering creativity and innovation. Developing countries need to work on improving their human capital and physical infrastructure as well as their capabilities to take advantages of the two unbundlings.

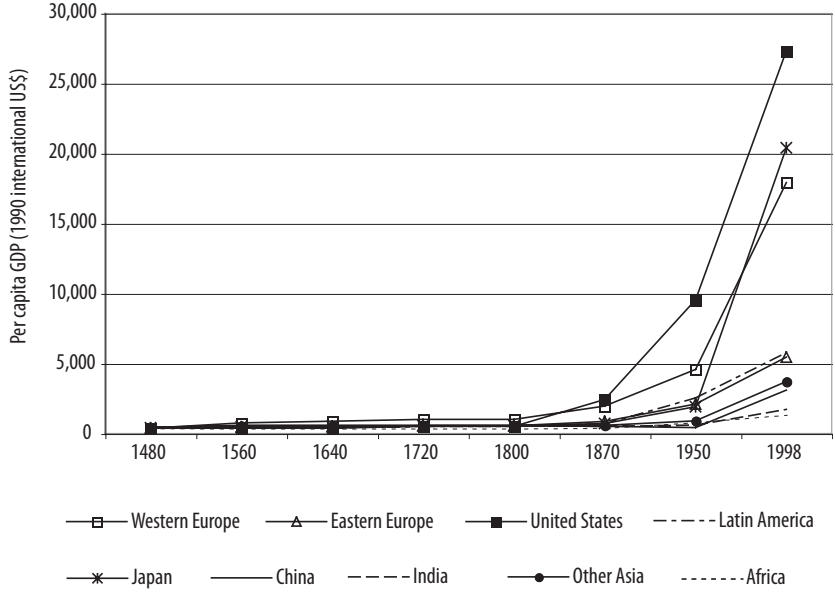
Finally, there are increasing fissures in the global system. There are large asymmetries in the global rules of the game and in the distribution of income and wealth. The least developed countries are falling further behind. The global system is not benefiting all equally. More efforts need to be made to open up possibilities for the disenfranchised.

Figure 1. The impact of technological advances on global population and GDP per capita – A two millennium perspective



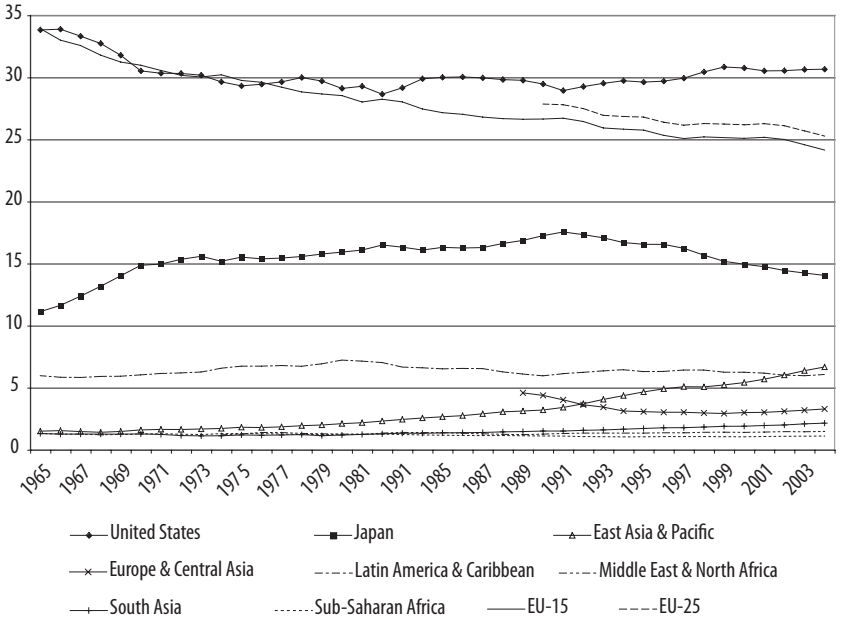
Source: Calculated from Maddison (2001).

Figure 2. The differentiation in regional and country performance since the industrial revolution, selected regions and countries



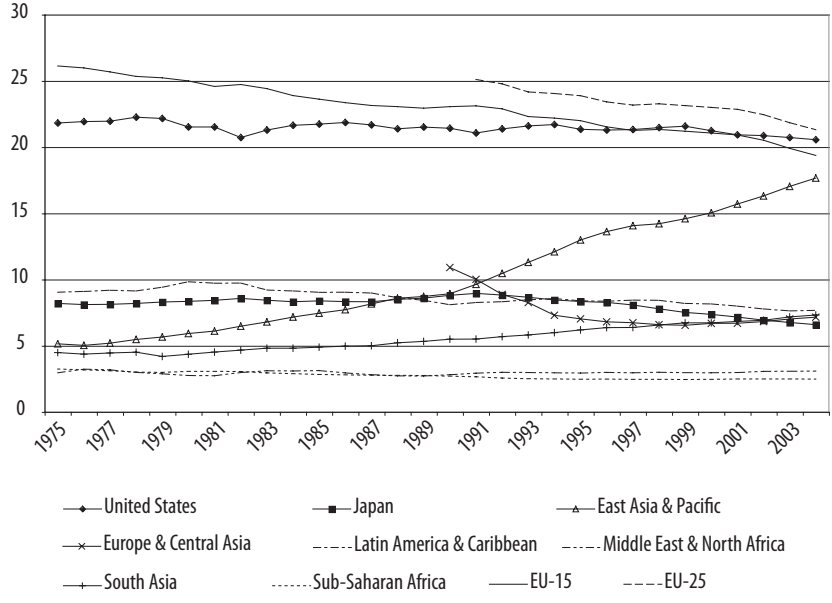
Source: Calculated from Maddison (2001).

Figure 3a. Shares of different world regions in global value added (constant 2000 US dollars),%



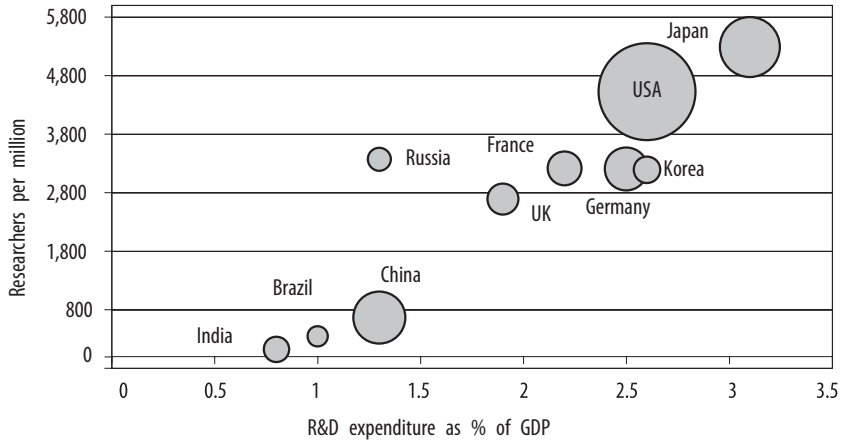
Source: Compiled from the World Development Indicators database.

Figure 3b. Shares of different world regions in global value added (PPP US$), %



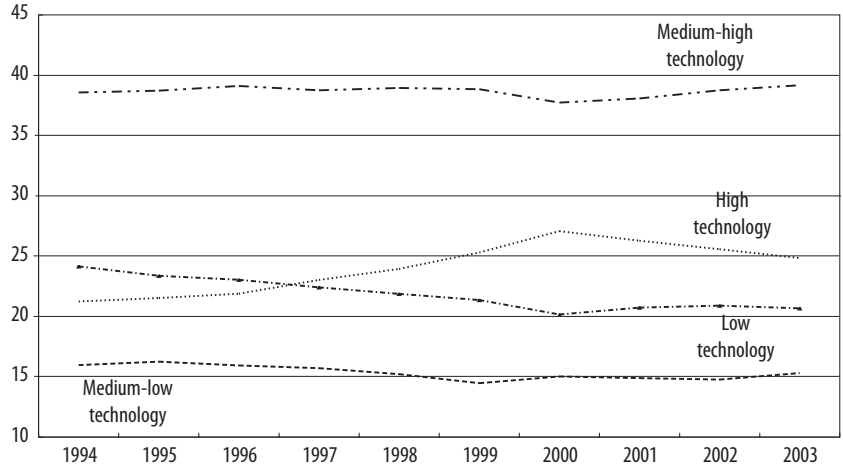
Source: Compiled from the World Development Indicators database.

Figure 4. Total gross domestic expenditure on R&D (PPP US$)



Source: Computed from data in World Bank (2006a).

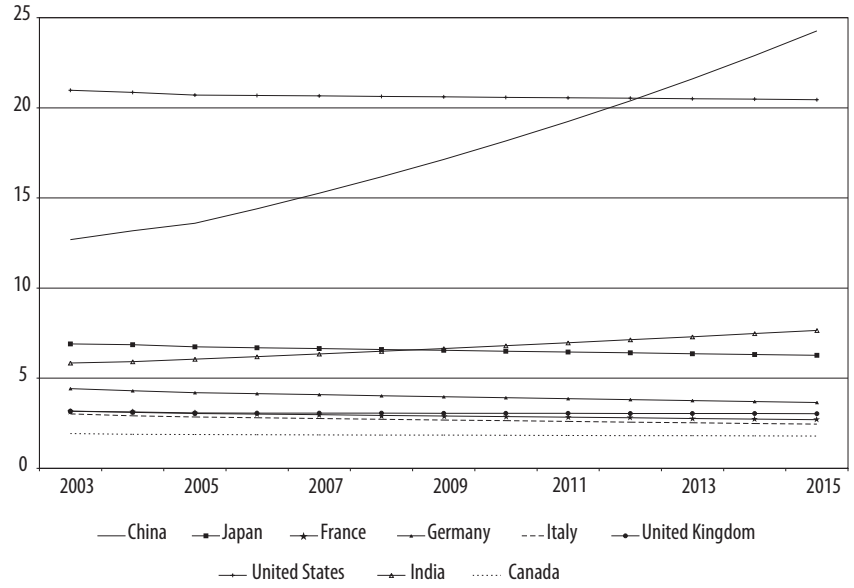
Figure 5. Structure of OECD manufacturing trade by technology intensity, %



Source: OECD (2005).

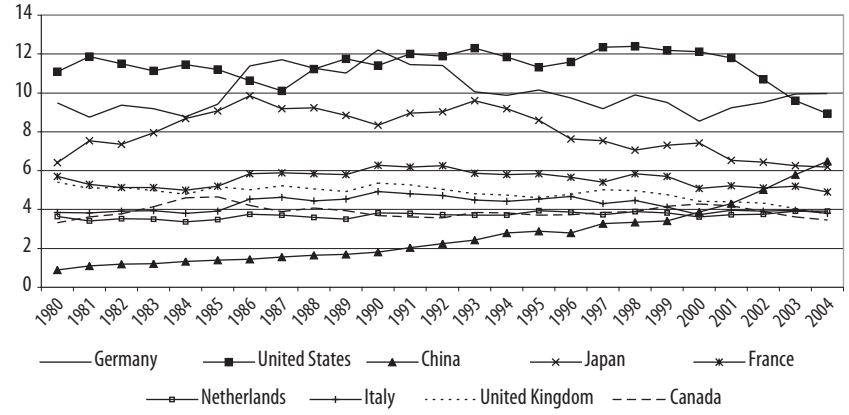
Obs.: excludes Luxembourg and the Slovak Republic.
Average value of total OECD exports and imports of goods.

Figure 6. Relative economic size and projections through 2015 for largest economies, % of global GDP



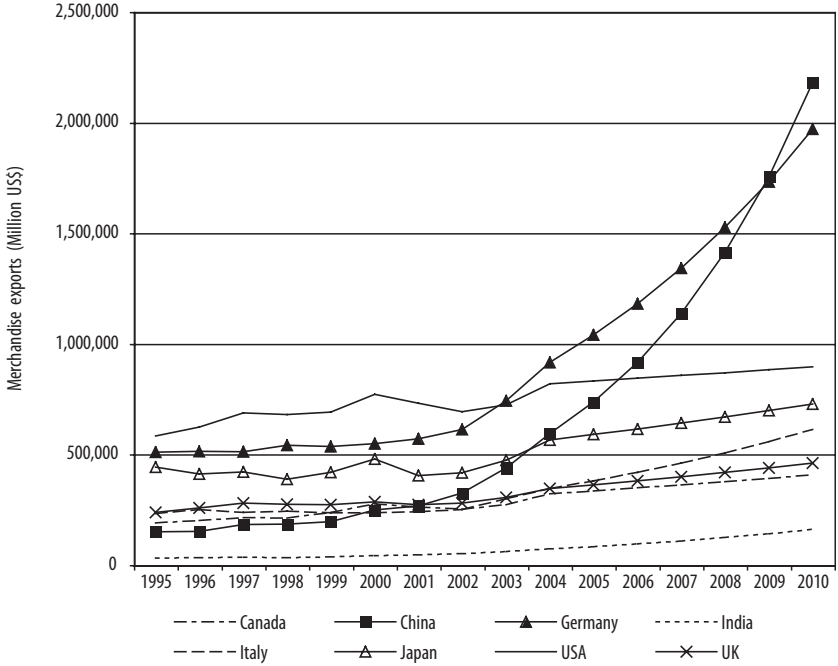
Source: Projected based on data from the World Development Indicators database.

Figure 7. Share of merchandise trade of main exporters, 1980-2004, %



Source: Calculated based on World Bank (2006a).

Figure 8. China's share of merchandise trade surpasses US by end 2006



Source: Projected based on data from the World Development Indicators database.

Table 1.
High performing plus BRICM

Country	1965-1980	1980-2004	1990-2004	2000-2004
Botswana	13.3	7.8	5.4	6.0
Brazil	7.9	2.5	2.0	2.6
China	7.3	9.7	9.7	9.0
Hong Kong (China)	8.7	5.4	4.1	4.6
India	3.3	5.8	5.7	5.8
Indonesia	6.9	5.4	4.8	4.6
Korea, Rep.	8.2	6.7	5.9	5.4
Malaysia	7.4	6.2	6.5	5.0
Mexico	6.6	2.8	3.1	2.6
Pakistan	5.8	5.2	4.1	4.0
Russian Federation	n/a	n/a	-1.1	6.8
Singapore	10.4	6.9	6.4	4.0
Taiwan (China)	n/a	6.4	5.3	3.3
Thailand	7.6	6.0	5.1	5.0

Source: Computed from World Bank (2006a).

Table 2.
Broad characterization of strategies toward trade and foreign direct investment (FDI)

	Outward	Inward
FDI passive	Hong Kong Indonesia Malaysia Thailand Vietnam	Brazil Mexico (although it turned outward with NAFTA)
FDI strategic	China (but now increasing own R&D) Singapore Taiwan	
Own R&D	Korea [Japan]	India Russia

Table 3.
The four high performing East Asian economies

	Hong Kong	South Korea	Singapore	Taiwan
GDP Growth rate (1999-2004)	4.8	5.4	4.2	3.3
Gross Capital Formation as % of GDP (1994-2003)	28.8	32.1	29.9	22.1
Trade as % of GDP (2004)	330.6	73.8	n/a	109.0
Tariff & Non-Tariff Barriers* (2006)	1.0	3.5	1.0	2.0
Gross Foreign Investment as share of GDP (average 1994-2003)	37.0	1.8	21.7	n/a
Royalty and license fee payments (millions US$ 2004)	491	4,450	3,334	n/a
Royalty and license fee payments/ million population (2004)	73.0	92.5	775.5	n/a
Royalty and license fee Receipts (millions US$ 2004)	196	1,791	197	n/a
Royalty and license fee Receipts/ million population (2004)	29.1	37.2	45.8	n/a
Manufactured trade as % of GDP (2003)	272.5	48.7	246.3	75.7
High technology exports as % of manufactured exports (2003)	12.7	32.2	58.8	43.0
Tertiary Enrolment Rates (2004)	26.0	84.7	43.8	n/a
Science and Engineering Enrolment Ratio (% of tertiary students 1998-2002)	30.2	41.1	n/a	n/a
Science enrolment ratio (% of tertiary students (1998-2003)	14.3	10.3	n/a	n/a
Researchers in R&D (2003)	10,639	151,254	18,120	87,394
Researchers in R&D / million population (2002)	1,568	2,979	4,352	3,937
Total expenditures on R&D as % of GDP (2002)	0.6	2.9	2.2	1.8
Scientific and Technical Journal Articles (2001)	1817	11,037	2,603	8,082
Scientific and technical journal articles/ million population (2001)	275.0	233.1	630.1	361.7
Patent applications Grant by USPTO (2004)	641	4,671	485	7,202
Patent applications granted by USPTO/ million population (2004)	93.6	97.0	111.8	318.5

Source: Compiled form WBI KAM (World Bank Institute Knowledge Assessment Methodology) 2006.
*Obs.: * The lower the number, the more open the trade regime to imports and exports.*

Table 4.
The second wave of East Asian high performers

	Indonesia	Malaysia	Thailand	Vietnam
GDP Growth rate (1999-2004)	4.6	5.1	5.1	7.1
Gross Capital Formation as % of GDP(1994-2003)	21.9	31.5	29.5	29.5
Trade as % of GDP (2004)	56.9	207.6	124.6	127.3
Tariff & Non-Tariff Barriers* (2006)	3.0	2.5	3.5	4.5
Gross Foreign Direct Investment as share of GDP (average 1994-2003)	3.1	5.4	2.9	5.9
Royalty and license fee payment (millions US$ 2004)	n/a	782	1,584	n/a
Royalty and license fee payments/ million population (2004)	n/a	31.5	25.4	n/a
Royalty and license fee Receipts (millions US$ 2004)	n/a	20	15	n/a
Royalty and license fee Receipts/ million population (2004)	n/a	0.8	0.2	n/a
Manufactured trade as % of GDP (2003)	24.1	139.3	82.7	64.8
High technology exports as % of manufactured exports (2003)	14.5	58.4	30.2	1.7
Tertiary Enrolment Rates (2004)	15.2	26.6	36.7	12.1
Science and Engineering Enrolment Ratio (% of tertiary students, 1998-2002)	n/a	40.1	n/a	19.7
Science Enrolment Ratio (% of tertiary students, 1998-2003)	n/a	16.3	n/a	0.00
Researchers in R&D (2003)	n/a	7,157	17,710	n/a
Researchers in R&D / million population (2002)	n/a	295	289	n/a
Total expenditures on R&D as % of GDP (2002)	n/a	0.7	0.2	n/a
Scientific and technical journal articles (2001)	207	494	727	158
Scientific and technical journal articles/ million population (2001)	1.0	20.8	11.9	2.0
Patent applications granted by USPTO (2004)	23	93	28	1
Patent applications granted by USPTO/ million population (2004)	0.1	3.7	0.5	0.0

Source: Compiled from WBI KAM 2006.
Obs.: * The lower the number, the more open the trade regime to imports and exports.

Table 5.
BRICM

	Brazil	Russia	India	China	Mexico
GDP Growth rate (1999-2004)	2.7	6.9	5.7	8.5	2.6
Gross Capital Formation as % of GDP (1994-2003)	20.9	20.9	23.1	39.5	22.4
Trade as % of GDP (2004)	30.0	52.6	30.5	66.1	58.5
Tariff & Non-Tariff Barriers* (2006)	3.5	3.5	5.0	3.0	2.5
Gross Foreign Investment as share of GDP (average 1994-2003)	3.4	1.9	0.7	5.1	3.0
Royalty and license fee payments (millions US$ 2004)	1,197	1,095	4201	3,548	805
Royalty and license fee payments/ million population (2004)	6.7	7.7	0.4	2.8	7.8
Royalty and license fee Receipts (millions US$ 2004)	115	228	25	107	92
Royalty and license fee Receipts/ million population (2004)	0.6	1.6	0.03	0.1	0.9
Manufactured trade as % of GDP (2003)	15.1	17.8	13.5	51.3	46.0
High technology exports as % of manufactured exports (2003)	12.0	18.9	4.8	27.1	21.3
Tertiary Enrolment Rates (2004)	18.2	69.8	11.4	12.7	21.5
Science and Engineering enrolment ratio (% of tertiary students, 1998-2002)	n/a	n/a	20.1	n/a	31.1
Science enrolment ratio (% of tertiary students, 1998-2003)	n/a	n/a	15.1	n/a	12.5
Researchers in R&D (2003)	59,838	487,477	117,528	810,525	27,626
Researchers in R&D / million population (2002)	352	3,415	120	633	274
Total expenditures on R&D as % of GDP (2002)	1.0	1.2	0.9	1.2	0.4
Scientific and technical journal articles (2001)	7,205	15,846	11,076	20,978	32
Scientific and technical journal articles/ million population (2001)	41.8	109.5	10.7	16.5	32.3
Patent applications granted by USPTO (2004)	161	173	376	597	102
Patent applications granted by USPTO/ million population (2004)	0.9	1.2	0.4	0.5	1.0

Source: Compiled from WBI KAM 2006.
Obs.: * The lower the number, the more open the trade regime to imports and exports.

Table 6.
Countries with annual growth rates of 5% or more

Country	1965-1980	1980-2004	1990-2005	2000-2004
Algeria	6.3	2.6	2.5	4.2
Botswana	13.3	7.8	5.4	6.0
Bosnia Herzegovina	n/a	7.8	19.5	5.0
Brazil	7.9	2.5	2.1	2.6
Cambodia	n/a	6.5	7.1	6.6
Chad	-0.5	5.3	5.3	12.0
Chile	3.3	5.1	5.5	3.8
China	7.3	9.7	9.7	9.0
Colombia	5.4	3.0	2.8	2.8
Congo Rep	6.0	4.0	2.0	4.4
Costa Rica	6.4	3.8	4.7	3.4
Côte d'Ivoire	6.3	0.8	1.5	-1.0
Dominican Rep.	6.4	4.1	4.2	3.6
Ecuador	5.9	2.4	2.7	4.2
Egypt	5.9	5.0	4.3	3.8
Gabon	8.0	2.3	2.4	1.8
Greece	5.8	1.9	2.6	4.2
Guatemala	5.7	2.5	3.6	2.6
Honduras	5.5	2.9	3.6	2.6
Hong Kong (China)	8.7	5.4	4.1	4.6
Iceland	5.3	2.8	2.6	3.2
India	3.3	5.8	5.7	5.8
Indonesia	6.9	5.4	4.8	4.6
Iran	n/a	3.2	5.0	5.6
Ireland	4.5	5.3	6.8	6.2
Israel	6.6	4.2	4.6	2.6
Jordan	5.0	4.6	5.1	5.4
Kenya	7.1	3.0	2.1	2.4
Korea, Rep.	8.2	6.7	5.9	5.4
Lebanon	n/a	3.1	7.9	3.8
Lesotho	7.6	3.9	3.3	2.4
Libya	8.3	n/a	n/a	4.6
Malawi	6.2	3.0	3.7	2.6
Malaysia	7.4	6.2	6.5	5.0
Mauritius	n/a	5.2	5.1	4.4
Mexico	6.6	2.8	3.1	2.6
Morocco	5.5	3.4	3.1	4.0
Mozambique	n/a	4.2	6.4	7.6

continued

Country	1965-1980	1980-2004	1990-2005	2000-2004
Nigeria	5.1	2.7	3.8	5.2
Oman	15.8	6.4	3.9	3.6
Pakistan	5.8	5.2	4.1	4.0
Panamas	5.7	3.2	4.7	3.2
Paraguay	7.1	2.8	2.1	1.6
Philippines	5.5	2.7	3.2	4.4
Portugal	5.6	2.7	2.3	1.0
Russian Federation	n/a	n/a	-1.1	6.8
Rwanda	6.3	3.2	3.3	5.4
Singapore	10.4	6.9	6.4	4.0
Sudan	3.3	4.4	5.1	6.0
Syrian Arab R.	7.9	4.0	4.7	3.0
Taiwan (China)	n/a	6.4	5.3	3.3
Thailand	7.6	6.0	5.1	5.0
Tunisia	6.3	4.5	4.9	4.8
Uganda	n/a	n/a	6.5	5.8
United Arab Emirates	n/a	n/a	6.1	7.2
Vietnam	n/a	6.7	7.4	7.2
Zimbabwe	5.3	2.0	-0.2	5.8

Source: Computed based on data from World Bank (2006), data for Taiwan estimated from CIA Factbook 2006.

Table 7.
Basic data on high performing East Asian countries plus BRICM (2004)

	Population (millions)	GNI (billion)	GNI per Capita	GNI (PPP Terms)	PPP GNI per Capita	Merchandise Exports (billion)
Brazil	184	552	3,000	1,460	7,940	96
China	1,296	1,938	1,500	7,634	5,890	593
Hong Kong (China)	7	184	26,660	217	31,500	266
India	1,080	673	620	3,369	3,120	76
Indonesia	218	248	1,140	757	3,480	72
Korea, Rep.	48	673	14,000	987	20,530	254
Malaysia	25	113	4,520	242	9,720	127
Mexico	104	705	6,790	1,001	9,640	189
Russian Federation	144	489	3,400	1,392	9,680	183
Singapore	4	105	24,760	116	27,370	180
Taiwan (China)	23	311	13,500	606	26,307	171
Thailand	64	158	2,490	505	7,930	97
Sub-Total	**3,197**	**6,149**	--	**18,286**	--	**2,304**
World Total or World Average	**6,365**	**40,282**	**6,329**	**56,289**	**8,844**	**9,145**
These 12 Economies as % World	**50.2**	**15.3**	--	**32.5**	--	**25.2**
Total for Low- and Middle-Income Countries	**5,362**	**8,050**	**1,502**	**25,334**	**4,726**	**2,472**
These 12 Economies as % of Low- and Middle-Income Countries	**59.6**	**76.4**	--	**72.2**	--	**93.2**

Source: Computed based on data from World Bank (2006), data for Taiwan estimated from CIA Factbook 2006.

Notes

1 At the broadest level, average per capita income is a good summary measure of the effective application of knowledge to production of goods and services, although in comparisons across countries it is necessary to be mindful of cases where rents from sale of natural resources such as oil bias per capita income upward.

2 See Maddison (2001) for a millennial historical overview.

3 See Perez (1992).

4 As pointed out by Gershenkron (1962), the advantage for late industrializers is that they can draw on the technology and experience of the already developed countries. However it is not so easy to replicate what other countries have done, as evidenced by the very small number of countries who have made a transition from low to high incomes.

5 See Abramovitz (1986) on catching up with developed countries.

6 See World Bank (2006a) for the different country groupings.

7 In May 2005 ten Central European countries joined the EU. Figure 3 has added their shares to those of the EC-15 back to 1990 to get an estimate of the EU-25 for comparative purposes.

8 The BRICs has become a popular aggregation since the Goldman Sacks report of 2003. Here Mexico has been added to the original list of BRICs as Mexico is the second largest economy of this group. Therefore we look at the BRICKM countries (with global ranking in 2004 in terms of economic size in parenthesis): Brazil (13th), Russia (16th), India (11th), China (5th) and Mexico (10th).

9 The Philippines does not because its average annual growth rate was only 2.7 per cent for 1980-2004.

10 The World Bank's East Asia Miracle book published in 1993 covered Hong Kong, Indonesia, Japan, Malaysia, Korea, Singapore, and Taiwan (Province of China) as the high performing Asian economies. It did not give any attention to China in spite of its already impressive performance. See Stiglitz and Yusuf (2001) for an updated view of the East Asian miracle.

11 The slowdown in growth was generic in Latin American countries. In the 1965-1980 period, 10 of the 41 countries that averaged more than 5 per cent annual growth were Latin American. In the 1980-2004 period, only one of the 19 countries that grew at more than 5 per cent was Latin American. That country was Chile whose growth fizzled to an average of 3.8 per cent for 2000-2004.

12 High growth during this period was also typical for the former soviet countries. Sixteen of the 49 countries that had average growth above 5 per cent for 2000-2005 were former soviet economies. It appears that after suffering severe economic contractions and undertaking key reforms in the economic and regulatory system, many were finally beginning to grow.

13 Hong Kong, Singapore and Taiwan are actually considered developed economies by the World Bank as their per capita incomes are above the US$10,066 threshold used, but they have been included as part of the developing countries' group here because until relatively recently they were considered as such.

14 See Lall's article in Lall and Urata (2003) for an elaboration of this distinction.

15 Table 3 on the second group of Asians includes Vietnam because it has had an average annual rate of growth of 6.70 per cent for 1980-2004.

16 See Kniivilä (2007), in this volume, for a review of the industrialization of the high performing East Asian economies with a special focus on poverty reduction.

17 Westphal, Rhee, and Purcell (1981) have pointed out that Korea acquired a lot of technology from its early engagement in trade. This consisted of design and production technology that was transferred by large foreign purchasers. It also included technical assistance provided by supplies of capital goods and turnkey plants. More generally, the fact that Korean firms were forced to export, made them more aware of the technology used by the competitors and forced them to keep up with new product and process improvements.

18 Kim (2003).

19 Kim (2003).

20 Logistics contributes 5.3 per cent of Hong Kong's GDP and employs 6 per cent of its working population.

21 See Tan, Lui and Loh (1992).

22 For a good account of Singapore's foreign investment strategy see Wong (2003).

23 See Wade (1999), and Noland and Pack (2003) for more detail.

24 See Aw (2003).

25 See Dahlman and Sannanikone (1991) for an early account of Taiwan's technology strategy.

26 Strong Brazilian companies in food processing are Perdigão and Sadia, which are exporting to many countries.

27 Less than one percent of the inputs (other than labour, and infrastructure services) were sourced from Mexico. Part of the problem was that many of the firms were already committed to purchases from their US supplier networks and did not find it attractive enough to develop Mexican suppliers due to low quality and scale economies.

28 As part of this, in 1970 India enacted intellectual property legislation that did not recognize product patents for pharmaceuticals or agro-industry products, and limited the protection for process patents to just five years in these sectors; and to 14 years in other sectors. Efforts were oriented towards mission oriented national programs in defense, nuclear energy space; the large capital-intensive state enterprise sector; small scale industry; and agriculture.

29 See Rodrik and Subramanian (2004) for a good account of the business liberalization that started before the trade liberalization of the early 1990s.

30 Most notable among these was the Council for Industrial and Scientific Research (CSIR), which by 1995 came out with a new strategy and vision for 2001. It changed its orientation from state industry and import substitution, to providing industrial research and development for the new competitive needs of the industrial sector.

31 World Bank Report (forthcoming 2007), The Environment for Innovation in India, Washington, DC: World Bank.

32 For a summary of the earlier stages see Yao (2003).

33 According to Premier Weng Jiabo's speech on the 15 year technology strategy in December 2005.

34 For a more positive assessment on the prospects for developing countries see the Economist (2006), "The New Titans". This survey points out that all major 32 emerging market countries are growing and had sounder macroeconomic balances. It presents a much more positive future for these emerging market economies.

However, it does not sufficiently distinguishing short term improvement because of increases in basic commodity and natural resource prices from the longer terms trends which are primarily being taken advantage of by China and to some extent India, as will be argued below.

35 But even in more traditional industries such as cars, there in an increase in the number of variety of products. It is now common for consumers to specify the options on the particular brand and model of car they wants to purchase, and have the car made to order.

36 Average weighted tariffs (using each country's imports from the world as weights) in developing countries have fallen from 19.7 per cent 1980-83 to 11.0 per cent in 2000-2001; and in developed countries from 5.8 per cent in 1989-1992 to 3.1 per cent in 2000 (UNCTAD, 2004).

37 See OECD (2004).

38 See Chang (2002) for a good development of this argument.

39 For a good exposition on modular production as applied to electronics see Sturgeon (2002).

40 For US MNCs, R&D undertaken by foreign affiliates increased from 11 per cent in 1994 to 13 per cent in 2002. For Swedish MNCs it increased from 22 per cent in 1995 to 43 per cent in 2003. For the world as whole, R&D expenditure by foreign affiliates is estimated to have risen from US$30 billion in 1993 to US$67 billion in 2002 – i.e., from roughly 10 per cent to 16 per cent of all global business R&D, US$403 billion (UNCTAD, 2005).

41 The use of unbundling for these trends is attributed to Baldwin (2006).

42 For a current analysis of this based on interviews with over 500 companies around the world see Berger (2006).

43 There is much debate on the number of jobs that might actually be outsourced, and Blinder's estimates tend to be on the high end, but the key point is that as ICT advances and more tasks can be digitized, many more jobs may be at risk.

44 In 2003, the top six MNCs (Ford, Pfizer, Daimler Chrysler, Siemens, Toyota, and General Motors) spent more than US$5 billion each. Only five developing countries came near to US$5 billion or more per year (Korea, China, Taiwan [Province of China], Brazil, and Russia) – see UNCTAD (2005).

45 UNCTAD (2005, various years).

46 In 2004, the exports of MNCs were approximately US$3,690 billion out of total world merchandise and non-factor service exports of US$11,069 billion (UNCTAD, 2000)

47 For an excellent perspective on this from no other than the CEO of IBM, see Palmisano (2006).

48 The economies, in decreasing order of FDI inflows in 2005 are: China, Hong Kong (China), United Arab Emirates, Brazil, Russia, Bermuda, Colombia, Mexico, and Taiwan—see UNCTAD (2006).

49 For a good exposition on supply chains and the difficulty of moving up see Kaplinsky (2005).

50 For example, according to a recent interview with the handicraft store chain Ten Thousand Villages, the main reason why there are so few handicraft products from Africa is that producers in African countries have trouble producing to the scale, quality, and timely delivery required.

51 Some of the most famous are companies such as Samsung, LG, and Hyundai from Korea; Acer from Taiwan; China Mobile, China Netcom, Founder, Lenovo, SAIC, Tsingtao Beer, and ZTE Corp from China; Bajaj, Bharat, Cipla, Dr. Reddy's Labs, Infosys, Ranbaxy, Reliance, Satyam, Tata, and Wipro from India; and Gerdau, Embraer, Natura, Perdigão, Sadia, and Votorantim from Brazil.

52 The World Bank developed a framework and methodology that captures indicators of all but the physical infrastructure elements (see http://www.worldbank.org/kam).

53 Palmisano (2006, p.132) for example writes, "Real innovation is about more than the simple creation and launching of new products. It is also about how services, are delivered, how business process are integrated, how companies and institutions are managed, how knowledge is transferred, how public policies are formulated - and how enterprises, communities, and societies participate in and benefit from it all".

54 See for example De Ferranti et al. (2002).

55 For the broad architecture of the kind of systems that need to be set up in developing countries, as applied to China, see Dahlman, Zeng and Wang (forthcoming 2006).

56 For an exposition on how the traditional factory production system has been replaced by logistics and the implications that has for workers see Ciscel and Smith (2005).

57 For a good exposition of this and of how some regions in the US are organizing public private partnerships to create this enabling infrastructure see Kasarda and Rondinelli (1998).

58 Ciscel and Smith (2005, p.431).

59 Studies from many countries show that efficiency gains are much larger when investments in hardware are accompanied not only by training but also by changes in organizational processes and procedures to take advantage of the potential offered by the new technologies (see OECD, 2005).

60 For another view on the impact of these two giants on developing countries see Altenburg et al. (2006).

61 Rather than using nominal exchange rates the figure uses purchasing power exchange rates. PPP rates provide a better measure for comparing the real levels of expenditure across countries. They are derived from price surveys across countries to compare what a given basket of goods would cost and use that to impute the appropriate exchange to use.

62 See Bergsten (2006) for a good analysis of the implications of China's rise for the US. See Dahlman and Aubert (2001) for an earlier analysis of the strengths and weaknesses of China as a knowledge economy.

63 According to Palmisano (2006, p.130) just between 2000 and 2003 foreign firms built 60,000 manufacturing plans in China, some targeted at the domestic market, but many targeted at the global market.

64 For a recent analysis of India's strengths and challenges see Dahlman and Utz (2005).

65 The rate of export growth in Japan and Korea was faster than in China, but they were smaller as a share of world exports.

66 See Evans, Kaplinsky, and Robinson (2006) for an explanation of the triangular production networks which have been established in East Asia where supply chain governor economies like Hong Kong and Taiwan organize production in China using inputs for the East Asian region, for buyers in the US and EU.

67 See IDB (2005) for some data on the degree of intra regional production chains.

68 For more on the impact of China in East Asia, see Gill and Kharas (2006), and Humphrey and Smitz (2006).

69 For more on the likely impact on Latin American countries see IDB (2005) and World Bank (2006b)

70 For more on the likely impact on Africa see Goldstein et al. (2006).

71 For a more optimistic assessment of Africa's prospects in natural resource-based industries including agriculture, see Kjöllerström and Dallto (2007) in this volume.

72 See Aubert et al. (forthcoming 2007) for some of the key elements of strategy that developing countries will have to master to take advantage of the opportunities opened up by the rapid changes in technology.

73 The per capita incomes of Norway and Switzerland are around US$50,000 compared to per capita income of around US$100 for Burundi, the Democratic Republic of Congo, and Ethiopia.

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Bibliography

Abramovitz, M. (1986), Catching Up, Forging Ahead, and Falling Behind, Journal of Economic History, 46 (2), 385-406.

Altenburg, T., H. Schmitz, and A. Stamm (2006),Building Knowledge-based Competitive Advantages in China and India: Lessons and Consequences for other Developing Countries, paper presented at Workshop of Asian Drivers of Global Change, St. Petersburg, Russia.

Aubert, J.-E., et al. (forthcoming 2007) Towards Knowledge Economies - Advanced Strategies for Development, World Bank Institute, Washington DC.

Aw, B.-Y. (2003), Technological Acquisition and Development in Taiwan, in Competitiveness, FDI and Technological Activity in East Asia, S. Lall and S. Urata, eds., Edgward Elgar, Northampton.

Baldwin, R. (2006), Globalization: The Great Unbundling(s), paper contributed to event on Globalization Challenges to Europe and Finland organized by the Secretariat of the Economic Council, Prime Minister's Office (June).

Berger, S., (2006), How We Compete: What Companies around the World are Doing to Make it in Today's Global Economy, Random House, New York.

Bergsten, C. et al. (2006), China The Balance Sheet: What the World Needs to Know About the Emerging Superpower, Institute for International Economics and CSIS, New York.

Blinder, A. (2006), Offshoring: The Next Industrial Revolution?, Foreign Affairs, 85 (2) (March-April).

Chang, H.-J. (2002), Kicking Away the Ladder, Anthem Press, London.

Ciscel, D. H. and B. E. Smith (2005), The Impact of Supply Chain Management on Labour Standards: The Transition to Incessant Work, Journal of Economic Issues, 39 (2), 429-437.

Dahlman, C. J., D. Zhihua Zeng, and S. Wang (forthcoming 2006), Developing a System of Life Long Learning in China to Enhance Competitiveness, World Bank, Washington, D.C..

Dahlman, C. J. and A. Utz (2005), India and the Knowledge Economy: Leveraging Strengths and Opportunities, World Bank, Washington, D.C..

Dahlman, C. J. and J.-E. Aubert (2001), China and the Knowledge Economy: Seizing the 21rst Century, World Bank, Washington, D.C..

Dahlman, C.J., and O. Sananikone (1991), Technology Strategy in the Economy of Taiwan: Exploiting Foreign Linkages and Investing in Local Capability, World Bank Industrial Strategy Policy Series Papers.

De Ferranti, D. et al. (2002), Closing the Gap in Education and Skills, World Bank, Washington DC.

Drucker, P. (1994), The Age of Social Transformation, Atlantic Monthly, Vol.274.

Economist, The (2006), The New Titans: A Survey of the World Economy, Special supplement in September 16th edition.

Evans, D., R. Kaplinsky, and S. Robinson (2006), Deep and Shallow Integration in Asia: Towards a Holistic Account, IDS Bulletin, 37 (1).

Freeman, R. (2006), Labour Market Imbalances: Shortages, or Surpluses, or Fish Stories?, paper prepared for Boston Federal Reserve Economics Conference - Global Imbalance - As Giants Evolve, June 14-16, Chatham, Massachusetts.

Gershenkron, A. (1962), Economic Backwardness in Historical Perspective: A Book of Essays, Cambridge: Belknap Press of Harvard University Press.

Gill, Indermit; and Homi Kharas (2006), An East Asian Renaissance: Ideas for Economic Growth, Washington DC: World Bank.

Goldstein, A., N. Pinaud, H. Reisen, and X. Chen (2006), The Rise of China and India: What's in it for Africa? Paris: OECD Development Centre.

Grossman, G. and E. Rossi-Hansberg (2006), The Rise of Offshoring: It's not Wine for Cloth Anymore, conference paper, Reserve Bank of Kansas, August 23.

Humphrey, J. and H. Schmitz (2006), The Implication's of China's Growth for Other Asian Countries, Institute of Development Studies, Brighton, UK.

Inter American Development Bank (2005). The Emergence of China: Opportunities and Challenges for Latin America and the Carribean, IDB Research Department, Washington DC.

Kaplinsky, R. (2005), Globalization, Poverty, and Inequality. Cambridge: Polity Press.

Kasarda, J. D. and D. A. Rondinelli (1998), "Innovative Infrastructure for Agile Manufacturers," Sloan Management Review, Vol. 39 (2), 73-82.

Kim, L. (2003). The Dynamics of Technology Development: Lessons from the Korean Experience, in Competitiveness, FDI and Technological Activity in East Asia, S. Lall and S. Urata, eds., Edgward Elgar, Northampton.

Kjöllerström, M., and K. Dallto (2007), Natural Resource-based Industries: Prospects for Africa's Agriculture, this volume.

Kniivilä, M. (2007), Industrial Development and Economic Growth: Implications for Poverty Reduction and Income Inequality, this volume.

Lall, S. (2003), Foreign Direct Investment, Technology Development and Competitiveness: Issues and Evidence, in Competitiveness, FDI and Technological Activity in East Asia, S. Lall and S. Urata, eds., Edgward Elgar, Northampton.

Maddison, A. (2001), The World Economy: A Millennial Perspective, OECD, Paris.

Noland, M. and H. Pack (2003), Industrial Policy in an Era of Globalization: Lessons from Asia, Institute of International Economics, Washington DC.

OECD (2005), Science, Technology and Industry Scoreboard 2005, OECD, Paris.

OECD (2004), Internationalization of Higher Education: Opportunities and Challenges, OECD, Paris.

Page, J., et al. (1993), The East Asian Miracle: Economic Growth and Public Policy, World Bank, Washington DC.

Palmisano, S. (2006) The Globally Integrated Enterprise, in Foreign Affairs (May- June).

Perez, C. (1992), Technological Revolutions and Financial Capital: The Dynamics of Bubbles and of Golden Ages, Edward Elgar, London.

Rodrik, D. and A. Subramanian (2004), From Hindu Rate of Growth to Productivity Surge: The Mystery of the Indian Growth Transition, National Bureau of Economic Research , Working Paper 10376 (March).

Singh, N. (2007), Services-Led Industrialization in India: Prospects and Challenges, this volume.

Stiglitz, J. and S. Yusuf (2001), Re-Thinking the East Asian Miracle, Oxford University Press and the World Bank.

Sturgeon, T. (2002), Modular Production Networks: A New American Model of Industrial Organization, Industrial and Corporate Change, 11 (3), 451-496.

Tan. W. B., C. W. E. Lui; and C. M. Loh,(1992), The Use of Information Technology by the Port of Singapore Authority, World Development, December, 1785-1795.

UNCTAD (2004), Development and Globalization Facts and Figures, Geneva.

UNCTAD (2005), World Investment Reports 2005: Transnational Corporations and the Internationalization of R&D, New York and Geneva.

UNCTAD (2006), World Investment Report 2006: FDI from Developing and Transition Economies-Implications for Development, New York and Geneva.

UNCTAD (various years), World Investment Reports. New York and Geneva.

Wade, R. (2003), Governing the Market, Princeton University Press.

Wong, P. K. (2003), From Using to Creating Technology: the Evolution of Singapore's National Innovation System and the Changing Role of Public Policy, in Competitiveness, FDI and Technological Activity in East Asia, S. Lall and S. Urata, eds., Edgward Elgar, Northampton.

Westphal, L., W. Y. Rhee, and G. Purcell (1981), Korean Industrial Competence: Where It Came From, World Bank Staff Working Paper 469, Washington DC.

World Bank (2006a), World Development Indicators 2006, Washington DC.

World Bank (2006b), Latin America and the Caribbean's Response to the Growth of China and India: Overview of Research Findings and Policy Implications, Washington, DC.

Yao, Yang (2003), In Search of Balance: Technological Development in China, in Competitiveness, FDI and Technological Activity in East Asia, S. Lall and S. Urata, eds., Edgward Elgar, Northampton.