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Party School of the Central Committee of the Communist Party of China

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This paper is produced as part of the Sustainable China Trade Project. The project is a joint effort of IISD and the Development Research Centre of the State Council of China, with research jointly conducted by Chinese and international experts. It seeks to help define the characteristics of a sustainable trade strategy for China—a strategy that helps contribute to environmental, social and economic improvements, primarily in China but also globally. Such an outcome is in line with the scientific concept of development first put forward at the 16th National Congress of the Communist Party of China in 2003, and with many of the goals of the 11th Five-Year Plan. The project will produce a series of eight working papers focusing on specific aspects of a sustainable trade strategy for China and a synthesized volume covering the body of work. The Sustainable China Trade Project is generously supported by the Swiss Agency for Development Cooperation.

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ASEAN	Association of Southeast Asian Nations
FTA	free trade agreement
G20	20-Nation Coordination Group
LDCs	least developed countries
WTO	World Trade Organization

1.0 Introduction: Upgrading and a sustainable trade strategy for China

The development process is often viewed as involving a series of transformations of a country's economy, societal relations and governance. One of the most prominent manifestations of development is the shift from widespread employment in agriculture into a fast-growing, jobs-intensive manufacturing sector. China has been able to pull off this particular transformation with impressive speed. While some of China's neighbours (Korea and Taiwan province) saw faster growth of value-added manufacturing during their first 30 years of takeoff,[1] the sheer scale of China's industrial development has been unique.

That scale, however, has had implications for China's use of natural resources, for the degree of harmony in international trade relations and, ultimately, for the case for China modifying its development trajectory. The relatively intensive use of resources and energy by Chinese manufacturing firms is said to have put pressure on worldwide commodity prices, though in fact it is total demand for commodities that influences prices, not any one source of demand. The growth of manufacturing exports from China has caused alarm in many trading partners, both industrialized and developing, as Chinese products compete directly with foreign firms in the latter's home and export markets. Plus, there is dissatisfaction from some quarters within China at the pace with which its firms are developing their own products, brands and innovative capabilities. Together these concerns have helped put the subject of upgrading by Chinese firms on policy-makers' agendas.

Having assessed the degree of upgrading by Chinese manufacturing firms and contrasted the Chinese experience with that of its trading partners, the purpose of this paper is to identify the challenges faced by Chinese firms in upgrading and the possible policy responses to those challenges. Since this paper is part of a larger project that seeks to flesh out a so-called sustainable trade strategy for China, it is worth recalling what the five objectives of that strategy are:

1. Promote the rebalancing of the Chinese economy away from its currently unsustainable path.
2. Promote added value in economic activities, not just sales.
3. Promote services, not just manufacturing.
4. Nationality matters; therefore, promote Chinese firms (including multinationals), brands and intellectual property rights.
5. Support a harmonious, sustainable architecture for international trade.

[1] See Brandt, Rawski and Sutton (2007, fig. 15.1), for evidence. This chart also shows that in the first 30 years of the country's takeoff , the expansion of Japanese value-added in manufacturing was slower than that in China.

Arguably, upgrading—to the extent that it results in more sought-after products made by Chinese firms, higher levels of production-process efficiency (which in turn is related to lower resource use) and other process innovations, and organizational improvements—can help meet all five of the above goals.[2] More efficient resource use helps attain the first goal. Product improvements, often the result of combining goods with services, help with the second and third goals. To the extent that the benefits of upgrading by Chinese firms are realized by those firms in the form of higher profits, the fourth goal is advanced. Reduced tensions with trading partners, especially those producing low-end manufacturing goods, may also be a payoff from upgrading, advancing the fifth goal.[3] These are the potential payoffs; what this paper aims to do is shed light on what the state can do to facilitate such upgrading.

At this stage it is important to distinguish between the manifestations of upgrading (product innovations, process innovations, more efficient resource use) and upgrading itself. In their review overview of Chinese industrial development, Brandt, Rawski and Sutton (2007) drew a contrast between the "revealed capabilities" of a firm—that is, the range of products that it currently produces, the unit costs of production (including resource use intensity) and the perceived quality of the product as manifested by the willingness of customers to pay for the product—and the "underlying capabilities" of a firm. The latter include the know-how that is collectively held by the firm's employees and the capacity to spot and take advantage of new opportunities as demand and technology change. This distinction is useful, as it forces analysts to focus on how firms and managers acquire, develop and retain underlying capabilities and the on capacity to successfully employ those capacities, along with other firm resources, to improve the firm's revealed capabilities.

Of course, it is not the firm that acquires, develops and retains underlying capabilities, but rather the firm's owners and managers. This raises a subtle point about the skills of these owners and managers and the basis upon which firms are competing. Ultimately, upgrading may require substantial changes in the very basis upon which a firm operates. Rather than continuing to compete on the basis of low production costs—which requires a certain set of managerial skills—upgrading is going to require acquiring expertise and the capacity to manage that expertise. The very role of a manager has to change, and this may not be something that the traditional tools available to governments can do much to influence. Indeed, government policy is likely to play an indirect role here, as the principal decisions are made by firm managers and owners, both in China and elsewhere. Certainly,

[2] We make no claim that upgrading alone is the only step necessary for China to attain all five goals. Other papers in this project explore the various contributions of state and non-state actors to the goals of a sustainable trade policy.
[3] Although, to the extent that Chinese firms begin producing higher-value-added goods that compete more intensively with goods and services produced in industrialized countries by persons with moderate or high skill levels, then in principle, trade frictions with those countries could increase. Many factors are likely to determine the severity of trade frictions between two countries. One factor that may mitigate trade frictions is whether each party's own commerce and markets for corporate control are in fact open to competition from another party's firms. Much will depend on policy-makers' weighing of the ability to compete with the outcome of such competition.

governments may offer financing and subsidies and establish institutions to enforce intellectual property rights, but they cannot directly upgrade firms.

Another important point is an appreciation of the motive for upgrading. Assuming that upgrading is desirable, it is useful to ask what market mechanisms and policies are most conducive to stimulating the effort and the expertise required to upgrade. Moreover, as the benefits of upgrading are typically not reaped immediately, then policy-makers need to give thought to the procedures that will ensure the commercial payoff from upgrading is sufficiently large. Taken together, then, the principal linkages are among government policy, the market environment facing a firm (including the protection of intellectual property rights and the enforceability of contracts), the incentives of managers and owners (given the many factors influencing the market environment), the capabilities of firms and the manifestations of upgrading. As will become clear, different analysts emphasize different links among these factors. Even so, at least in principle, analysts and decision-makers should be open to the fact that there may be several recipes for success and therefore, perhaps, menus of options for Chinese policy-makers.

The rest of this paper is organized as follows: Section 2 examines the domestic and international imperatives for upgrading, making a particular link to the context of the expansion of global value (supply) chains in recent years. Section 3 provides a detailed overview of the current upgrading of Chinese manufacturing firms, identifying corporate opportunities and four related challenges faced by Chinese firms. We present two industry studies, one for the textile and apparel sector and the other the electronic and communications equipment sector. We then discuss international experience with respect to corporate upgrading in Section 4. We describe the state measures that can promote industrial upgrading, as well as some principles to guide decision-makers, in Section 5.

2.0 Domestic and international imperatives for upgrading

Since the 1980s, fierce competition in global markets has pushed multinationals into adopting a new business strategy, creating one sizeable and ongoing opportunity for firms in developing countries to upgrade.[4] By formulating unified design rules and technical standards, multinationals broke up the entire production and operation process into a number of value-added links such as product design, procurement, production of components and intermediate goods, processing and assembly, training, sales, and research and development. Then, through direct investment and outsourcing, the independent and closely interrelated value-added links were deployed in the most appropriate regions around the world, thereby forming a global value chain in the industry.[5] The globalized deployment of industrial chains has resulted in the enormous enhancement of the efficiency of modern industries and the rapid development of the competitiveness of core enterprises. Such a new business strategy quickly came into extensive use in all industries, including both labour-intensive industries that make garments, shoes and hats and the capital- or technology-intensive industries of auto-making and communications, and including both manufacturing industries and service industries.

The expansion of global value chains has provided a new option for the industrial growth of developing countries. By introducing foreign capital and by outsourcing, developing countries can integrate with the global industry chain, starting from the link of processing and assembly at the lowest end and gradually moving up toward the links of high added value, such as upstream manufacturing and research and development and downstream sales, through continuous capital accumulation and technological progress. This is a new route, whereby the developing countries can achieve industrial growth and upgrading against the background of globalization. In 1970s the Asian "Four Small Dragons" accelerated their industrialization process and realized economic prosperity through such integration with global value chains. Since the 1990s, as the largest undertaker of the transfer of the global manufacturing industry, China has become a base of global manufacturing and created a wonder of international trade and economic growth.

[4] It would be wrong, however, to conclude that upgrading in developing countries would have not happened in the absence of the development of global supply chains. As will become clear later, one school of thought argues that the integration of the national market in China (that is, the gradual removal of interprovincial trade barriers) facilitated intensified competition between Chinese firms and promoted upgrading too.

[5] For the development of global value chains—or global production networks, as some prefer to refer to them—see Hess and Yeung (2006). This paper summarizes much recent research on global production networks, including the relationship to upgrading. In this regard Hess and Yeung argue that various aspects of the business environment in which multinationals operate in developing countries influence how much local value-creation and upgrading takes place. Moreover, they argue that the lessons for China from other developing countries may be limited by the fact that the former is seen as "must invest" location for multinational investment.

The expansion of the global value chain has posed challenges to the industrial growth of developing countries. On the one hand, by leading technological innovations and systemic change, multinationals are gradually concentrating most of the added value of the entire value chain into the core links and continuously slashing the total profits to be made along the manufacturing chain. On the other hand, through outsourcing and original equipment manufacturing, more and more developing countries are squeezing into the low-end links of the industry chains, creating intense competition that has placed the developing countries involved in the links of processing and manufacturing under unprecedented pressure to upgrade. Moreover, the international transfer of the low-end manufacturing industry is often accompanied by the transfer of high pollution, high energy consumption and high raw material consumption as well as causing frequent trade frictions. Therefore, although the pursuit of "clean" upgrading and sustainable trade growth are the important tasks of developing countries, they tend not to be seamlessly accomplished.

2.1. "Made in China": China's role in global value chains

Since the inception of reform and associated opening up to the world economy, China set out on the development route of international industrial transfer by enthusiastically introducing foreign capital and working hard to develop foreign trade. Thanks to China's abundant, high-quality and low-price labour resources; a potentially huge domestic market; preferential policies for foreign capital and foreign trade; and a stable political and social situation, China has gradually become one of the largest global destinations of direct foreign investment. From 1979 to 2007 China cumulatively introduced several hundred billion U.S. dollars of direct foreign investment, of which 70 per cent went into the manufacturing industry, which mostly consists of the processing and manufacturing links in the global value chain. The concentration and development of the global value chains of all industries, including the high-tech industry, on the eastern coast of China have boosted the sustained, rapid growth of Chinese exports and caused a marked improvement in the country's export makeup, resulting in China becoming a base of manufacturing industry and capturing global attention (the so-called "Made in China" phenomenon). As can be seen In Figure 2.1, since the mid-1990s the processing trade (of parts, components and raw materials) has accounted for half of the Chinese export trade, and foreign-invested enterprises have become an important force propelling Chinese exports. This adequately reflects the aggregation and expansion of the processing and manufacturing links of the global industrial value chain in China and shows that the development of the Chinese manufacturing industry has merged deeply with the global value chain and the system of international division of labour.

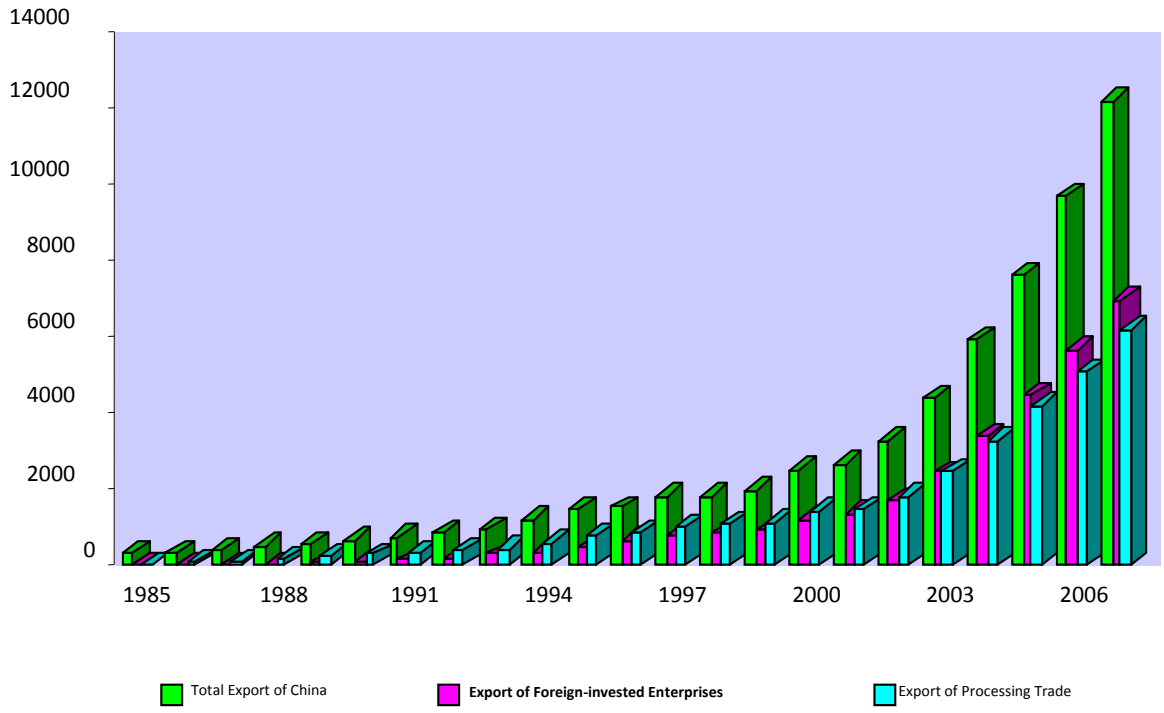

Figure 2.1 Growth of Chinese exports, 1985 to 2007. Source of data: China statistical yearbooks.

However, many surveys and studies have shown that, in spite of the noticeable differences among different industries and regions, "Made in China" still lies among the low-end links of the global value chain for most industries, which carry out processing and manufacturing activities of lower added value. This phenomenon finds expression in the fact that not only are over two-thirds of Chinese processing trade enterprises still engaged in labour-intensive production and processing but also that the added value of most Chinese manufacturing industries is far below that of developed countries. For quite a long time, the share of value-added in the processing trade has remained around 50 per cent. Besides, under China's mode of extensive economic growth, the expansion of the manufacturing industry has further projected the negative effects brought by international industrial transfer, and China has become one of the global regions with the worst environmental pollution. As its gains from the division of labour on the global value chain are falling and the profit space of its enterprises continues to dwindle, China faces intensifying international trade frictions, increasing risks of internal-external economic imbalance and grave challenges to the sustainability of its economic growth.

It has always been a policy objective of the Chinese central government and of local governments to promote the technological progress of enterprises and expedite industrial upgrading so as to increase the gains from the division of labour in the global value chain. Under the guidance of the new

concept of development—"sustainable development"—China has developed an even more clear-cut policy orientation toward new industrialization and lifting the position and role of "Made in China" on the global value chain. Therefore, the achievement of "clean" upgrading and sustainable development is becoming an integral part of "promoting the good and rapid development of the national economy" (Hu, 2007). Since the beginning of the new century the shortage of labour has hit the Pearl River delta and the Chang Jiang River delta; the unlimited supply of labour has materially changed; the price of energy and other elements has risen sharply; and China's traditional low-cost advantage has begun to trail off.

In addition, as the incomes of Chinese private consumers have risen, so has the demand for higher-quality domestically made products. The days when consumers would buy anything that firms chose to make are coming to a close. Managers must therefore learn what customers want and keep abreast of the changing tastes of potential buyers, in particular those willing to pay higher prices. Once a firm has spotted new consumer trends, it must also have staff who can develop new products and bring them to market expeditiously and within budget. Competition on the basis of time to market requires a broader range of managerial skills than has hitherto been necessary.

In the meantime, the environmental protection standards for all industries have been raised continuously and are progressing steadily. After nearly three decades of reform and opening, China is feeling urgent internal pressure for upgrading, which requires "Made in China" to move up along the global value chain toward upstream and downstream processes while lowering resource and energy consumption so as to realize environmentally friendly, clean development. For a large developing country in transition, this will be a difficult takeoff.

2.2 The international context: Diminishing returns from competing on the basis of low costs

The upgrading of Chinese manufacturing firms should be seen in the context of disparate foreign commercial and political dynamics. Collectively, effective competition from Chinese firms in the manufacture of low-tech products and the assembly of goods has put considerable pressure on the profits and employment levels of firms in developing and industrialized countries. This has manifested in a growing number of trade disputes and trade-defence measures against Chinese exports (see Evenett and Li, 2010, also from this project, for more details). One suggested response to these pressures is for Chinese firms to upgrade their product offerings, thereby, so the argument goes, relieving the pressure on low-skilled workers abroad and the associated protectionist pressure. (Whether calls for trade restrictions on Chinese products would in fact decrease after Chinese firms had upgraded and were competing directly with mid- to high-tech firms and their employees is another question.)

Another important consideration facing Chinese firms is that, in some sectors, they face low-wage competition from nearby neighbours in the Greater Mekong subregion. Ultimately, in many Chinese manufacturing sectors, competition based on low costs is probably not sustainable.[6] Firms need to innovate in their product offerings and processes to keep one step ahead of rivals, so the very basis of competition between firms must evolve. Moreover, cutting Chinese wages or not sharing enough of any productivity increases with workers is a recipe for social instability, and therefore it is not surprising that some advocate upgrading Chinese products so as to raise both long-term living standards and the competitiveness of Chinese industry.

Historically, of course, much has been made of the so-called flying geese characterization of export patterns and associated upgrading within East Asia, with Japan being the first goose to set off on this trajectory. Seen in this light Chinese upgrading is part of a long-established trend within the region. However, the very scale and growth of the Chinese manufacturing sector, with its impact on world markets, is distinctive. Indeed, it has been argued that because of China's export growth, some trading partners are reluctant to lower their tariff barriers in the Doha Round of multilateral trade negotiations.

In addition to pressure from firms that compete with imports and from the governments they complain to, other potential partners for Chinese companies that are headquartered in industrialized countries may demand as part of their collaboration that their Chinese counterparts improve their product offerings and production and organizational processes. Upgrading may thus become a more prevalent prerequisite for Chinese corporate engagement in higher-value-added, collaborative initiatives. More generally, to the extent that broad-based upgrading leads to increased national productivity levels, living standards can improve in China and the nexus between export growth and national economic growth will likely strengthen.

The international context reinforces domestic dynamics—including those created by governmental priorities for cleaning up the environment and the more demanding aspirations of Chinese consumers for better products—and points to the need for upgrading. The question arises as to how such upgrading can be done, whether policies to foster upgrading exist and whether upgrading can be undertaken in a way that is consistent with the other development objectives of the Chinese central government. Much of the rest of this paper seeks to shed light on these matters.

[6] A January 2008 report by the Boston Consulting Group examined the factors underlying the overseas expansion strategies of the 100 largest internationally active firms headquartered in developing countries (Boston Consulting Group, 2008). The authors of the study found that in only 14 per cent of cases did the firms' overseas expansion strategy turn principally and solely on low-production-cost advantages. The remaining 86 per cent of firms expected to compete principally on some other basis. This is not to imply that low production costs are not important for a firm, just that for many of the developing world's multinationals, low cost is not the expected basis for competition in international markets. Low production costs may well reflect efficient resource use and, if so, are desirable from the perspective of sustainable development. Finally, it is worth noting that 40 per cent of the 100 firms examined in the Boston Consulting Group study were Chinese.

3.0 Upgrading of "Made in China": Status quo, opportunities and challenges

In the first part of this section we present raw data on Chinese manufacturing sectors to provide an indication of the degree to which Chinese firms have upgraded. Recall that upgrading is a firm-specific process that takes place over time and ultimately manifests itself in terms of the types of products a firm offers to sell, whether those products are combined with services, a firm's costs or its productivity growth. This is important for a number of reasons. First, ideally, firms need information on the inputs associated with upgrading—such as managerial effort, skill acquisition and deployment—not just outputs that are potentially affected by a decision to upgrade. Second, upgrading can impact many indicators of firm performance, so firms must be cautious about drawing too many inferences from any one indicator. Third, in a perfect world, decision-makers would like to know the effect on a group of performance indicators of different upgrading decisions made by managers and, ultimately, the link between policy instruments and those upgrading decisions. Unfortunately, information on the latter linkages is rarely available, and analysts often only have piecemeal information on the various relevant causal factors.

3.1 Upgrading process of the manufacturing industry: A factual overview

Since the turn of the century the manner in which Chinese manufacturing firms are upgrading has become clearer. Such upgrading was initially represented by the rapid growth of the heavy and chemical industries (including steel, machinery and chemical engineering, and technology-intensive industries such as electronics and communication equipment). According to available statistics, heavy industry has grown faster than light industry. By 2006 the percentage of total industrial output represented by the heavy and chemical industries had reached 70.04, while that of light industry had dropped to 29.95. While the proportion represented by traditional industries has declined, the tendency toward heavy industrialization has strengthened continuously. Some industries, such as precision machinery and specialized equipment, are also showing a trend of accelerated development. The rapid growth and increasing driving force of these industries will undoubtedly further speed their structural adjustment and upgrading. Table 3.1 lists the top five industries contributing to industrial added value in different years. As can be seen from the table, compared with 1995 the proportion represented by the textile industry has gone down gradually since 2000, while the proportion of technology-intensive industries, such as chemical industries and the electronic and communications equipment industry, went up. By 2003, as the textile industry dropped out of the top five, the technology-intensive industries had built up to become the leading industries and an industrial group that was growing rapidly in a new round of a boom cycle.

Table 3.1 Top five industries contributing to industrial added value in different years. Source of data: China statistical yearbooks.

Year \ Rank		1	2	3	4	5
1995	Industry	Ferrous-metal smelting & rolling	Chemical raw materials & chemical product manufacturing	Oil & natural gas extraction	Nonmetal mineral products	Textiles
	Proportion (%)	6.82	6.10	6.08	5.82	5.81
2000	Industry	Oil & natural gas extraction	Electronic & communicatio ns equipment manufacturing	Chemical raw materials & chemical product manufacturing	Transport equipment manufacturing	Textiles
	Proportion (%)	8.70	7.18	5.57	5.21	5.01
2003	Industry	Electronic & communicatio ns equipment manufacturing	Transport equipment manufacturing	Ferrous-metal smelting & rolling	Chemical raw materials & chemical product manufacturing	Oil & natural gas extraction
	Proportion (%)	8.29	6.90	6.73	5.87	5.69
2006	Industry	Electronic & communicatio ns equipment manufacturing	Ferrous-metal smelting & rolling	Oil & natural gas extraction	Chemical raw materials & chemical product manufacturing	Transport equipment manufacturing
	Proportion (%)	7.74	7.66	6.54	5.90	5.39

In contrast with the heavy industrialization based on raw materials in early 1990s, more recent industrial growth has tended to be in more technologically sophisticated sectors and to involve processing activities. Table 3.2 shows the shift in production toward Chinese industries with greater technological intensity, with industries classified based on an OECD scheme. Comparing the data for 2006 with that for 1995 reveals that the contribution to industrial added value made by the low- or medium-tech industries decreased gradually, while that made by medium-high and high-tech industries increased, especially for the latter industries. Table 3.3 shows the changes in the distribution of added value made by the components of the chemical industry. According to the data in the table, from 1995 to 2003 the mining industry's proportion of heavy industry dropped by 4.58 percentage points, that of the processing industry rose by 4.84 percentage points and that of the intermediate category, raw materials, fell slightly. The ratio between these industries was 1 to 2.1 to 2.1 in 1995, compared with 1 to 2.77 to 3.09 in 2003, which reflects the upgrading of Chinese industries in the direction of greater processing. Influenced by the changes in world prices of energy and raw materials, the size of the mining industry rebounded dramatically in 2006, and that of the

processing industry went into reverse. As a whole, Chinese manufacturing industries have continuously improved in technological capability and processing depth.[7]

Table 3.2 Technological intensity level of the Chinese manufacturing industry, as percentage of total. Source of data: China statistical yearbooks.

Year	Low-tech	Low-medium-tech	Medium-high-tech	High-tech
1995	44.13	25.50	20.85	9.52
2000	47.34	19.75	20.10	12.81
2006	42.58	22.82	21.25	13.35

Table 3.3 Proportion of Chinese heavy industry by sector, as percentage of total. Source of data: China statistical yearbooks.

	Mining	Raw materials	Processing
1995	19.16	40.57	40.26
2000	19.82	39.12	41.06
2003	14.58	40.32	45.10
2006	18.14	40.61	41.25

Structural upgrading has also occurred as multinationals have moved into a new phase of their industrial transfer toward China. In pace with the rapid growth and restructuring of the Chinese economy, multinationals have adjusted their strategy of investing in China and changed the industrial makeup of their transfer into China. Since China's accession to the WTO, multinationals around the world have expanded their operational objectives in China and integrated their business operations there by introducing into China the upstream research and development, design and manufacturing of core components and intermediate products, as well as downstream sales and logistics.

According to published government statistics, since 2000 substantial foreign investment has been made in industries that manufacture electronic and communications equipment, transport equipment, electrical appliances and apparatuses, general-purpose equipment, and chemical raw materials and chemical products, in contrast with a dwindling flow into light textiles and other labour-intensive industries. Meanwhile, investment in research and development has been on the rise. By the end of 2006 over 980 R&D centres had been set up by multinationals in all forms. A new pattern has unfolded that features an obvious upstream and downstream extension of the industrial chain in China. China is becoming an important provider of new technologies and new

[7] Similar evidence, based on indexes of revealed comparative advantage, can be found in Bennett, Vaidya and Liu (2007). These authors conclude that from 1987 to 2005, Chinese exports shifted toward more medium- and high-tech sectors, notably in electronics and electrical products and in telecommunications. The authors recognize that the rate of technological improvement inevitably varies across firms and sectors, but they are not as pessimistic as some observers (such as Nolan, 2001). It is also possible to compare Chinese export performance in higher-tech sectors with that of other developing countries. Once such analysis, which presents evidence of faster upgrading of Chinese exports compared with Mexican rivals, can be found in Gereffi (2009). This paper considers the pattern of exports from China and Mexico to the United States, a market that both countries' exporters actively contest.

products, and the Chinese manufacturing industry has begun to shift from a base of processing and assembly to a base of production, procurement, and research and development.

Table 3.4 lists the top five industries contributing to the industrial added value of foreign-funded enterprises in different years. As can be seen from the table, since the mid-1990s the manufacturing of electronic and communications equipment has been the largest contributor to the industrial added value of foreign-funded enterprises, reflected in a proportion that has risen each year to reach 21.43 per cent in 2006. At the same time, the textile and apparel industries fell back in the ranking until they dropped out of the top five in 2006, compared with the strong buildup in the electrical appliance and transport equipment manufacturing industries. By 2006, capital- and technology-intensive heavy- and chemical industries occupied all of the top five places, and the ratio of their contribution to the industrial added value of foreign-funded enterprises reached as high as 47.18 per cent. A comparison of Table 3.4 with Table 3.1 shows that they are nearly the same, consistent with a significant contribution from international transfer of technology and managerial practices to the industrial upgrading of China.

Table 3.4 Top five industries contributing to the added value of foreign-funded enterprises. Source of data: China statistical yearbooks.

Year \ Rank		1	2	3	4	5
1995	Industry	Electronic & communications equipment manufacturing	Transport equipment manufacturing	Textiles	Apparel & other fibre product manufacturing	Electrical appliance & apparatus manufacturing
	Proportion (%)	14.44	7.32	7.05	6.72	5.39
2000	Industry	Electronic & communications equipment manufacturing	Electrical appliance & apparatus manufacturing	Transport equipment manufacturing	Chemical raw materials & chemical product manufacturing	Apparel & other fibre product manufacturing
	Proportion (%)	19.59	6.92	6.70	5.01	4.75
2003	Industry	Electronic & communications equipment manufacturing	Transport equipment manufacturing	Electrical appliance & apparatus manufacturing	Chemical raw materials & chemical product manufacturing industry	Textiles
	Proportion (%)	20.90	11.13	6.15	5.33	3.97
2006	Industry	Electronic & communications equipment manufacturing	Transport equipment manufacturing	Electrical appliance & apparatus manufacturing	Chemical raw materials & chemical product manufacturing	General-purpose equipment manufacturing
	Proportion (%)	21.43	9.14	6.67	6.07	3.87

The change in the profile of China's exports of goods is the most direct reflection of structural upgrading. Since the beginning of the new century, the upgrading of the industrial structure has found a vivid expression in the export structure of China. As shown in Table 3.5, from 2000 to 2006 the export proportion composed of primary products fell from 10.2 per cent to 5.5 per cent, compared with an increase in the export proportion of industrial products from 89.8 per cent to 94.5 per cent. The most prominent expression of the changes in export structure is the sharp rise in the proportion of exports that is made up of mechanical and electrical products and high-tech products. The proportion of exports composed of mechanical and electrical products rose from 42.3 per cent in 2000 to 56.7 per cent in 2006, accounting for more than half of total exports. The proportion composed of high-tech products rose even faster during this period, from 14.9 per cent to 29.1 per cent. Since a large portion of exports are conducted by foreign-funded enterprises

through the processing trade, the structure of export products is insufficient to support a judgment about the position of Chinese industry in the global chain of industries. Nevertheless, the transition of the export-product makeup from traditional, labour-intensive products to technology-intensive products indicates that "Made in China" has upgraded successfully between different types of industries.

Table 3.5 Composition of Chinese exports, as percentage of total. Source of data: Statistical data of customs.

Classification / Year	Primary products	Finished products		
		Total	Mechanical & electrical	High-tech
1995	14.4	85.6	29.5	6.8
2000	10.2	89.8	42.3	14.9
2003	7.9	92.1	51.9	25.2
2006	5.5	94.5	56.7	29.1

Since 2005 the imperative to upgrade has strengthened due to soaring production costs in coastal regions and a series of government policies. The Pearl River delta is where foreign-funded enterprises settled when they first entered mainland China and also where the labour-intensive industries and the links of processing and assembly, such as of garments, shoes, hats and toys, have concentrated. In recent years, however, traditional labour-intensive enterprises have begun to relocate as a result of the constant rise in wages and land cost as well as in the standards for environmental and labour protection. In the city of Dongguan, in 2007 alone 15 per cent of shoemaking enterprises were closed down or relocated (Mitchell, 2008). They moved part of their production lines or processes either to hinterland provinces such as Jiangxi or to Southeast Asian countries such as Vietnam. Still, most of the enterprises have chosen to stay because of the first-rate infrastructure in the Pearl River delta, skilled labour force, tight-knit upstream and downstream supply chains, and an enormous market. They also try to meet the challenges of rising costs, trade frictions and appreciation of the Chinese yuan by enhancing productivity and optimizing production modes.

In the meantime, the shifting out of low-end industries has provided space for the shifting in of mid- to high-end industries. In Dongguan the shortage of land made it impossible for over 100 foreign-invested projects to move in during the first half of 2006. These industries involved a total of US$2.8 billion (Chen, 2006). The shift out of traditional industries, such as shoe and hat manufacturing, is no doubt a precondition for the entry of high-tech enterprises. Also, according to statistics, in 2007 China absorbed US$74.8 billion of direct foreign investment, registering a year-over-year rise of 13.6 per cent. During the same period, the number of newly established foreign-funded enterprises was 37,888, a year-over-year fall of 8.69 per cent. While the influx of capital increased, the number of newly established foreign-funded enterprises decreased. This is proof that the influx of foreign capital has not been entirely stifled by rising costs. Instead, the quality of the

new influx of foreign capital is improving steadily, for foreign-funded projects of large scale and high added value are gradually becoming mainstream. The value-added ratio of the processing trade is an indicator that measures the added value created by an industry and indirectly reflects the upgrading status of the industry on the global value chain. From Figure 3.1 we can see clearly that after nearly eight years of hesitation from 1998 to 2005, the value-added ratio of the Chinese processing trade began to manifest a marked upward trend in 2006 and 2007. This is a new change in the processing trade, which occurred after production costs started their uphill climb, and presents an optimistic prospect for the upgrading of Chinese processing trade.

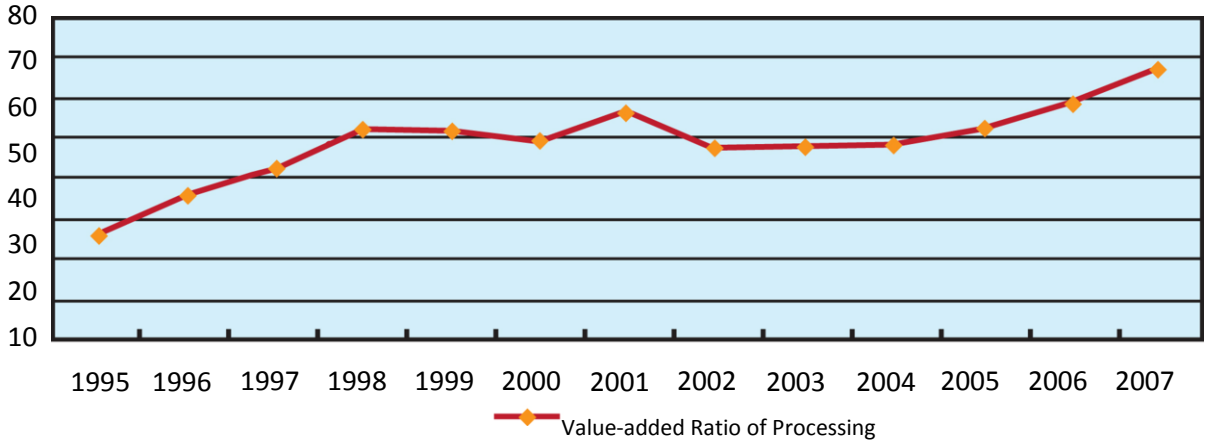

Figure 3.1 Value-added ratio of the Chinese processing trade.

3.2 Other economy-wide perspectives on Chinese upgrading

Here we summarize other, economy-wide evidence on the extent of and factors determining upgrading by Chinese manufacturing firms. Our starting point is the recent, detailed overview of Chinese industrial development found in Brandt, Rawski and Sutton (2007), three leading scholars of either the Chinese economy or the behaviour of firms in developing countries. These authors argue that "starting from the late 1970s, liberalization and market expansion arising from the gradual demise of planning, the relaxation of control over international trade and investment, and improvements in transport and communication stimulated entry into formerly closed markets, intensified competition, and deepened market integration" (p. 576).

In the authors' view, intensified competition provides the incentives managers need to upgrade production processes and products. Put another way, beyond the intensification of competition through reforms, these authors give little credit to state policies for fostering upgrading. They accept that circumstances differ across industries and sectors, and therefore that the response to greater

competition is not always the same. Indeed, Brandt et al. argue that industry-specific factors are likely to be important enough that Chinese firms' upgrading will ultimately follow that seen in other countries (p. 570).[8]

In general, Brandt et al. argue greater competition has three effects on firm performance and upgrading. The first is that greater competition puts downward pressure on prices, and the least capable firms are less likely to be commercially viable. Pressure to upgrade production processes so as to lessen costs would then follow from this intensification of competition. Failure to improve performance leads to firm' exits and to consolidation within the sector. Second, firms intensify research and development expenditures in response to greater competition and the ensuing shakeout. The goal is to enhance the very capabilities defined in the introduction to this paper as being central to the notion of upgrading. Third, shocks to the market environment, brought about by changes in competitive pressure but presumably also other sources, can sometimes reveal a gap between a firm's current revealed capacities and its underlying dynamic capacities. When this gap emerges, the firm may lose market share, and its future may be in jeopardy. From this perspective, competition and the upgrading it induces are likely to produce substantial changes in market shares (and perceived market leadership among firms.) This outcome is, the authors argue, not anomalous or perverse, even if it is likely to lead to job loss and dislocation.

Brandt et al. (2007) point to several indicators of upgrading by Chinese firms. At the end of 2005 nearly 144,000 firms had met International Organization for Standardization standards, up from around 7,500 in 2001 (p. 616). Defect rates in industries subject to international benchmarking, such as automobiles, have fallen considerably. Detailed analyses of patterns of Chinese exports to demanding overseas markets such as the United States show breakthroughs into higher-quality product market segments (they cite the research of Schott, 2008, and Hallak and Schott, 2008.) They note the growing qualitative evidence connecting these positive developments to various international linkages developed by Chinese firms, including participation in value chains and the foreign direct investments along the Eastern seaboard (pp. 623–624). Still, the situation could improve. Research and development expenditures as a share of sales are still relatively low. More generally, however, the authors argue that "the gains of high-performance firms cluster within the realm of production: industry has recorded much smaller advances along other segments of the industrial value chain, including R&D, design, product development, branding, and management of supply networks" (p. 624).

These authors explore this logic for a number of fast-growing Chinese manufacturing sectors. These sectoral accounts do not give much (if any) weight to positive government interventions to promote upgrading. It is not that these authors deny that there has been substantial intervention in various

[8] This suggests that there will not be a particular Chinese approach to upgrading. Presumably this claim relies on the implicit assumption that the principal determinant of upgrading in the Chinese case remains competition and not a specific set of policies tailored to Chinese circumstances.

sectors (pp. 623–624). On the contrary, they criticize government measures to "cushion" (offer financial support to) less successful firms, for example, in the case of televisions (p. 586). They say, "Official efforts to shield client firms and their employees from the rigors of the market competition, though diminishing, continue to obstruct the process of upgrading by blunting incentives and prolonging the lives of uncompetitive firms" (p. 624).

In sum, Brandt et al. put competitive pressure and international linkages at the heart of their explanation for the current extent of Chinese upgrading, though one could argue that competition for international linkages is another form of competitive pressure. As will become clear in a later section of this paper, this perspective is consistent with Michael Porter's (1990) account of the factors that determine upgrading and innovation by firms.[9]

Further information on the extent and form of innovation by Chinese manufacturing firms, and on impediments to such innovation, can be found in the recently published study by Alcorta, Urem and Tongliang (2008). This study reports the results of a professionally conducted survey of a sample of manufacturing firms located in Jiangsu Province. The survey instrument was based on that used by the European Commission and the Organisation for Economic Co-operation and Development. In this survey, "innovation was defined as the commercial introduction of new products and processes," and therefore the paper focused on improvements that were brought to market. To provide a comparator, the survey was also put to firms that had not been successful in innovating (what the authors referred to as "non-innovators"). The authors distinguished between radical innovation, which "involves a transformed design, profound changes in the technical characteristics and features, alternative inputs or components and/or creating different uses or applications for a good," and incremental innovation, which "involves adaption, enhancement or upgrading in design, technical characteristics, use of inputs and components and applications of the good" (p. 562). The third major modification of the survey was to determine the degree of novelty of the innovation. Innovations were, therefore, classified as "new to the world," indicating a high degree of novelty, or "new to the firm," a lower degree of novelty.

With respect to the degree of innovation, Alcorta, Urem and Tongliang found that 91.3 per cent of surveyed firms claimed to have introduced some form of innovation. Just over 80 per cent claimed to have introduced both process and product innovations. Around one-eighth claimed to have introduced only product innovations, and 6.8 per cent claimed to have introduced only process innovations. Three-fifths of sales were associated with products that had undergone incremental innovation, providing one indicator of the relative importance of incremental versus radical

[9] These findings are consistent with those a study that employed a very different economic methodology. Jefferson, Rawski and Zhang (2007) used standard econometric techniques to assess, among other matters, the productivity dynamics of China's largest manufacturing firms over the years from 1998 to 2005. They found that the entry and exit of firms, a consequence of the competitive process, was a significant contributor to the improvement in industry productivity levels and the convergence across Chinese regions in productivity levels of firms in the same sector.

innovation. Innovations concerning established products accounted for three-fifths of sales too. Only 4 or 5 perc ent of innovations by the surveyed firms were new to the world;[10] between 8 and 12 per cent were new to China or to Jiangsu Province. About 15 per cent of product and process innovations were new to the firms themselves (pp. 565 & 566, Tables 1 & 2). The authors argued that, despite the inevitable difficulties in making international comparisons of innovation based on firm-level surveys, the Jiangsu Province innovation survey showed that the extent of innovation in Chinese firms compared favourably with those in many industrialized and developing countries (for which they cite comparable percentages). They also noted that the most common form of innovation found in the survey was of the "catching up" type (that is, adopting innovation closer to best practice as opposed to defining new best practice).

The survey also considered the motives for innovation and examined whether any significant differences existed between innovating and non-innovating firms. They succinctly summarize their findings thus:

> By and large, the most important objective underlying innovation is to improve general competitiveness. Managers in China seem to be clearly aware of the relationship between developing new products and processes and their relative position *vis-à-vis* their domestic and international competitors. Indeed, the next four top objectives—improving product quality, increasing or maintaining market share, extending product range and creating new markets—can be seen as specific manifestations of this more "generic" competitiveness objective. The next objectives by importance were responding to R&D projects by competitors, lowering production costs and obtaining revenues from licensing. Bottom of the list was reducing environmental damage. (p. 579)

These findings suggest that innovation by Chinese firms is motivated by very conventional considerations. For a project such as this one, the low ranking given to reducing environmental damage is depressing. However, the authors' further analysis revealed that innovating firms placed a greater weight on environmental improvement as an objective than non-innovating firms. Likewise, innovating firms placed a greater weight on improving the conditions and safety of workers than did non-innovating firms. Perhaps the conclusion to draw here is that while innovation tends to be motivated by more traditional commercial factors than by sustainability considerations, inducing a firm to innovate (and therefore leave non-innovating status) itself increases the priority given to the sustainable motives for innovation.

[10] The authors noted that the new-to-the-world product innovations were found in the biotechnology, electronics, machinery, new materials and toys sectors. New-to-the-world process innovations were found in heat-process technologies, specialized conservation techniques for wine, new fermentation processes for pharmaceuticals, and grinding and surface technologies in mechanical engineering (p. 566).

This survey also elicited responses from firms concerning the impediments to innovation (pp. 582–586). Here the findings are revealing precisely because they highlight the relative unimportance of government-related factors as impediments to innovation. "Legislation, norms, regulations, standards, and taxation" were among the lowest-ranked impediments to innovation, along with form of ownership, resistance to change within the enterprise and the view that prior innovations by the firm were sufficient. Instead, concerns about the "innovation potential" of a firm, lack of information about available technologies, lack of information about product markets, lack of skilled personnel and the long payoff periods for innovation were seen as the most important impediments. If these findings are correct, the role implied for the state is one of providing the necessary ingredients (skilled personnel and information) for firms' innovative activities, rather than direct regulatory intervention.

3.3 Upgrading of specific manufacturing industries

A specific look at the industries can reveal more about the status quo of the upgrading of Chinese industries. On the global value chain, the upgrading of industries can assume four states: technological-flow upgrading, aimed at improving productivity through the transformation of technology and production processes; product upgrading, from the production of simple products at a lower level to the production of complex and precision products; functional upgrading, from the low-end links of low added value to the high-end links of high added value on the same value chain; role-change upgrading, from low-level suppliers of poor technical capability on the industrial value chain to high-level suppliers having independent know-how and technological property rights. Meanwhile, according to different driving forces of the industrial chain, the global value chain can be divided into two types: driven by producers and driven by buyers. For the former, the strategic links are research and development and the production of core components; for the latter, the strategic links are design and marketing. Generally, industrial upgrading follows a progressive process, from flow upgrading to product upgrading, then to functional upgrading and finally to role change. The process of moving from original equipment manufacturing to original design manufacturing and then to original brand manufacturing is usually seen as a sequence of functional upgrading, while the upgrading process from non-strategic links to the strategic links is a symbol of role change. Different characteristics of industries lead to different status quos and trends in the upgrading of each industry. We have selected as our cases the buyer-driven textile and apparel industry and the producer-driven electronic information industry.[11] By analyzing and describing the

[11] Other recent sector-specific studies of upgrading include studies on mobile phones (Imai & Jingming, 2007) and thermionic values, telecommunications equipment, electrical machinery and office machines (Devadason, 2009). The former study documents the impressive development of the organic mobile-handset industry in China, the growing technical capabilities of domestic firms and the diminished importance of foreign subsidiaries. That study does note that a constraint on innovation by Chinese firms is the availability of specialist engineering talent, confirming a point made earlier in this paper. The latter study compares the exports of Malaysia and China in the four sectors identified above. The author concludes that Chinese firms have quickly established themselves as producers of sophisticated goods and notes the importance of the intensity of competition in the respective markets for these products in China.

two industries, we can roughly judge the achievements and challenges of China's traditionally advantageous industries and rising high-tech industries in upgrading within the new economic situation.

3.3.1 Textile and apparel industries

The textile and apparel industries are the representative of China's traditionally advantageous industries and also two of the industries that were opened the earliest and widest to the outside world. At the beginning of reform and opening, the foreign capital introduced by China was mostly tied to investment projects in the labour-intensive industries of the small and medium-sized enterprises in Taiwan, Hong Kong and Macau. The textile and apparel industries became two of the Chinese industries that introduced the largest amount of foreign capital. The textile and apparel enterprises in Taiwan, Hong Kong and Macau transferred their processing and manufacturing links to mainland China, especially the Pearl River delta, opening the door for the international textile and apparel industries to move to mainland China. Since the 1990s global multinationals have flooded into China, and foreign investment in the textile and apparel industries has grown rapidly. Driven by these foreign developments and by competition against foreign-funded enterprises, China's textile and apparel industries not only made great progress in processing technology, product quality and business management but also merged into the global value chain and secured a vast foothold on the world market.

After China's accession to the WTO, large multinationals strengthened the structural upgrading of their investments in the Chinese textile and apparel industries, which became integrated even more deeply and completely with the global production system and began to seek upgrading that was supported by technological progress in the global industrial chain. Table 3.6 shows the increasing proportion of the foreign-funded economy among the major economic indicators of the Chinese textile and apparel industries, and Table 3.7 shows the rising proportion of Chinese exports among global textile and apparel exports. These two data sets are sufficient proof that the Chinese textile and apparel industries have involved themselves fully in the global production network and have continuously lifted their position and expanded their influence globally.

Table 3.6 Major economic indicators of foreign-funded firms in the textile and apparel industry, percentage of respective industry totals. The reported figure for the proportion of total profits in 1995 is in fact the proportion to total profits and taxes. Source of data: China statistical yearbooks.

Textiles					
Year	Industrial added value	Total value of assets	Product sales income	Total profits	Value-added tax payable in the year
1995	20.28	18.81	17.88	24.89	12.68
2000	20.73	20.76	21.16	24.62	16.32
2003	24.16	24.15	23.34	24.64	16.59
2006	24.85	28.02	24.51	25.70	20.13
Apparel					
Year	Industrial added value	Total value of assets	Product sales income	Total profits	Value-added tax payable in the year
1995	50.02	47.91	50.81	44.79	39.20
2000	48.83	45.35	49.05	50.38	40.88
2003	47.11	44.81	47.28	45.30	39.13
2006	47.39	48.20	45.37	43.12	43.82

Table 3.7 China's share of world textile and apparel production. Source of data: www.wto.org.

	1990	1995	2000	2003	2006
Global trade of textiles (billion US$)	104.33	151.58	154.74	173.73	218.59
Chinese exports of textiles (billion US$)	7.22	13.92	16.14	26.90	48.63
China's share of global trade (%)	6.90	9.20	10.40	15.48	22.25
Global trade of apparel (billion US$)	108.10	158.30	196.78	232.56	311.41
Chinese exports of apparel (billion US$)	9.67	24.05	36.07	52.06	95.39
China's share of global trade (%)	8.90	15.20	18.30	22.39	30.63

In recent years the upgrading of the Chinese textile and apparel industries on the global value chain has been reflected in flow upgrading, product upgrading and functional upgrading.

Through large-scale technological transformation, the textile and apparel industries have witnessed a great improvement of equipment and production technology. In the period covered by the 10th Five-Year Plan, imported advanced equipment accounted for 50 per cent of the total investment in equipment for the textile industry, thereby bringing most domestic equipment up to the international levels reached in the1990s. Accordingly, the technology for production of textile equipment has greatly improved. At present, the production of advanced frames for spinning cotton has been nationalized, so that Chinese-made complete sets of blowing-carding equipment have accounted for 70 per cent and homemade chemical fibre equipment 50 per cent of the domestic market for such equipment. New-tech equipment, such as digital printing and screen-making, has entered the stage of batch production. In some fields, textile and apparel technology has reached or

is close to the advanced international level, for example, in the cases of automatic colour-separation systems for printing designs and the comprehensive control systems for yarn bleaching and dyeing. New fibres developed independently in China, such as bamboo pulp fibres, protein fibres and high-performance fibres, have found use in some important fields such as space flight, military applications and special uniforms. China has seen breakthroughs in the processing and weaving technologies for natural hemp, bamboo and true silk fibres (Chinese Academy of Social Sciences [CASS], 2007, p. 321). In addition, conspicuous results have been achieved in the transformation of information technology in the textile and apparel industries. Computer-aided design and computer-aided manufacturing systems are now in widespread use in all links of the textile and apparel industries, including production, design and product development. Some advanced domestic apparel enterprises have set up quick response systems for producing small batches and multiple varieties by leveraging these computer-aided design and computer-aided manufacturing systems (CASS, 2003, p. 158).

Moreover, benefiting from the continuous enhancement of equipment and production technology, the textile and apparel industries are feeling a palpable itch for product upgrading. Since the 1990s the product categories of the Chinese apparel-processing trade have gradually changed, from the predominant underwear, T-shirts and shirts in the early days to apparel products that require more advanced and complicated technology. These include Western-style clothes, overcoats, and ladies' wear. Many enterprises emphasize the development and application of new fabrics, raw materials and auxiliary materials and use advanced technologies, resulting in a tremendous enhancement of the overall level of Chinese apparel products. Chinese enterprises have widely adopted technologies for non-creasing and no-iron fabrics for shirts, pants and casual dresses. Fabrics that are high-count, lightweight, and resistant to shrinkage and moths are used in quantity for high-grade suits and occupational uniforms. Accompanying the trend toward greater environmental protection, the production of green cloth has also started in China (CASS, 2003, p. 158). Currently, except for some top-grade apparel, China can produce nearly all complicated, high-end apparel products.

In addition, on the basis of equipment updating and the progress of product technology, the design capabilities of the textile and apparel industries have expanded quickly, and some enterprises have begun to shift from original equipment manufacturing to original design manufacturing. The added value contained in Chinese textile and apparel exports has also been continuously rising. A distinct new upgrading posture has begun to emerge. The increasingly fierce competition in domestic and foreign markets, as well as increasing production costs, is forcing the Chinese textile and apparel industries to hasten the processes of independent innovation and building up their own brands. The development of new fabrics and new technology through technical innovation has become the production and operation guideline for textile enterprises, and brand-based growth has become the common choice of apparel factories, which have long relied on original equipment manufacturing.

In 2007 the growth of profits outpaced that of output, and the growth in export prices outpaced growth in export quantity for the Chinese textile and apparel industries ("Upgrading urge," 2007), indicating that firms are succeeding in both technical progress and brand management in the domestic and foreign markets. Meanwhile, government policies have tightened control over energy savings, reduction of energy consumption and environmental protection. In July 2006 the Chinese State Environmental Protection Administration released the industry standard Clean Production: Textile Industry, which guides the environmental protection efforts of the textile industry. The standard is one of the environmental protection policies promulgated by the central government in recent years. "Ecological environmental protection, energy savings, reduction of emissions and clean production" are the objectives pursued by the textile and apparel industries through their technical innovations.

But the Chinese textile and apparel industries are also faced with a number of restraints in its upgrading, which constitute a challenge to the traditional, labour-intensive industries. Rising production costs are the foremost issues confronting the textile and apparel industry now. As the largest global exporter of textile and apparel products, China relies on low cost as the strongest competitive edge for this industry. In recent years, however, the price hikes for domestic factors such as land, raw materials and labour have caused enterprises' production costs to continuously increase. In 2005 the average annual pay for employees of the textile industry rose by 81.1 per cent from that in 2000. Data from the State Statistics Bureau show that in 2006, the principal costs of the textile industry chalked up a year-over-year increase of 21.3 per cent. At present, compared with some other developing countries, the Chinese textile and apparel industries maintain the upper hand in industrial matching and market systems, but their edge in production costs basically no longer exists (CASS, 2007, p. 323). On the global industrial chain, the Chinese textile and apparel industries have long been among the links of low added value. Given the small scales of enterprises, low profits and poor capital accumulation, whether or not upgrading can be accomplished before the cost edge is totally lost has become a critical concern for these industries' survival.

Weak innovation capabilities and low levels of research and development are among the major obstacles for the Chinese textile and apparel industries. For a long time the industries have been held back by the stress placed on expanding scale of production to the neglect of efficiency enhancement, and by the stress placed on equipment introduction to the neglect of getting the most out of existing plants and equipment. The textile and apparel industries fall visibly behind the advanced world level in the five major technical links of fibres, yarns, weaving, dye-finishing and design. The Chinese textile industry features low variety, substandard quality and reliance on the import of fabrics for large-scale garment processing, which seriously hinders the progress of industrial upgrading. Furthermore, the industry does not pay enough attention to technical innovation, and investment in research and development is acutely inadequate. The industry not only wants original technology, with independent intellectual property rights, but also has failed to make a major breakthrough over

the years in the crucial technology that prevents Chinese textile products from rising in grade, such as deep-processing and after-finish technology. There is even a gap in the research and development of such new technologies as multi-component fibres, compound fibres and modified fibres. Data from the general economic survey conducted in 2004 show that the R&D investments by Chinese textile enterprises accounted for merely 0.287 per cent of sales proceeds, much lower than the average level of 5 per cent in developed countries (CASS, 2007, p. 321). As cost advantage wanes, the low technological level and weak R&D power are a stern challenge to the textile and apparel industries.

Brand popularization and operation is another vulnerability of the Chinese textile and apparel industries. Of the Chinese garment products sold on the international market, 85 per cent are original equipment manufacturing products, and less than 10 per cent of them use independent brands, which are mostly sold to developing countries (CASS, 2006, p. 231). The protracted pursuit of processing and original equipment manufacturing production has both caused most enterprises to rely on introductionary technologies and placed these enterprises at a great disadvantage. Original equipment manufacturing is characterized by low added value and narrow profit margins. Whenever something goes wrong, purchasing agents will immediately pass the buck to the manufacturing enterprises. Although the state encourages independent brands, and the importance of brand management has begun to dawn on Chinese enterprises, most of them do not have the ability now to really grasp the core of brand management.

Finally, restrictions on resources and the environment are exerting more and more constraints on the development of the Chinese textile and apparel industries, which have become more reliant on imports of raw materials. Currently 40 per cent of cotton, 75 per cent of wool, 60 per cent of hemp and 60 per cent of chemical fibres have to be imported. This high reliance on imports has made textile enterprises susceptible to the impacts of fluctuating world prices and destabilized business operations. Some enterprises have even been pushed to the critical point between profit and loss by the rising prices of raw materials.

The textile industry is highly sensitive to resources and the environment. Influenced by factors like insufficient investment, the small scale of enterprises, and a low level of technology and equipment, the textile industry has never managed to lower its consumption of water and energy. Rather than being eradicated, the environmental pollution and damage caused by waste water, waste gas and noise tend to get worse. For example, total emissions of waste water are increasing alongside the growth of production capacity. Now that the enterprises causing the most serious environmental pollution, such as the textile industry's printing, dyeing and chemical fibre enterprises, are concentrated in the densely populated regions of Jiangsu, Zhejiang and Guangdong provinces, their development has placed heavy pressure on the local environment. Furthermore, the production of raw materials in the textile industry depends mainly on the products and by-products of agriculture

and animal husbandry, and production activities are basically extensive. This means that chemical fertilizers, pesticides and other chemical products are used more and more, causing considerable pollution and damage to the environment (CASS, 2005, p. 213). In short, the textile and apparel industries face the pressing and difficult task of realizing energy savings, emission reductions and cleaner production.

3.3.2. Electronic and communications equipment

In contrast to the textile and apparel industries, China's electronic and communications equipment manufacturing industry is an epitome of high-tech industry that has risen quickly under the impetus of foreign capital after the start of reform and opening. From the end of the 1970s to the early 1980s, under the pressure of falling prices for global electronic products and rising production costs on the island, Taiwan-based electronic information industries began to gradually transfer processing and manufacturing links to the mainland, enabling China's electronic and communications equipment manufacturing industry to find its way into the global value chain as a low-end supplier. In the 1990s, as the global electronic communication industry accelerated its outsourcing, China accepted in a big way the part of the manufacturing industry chain that was transferred from the electronic communications industry of developed countries. In the meantime, the effects of reform and opening began to emerge, and the potential of the domestic market loomed larger. China's electronic and communications equipment manufacturing industry boomed under the joint drive of the large-scale transfer in from external industries and the strong demand of the domestic market. Following China's accession to the WTO, the position of this industry as an important global processing and manufacturing base and a potential market was consolidated and enhanced. Multinationals not only vied with each other to transfer production but also set up their R&D organs in China. China's electronic and communications equipment manufacturing industry approached development through combined scale expansion and industrial upgrading. Figure 3.2 shows the industry's rapid growth since the mid-1990s, and Table 3.8 reflects the position and role of foreign capital in the industry.

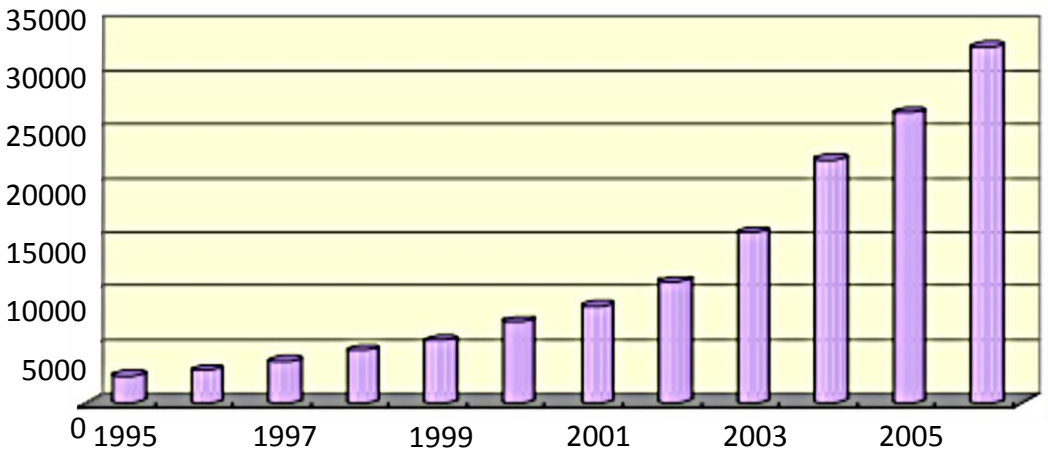

Figure 3.2 Total industrial value of China's electronic and communications equipment manufacturing industry (in 100 million yuan).

Table 3.8 Percentage of major industry-wide indicators in electronic and communications equipment manufacturing accounted for by foreign-funded enterprises. The reported figure for the proportion of total profits in 1995 is in fact the proportion to total profits and taxes. Source of data: China Statistical yearbooks.

Year	Industrial added value	Total value of assets	Value of product sales	Total profits	Value-added tax payable
1995	58.82	44.49	60.80	60.36	48.94
2000	65.39	55.89	72.21	70.45	57.49
2003	69.62	63.25	78.27	71.87	60.32
2006	77.29	71.24	82.07	79.53	56.85

As a rising industry, electronic and communications equipment manufacturing in China has not only grown rapidly in production capacity but also has made remarkable headway in technical flow upgrading, product upgrading and functional upgrading. This headway is well embodied in all the sector's subindustries. In the integrated circuit industry, since the start of the 21st century China has made considerable progress in the independent design and development of integrated circuit chips, mastery of core technology and possession of independent intellectual property rights. In the field of design, a number of "Chinese chips" with fully independent property rights have been developed, including Ark, Loongson and Patriot. The design capability of the domestic integrated circuit industry has exceeded 500 categories, which involve complete machines and many aspects of informatization engineering, including computers, communications, consumption and industrial control. In the field of chip production, China's integrated circuit mass-production technology has

reached 12 inches and 0.11 microns, with the proportion taken up by eight-inch silicon chips going up continuously. With the rapid development of chip manufacturing and design industries, the structure of the Chinese integrated circuit industry has changed. By 2006 the ratio of chip manufacturing to design and encapsulation testing in the integrated circuit industry was 30.7 to 18.5 to 50.8 (CASS, 2007, p. 308).

In the computer industry, the technology of domestically made PC servers is equal to that at the advanced international level and can compete with the products of leading international server manufacturers. Chinese development and production of high-performance computers has also broken the monopoly of developed countries. And as far as domestic manufacturing of network products, Chinese routers have not only dominated the low- to mid-end market thanks to their cutting-edge advantage in price and service, but have also broken into the high-end market, so that Chinese-made high-end routers are now used by many operators on a large scale, including China Telecom and China Mobile, smashing the monopoly of foreign competitors in the high-end market.

In the communications equipment industry, the independent R&D capabilities of Chinese enterprises have constantly strengthened. Currently China possesses a full line of communications products and has begun to come into an advantageous position domestically in some important fields, such as program-controlled exchangers, SDH/DWDM transmission equipment and cellular communication equipment. In the research and development of 3G mobile communication equipment, optical networks and core exchange routers, China has also begun to stand at the forefront of the world to participate in the formulation of the international communication standard and develop core technologies with independent intellectual property rights (CASS 2007, pp. 306–307). In the components industry, products are becoming more miniaturized, chip-based and high-frequency, and the chip-using rate of electronic components has topped 80 per cent.

In colour TV production, by the end of 2006 China had constructed three G5 thin-film-transistor LCD display-board production lines, and the number of patents owned in this field also increased sharply. In cellphone production, the enterprises producing domestic-brand cellphones have initially mastered the technology of cellphone structure, industrial design, development of application-layer software, RF modules and the production technology for large batches, and have made great progress in the development of core chips and low-level protocols. Overall, the electronic and communications equipment manufacturing industry has made great technological strides. In most subindustries, native enterprises have followed a route from assembly of finished products, to production of general parts, to production of key intermediate products, to production of final products. Most enterprises have gotten into the production stage of general parts and intermediate products and have completed the upgrading shift from original equipment manufacturing to original brand manufacturing.

Still, the upgrading prospects in the electronic and communications equipment manufacturing industry are not that bright. The first and foremost restraint is that the industry possesses weak capability for technological innovation and insufficient investment in scientific research. Because of its late start and poor foundation, the industry lags far behind that of developed countries in core technology innovation, a fact highlighted by the small quantity of patent applications, low product quality, lack of technical standards and reliance of most firms on imports for the supply of core technology and crucial components, such as the CRT production technology of the colour TV industry, the CPU technology of laptop computers and LCD display technology. The integrated circuit industry is the core of the electronic and communications industry. But China is still weak in its capabilities for independent design and development of integrated circuits, and chip-design manufacturers' products are mostly concentrated in the field of low- and medium-grade consumer products. Basically all the machines installed on integrated circuit production lines are foreign products, as the stability and reliability of domestically made machines still cannot meet needs.

The shortage of core technology has not only plunged the Chinese industry into increasing intellectual property right disputes but also greatly increased production costs and reduced the profitability of enterprises, thereby inhibiting their technological progress and investment in innovation. Another important reason for and expression of the weak capability for innovations in core technology is the inadequate R&D investment of enterprises in research and development. Although enterprises that manufacture electronic and communications equipment now place more and more emphasis on technological innovation and are increasing their R&D investment year after year, the scale of investment remains small in comparison with that of developed countries. As shown in Table 3.9, China lags far behind not only the United States and Japan but also the rising industrialized countries such as South Korea in the strength of research and development in its electronic and communications equipment manufacturing industry.

Table 3.9 R&D intensity of electronic and communications equipment manufacturing industries in various countries and years. Here R&D intensity is the ratio between R&D expenditures and the total added value of the industry. Source of data: www.sts.org.cn, Statistics of Chinese High-Tech Industries.

China (2005)	USA (2003)	Japan (2003)	Germany (2002)	France (2002)	Britain (2003)	Italy (2002)	South Korea (2003)
6.9	26.9	15.2	37.6	57.2	27.5	17.6	23.4

Closely associated with the weak capability for technological innovations is the shortage of high-calibre talent. Since 2003 the number of employees of China's electronic information industry has increased at a rate of 25 per cent annually. In 2005 that growth rate reached as high as 48 per cent. The gap between supply and demand is widening each year and is hard to fill with university graduates alone. China has only 20,000 integrated circuit designers, including only 4,000 senior personnel, compared with 500,000 designers in the United States. Meanwhile, many multinationals have set up R&D organs in China to fight with native enterprises for talent, which has exacerbated

the shortage of talent and turned into a serious restraint on the technological progress and upgrading of China's electronic and communications equipment manufacturing industry.

The second constraint to the upgrading of China's electronic and communications equipment manufacturing industry is its mode and route of development. This is an export-oriented industry that has quickly merged into the global industrial chain and then realized rapid growth by leveraging the introduction of foreign capital and the export-led strategy. The negative effect of such a mode and route is the dominance of foreign capital and the dependency on exporting. Foreign-funded enterprises occupy a dominant position in the industry. Multinationals invest in China mainly to make full use of the country's cheap labour force. Therefore, in mainland China they deploy the processing and manufacturing links of low added value on the global industrial chain. The foreign-funded enterprises in China lack both the necessity and urgency for technological innovation, with equipment updating and technical progress relying completely on and obeying the edicts of their parent companies. Additionally, foreign-funded enterprises make use of their global edge to transfer profits so that their book sales profit margin (3.4 per cent) is lower than that of native enterprises (4.2 per cent) and the average level of the entire industry (CASS, 2007, p. 310), thereby further lowering the economic benefits of the industry and inhibiting its R&D and innovation activities. Research shows that in China's electronic and communications equipment manufacturing industry, the R&D intensity of foreign-funded enterprises has remained lower than the average level of the entire industry since 2000 (CASS, 2006, p. 317).

The negative impact on the development of the industry caused by the prolonged policy preferences for foreign capital and export incentives is gradually exhibiting. The preferential policies for foreign capital have caused unfair competition between domestically funded and foreign-funded enterprises, reinforced the dominant position of the foreign-funded economy in the industry, and impaired the capability of domestically funded enterprises for independent innovation. Furthermore, under these policies a large number of labour-intensive links continue to move inland, further abetting the quantitative growth of the industry. Under the export incentive policy, electronic and communications products that are sold on the domestic market will be subject to a value-added tax as high as 17 per cent, which is refunded if the products are exported. This makes the enterprises that manufacture electronic and communications equipment more willing to work for foreign companies. As a result, the immense demand of a large number of domestic manufacturers for integrated circuits cannot be satisfied and can be met only through imports. This has intensified the growth pattern of the processing trade in the industry and is likely to lock the industry into the processing and assembly link of the global value chain, from which it will have difficulty breaking away.

The third constraint on the upgrading of the electronic and communications equipment manufacturing industry is resources and the environment. For a long time people have equated high

technology and high capital intensity to low consumption of resources and low environmental pollution. People lack a sufficient understanding of the resource and environmental concerns of the electronic and communications equipment manufacturing industry. But with the development of this industry, these concerns have begun to gradually emerge. The shortage of water resources and electrical power has become an important factor blocking the development of the industry. China is a country with meagre water resources, and over 400 of the 600-plus cities across the country suffer from an inadequate supply of water (Beijing Energy Saving & Environmental Protection website, www.bjjnhb.com.cn). This is worsened by the serious pollution of China's water resources: 40 per cent of its rivers and 50 per cent of its lakes have been seriously polluted. The semiconductor industry has high water consumption and very high requirements for water quality. It is now mostly concentrated in the Chang Jiang River delta, Beijing–Tianjin Rim–Bohai Bay belt and Pearl River delta, which face a shortage of water resources and deteriorating water quality. This has become a bottleneck that holds back the development of semiconductor production.

In the last couple of years, power shortages have become an important factor that undermines the normal industrial production in coastal areas. All four regions where China's electronic and communications equipment manufacturing industry is concentrated—the Chang Jiang River delta, Pearl River delta, Rim-Bohai Bay belt and Fuzhou-Xiamen region—are all hard-hit by power shortages, which have already deterred follow-up investment by foreign-funded enterprises in some areas.

Regarding the environment, the high pollution generated during the production of electronic products and disposal of waste electronic products is a common thorny issue encountered in global development. But China's understanding of high-tech pollution is insufficient, and its supervision of environmental protection is incomplete. In recent years, with the rapid increase in the domestic market demand for semiconductor products, the global semiconductor industry has sped up its transfer to China and quickly formed a complete industrial chain in China that extends from research and development, design, manufacturing and encapsulation to testing, resulting in a fast-expanding production scale. However, the environmental problems created during semiconductor production have not been fully recognized or effectively controlled. Furthermore, as the world's largest consumer of electronic products, China has entered a peak period for disposal of waste electronic products. From 2003 onward, 5 million TV sets, 4 million refrigerators and 6 million washing machines have needed to be scrapped each year. But the prevention and control of the pollution caused by electronic refuse is just starting, and the toxic substances created during the disposal of the refuse have created serious pollution (CASS, 2005, p. 278). In addition, imports of electronic wastes to China are increasing, and cause serious pollution to the local environment. Environmental pollution has become a major obstacle to the further development of China's electronic and communications equipment manufacturing industry.

4.0 Upgrading opportunities and challenges to the manufacturing industry

"Made in China" is presented with a golden opportunity for upgrading on the global value chain. Insofar as the external environment is concerned, the expansion of the global value chain dominated by the multinationals of developed countries, and the transfer of international industries driven by it, are picking up speed, expanding in scale and continuously upgrading structures. Studies show that the chain of the manufacturing industry is continuously moving and outsourcing to countries with low costs, and from chains and sectors of low added value to chains and sectors of high added value (Balasubramanian & Padhi, 2005). In the 1990s the transfer and outsourcing in the manufacturing industry centred on the labour-intensive industries, represented by garments, shoes and hats, and some technology-intensive industries, represented by computer hardware and home appliances. Since the beginning of the new century, the transfer and outsourcing of manufacturing industries has focused on more technology-intensive industries such as automaking, biopharmaceuticals and communications equipment.

Meanwhile, the configuration of the global value chain and the international transfer of industries are extending along the chain from manufacturing industries toward service industries and the R&D sector. Since the 1990s the outsourcing and offshore movement of the service industry have jointly stirred up a surge in the international transfer of the industry. In spite of this rapid development, service outsourcing is still at an early stage, and the outward movement and outsourcing of global service industries have broad prospects (Zhan, 2005). The universal globalization of R&D efforts began to appear in the late 1980s. From then on, multinationals have been increasing the quantity and expanding the scale of their overseas R&D establishments, so that globalization of R&D has become an important integral part of their global strategy. In the global deployment of the industrial chain of these multinationals, China is no doubt one of the most competitive locations, whether for the links of processing and manufacturing or for the links of research and development and service. This new pose in the deployment of the global value chain and the international transfer of industries has brought new opportunities for upgrading of Chinese industries.

Insofar as the domestic environment is concerned, the supply and demand conditions have improved continuously in ways that promote industrial upgrading in China, and the Chinese manufacturing industry is embarking on a new journey of sustainable growth.

First, the Central Committee of the Communist Party of China adopted the scientific concept of development for all-round, coordinated and sustainable growth, underscores the importance of environmental protection and the growth of "green GDP" and encourages independent innovations

and technical progress, thus creating an excellent atmosphere throughout society for the "clean" upgrading and sustainable development of industries. The report delivered by Hu Jintao to the 17th Party Congress lists three vital aspects of the efforts made to boost the positive and rapid development of the national economy. These are:

1. "Enhance China's capacity for independent innovation and make China an innovative country."
2. "Accelerate transformation of the mode of economic development and promote upgrading of the industrial structure."
3. "Improve energy, resources, ecological and environmental conservation and enhance China's capacity for sustainable development."

With this as guide, from the central government to the localities, the concept of economic growth focusing on "scale, speed and output value" is changing to the concept of economic growth focusing on "technology, benefits and environmental protection." A series of system changes are underway, and the government has gradually taken relevant policy measures, including increasing the proportion of R&D expenditures to GDP, adjusting the state system for management of scientific and technological plans, and establishing the responsibility and insurance system for environmental pollution. The dynamics in all fields and links are showing that independent innovations and clean growth have become the theme of China's new approach to industrialization.

Second, the increasing income of Chinese nationals and the accelerated development of the heavy and chemical industries have ignited robust domestic market demand for industrial upgrading. A notable hallmark that distinguishes China from other developing economies in East Asia is the huge domestic market, which has not only attracted massive investment from multinationals but has also helped native enterprises grow gradually on the low-end market segment. Three types of market changes will push the upgrading of the Chinese manufacturing industry forward:

1. The increasing income of Chinese nationals has enabled some regions to become moderately prosperous after meeting subsistence needs. Consumer spending is gradually displaying the characteristics of structural upgrading, including diversification and refinement, which has raised requirements for equipment manufacturing, product design and after-sale service and formed increasingly more evident pressure on enterprises to extend toward the upstream and downstream industrial chains.
2. After over 20 years of development, the processing and manufacturing links oriented toward the international market have developed an enormous processing and assembly capability, creating huge market demand for the upstream and downstream component industries.
3. The quickened urbanization process and surging construction of urban infrastructure in China have triggered strong market demand for heavy and chemical industries such as steel, cement, petrochemical engineering and construction machinery (Long, 2007, p. 6).

Third, since the beginning of reform and opening, the country's high investment in education has begun to pay off significantly and has provided abundant sources of high-quality labour for industrial upgrading. China has a time-honoured tradition of valuing education, as reflected by the fact that the government enthusiastically develops education and every Chinese family, rich or poor, gives top priority to their children's education. The results of China's high investment in education have been gradually emerging in recent years. Since the beginning of the new century, the number of graduates from regular Chinese institutions of higher learning has grown rapidly at a two-digit rate. Now the number of undergraduate students exceeds 16 million, and over 3.5 million people a year graduate from university, including nearly 700,000 with bachelor degrees and nearly 100,000 with advanced degrees in science and engineering (China Statistical Yearbook, 2007).

Returning students add new blood to firms and are increasing in number year after year.[12] Most of them have working experience in the manufacturing or service industries, especially high-tech industries in developed countries. The flourishing domestic economy, upbeat expectations for the future and strong state support have led to a tide of expatriates returning to China and starting businesses. At present, more and more students are becoming qualified for study abroad, and more and more students are returning after completion of their studies to start businesses. Since 2005 the number of students returning home has reached more than 30,000 each year. These returned students have become the main force behind "Made in China's" push into the high-tech industries and to compete on the world market. They are also an important factor in drawing multinationals to invest in Chinese equipment manufacturing and service industries and to launch their R&D centres.

4.2 Challenges confronting the upgrading of the manufacturing industry

Both theory and practice have proven that on the road of industrialization, natural comparative advantages in the labour force can enable the labour-intensive industries and links of developing countries to develop smoothly, but the acquired accumulation of capital and technological advantages and the development of capital- and technology-intensive industries and technology-intensive links driven by such accumulation cannot be taken for granted. Although the Asian "Four Small Dragons" are a successful precedent, China, as a large, socialist, developing country without abundant natural resources, is faced with more complicated and severe challenges to accomplishing the upgrading of its industries on the global value chain.

[12] This is in addition to the "brain circulation" identified by Saxenian (2005). Brain circulation is the growing cooperation between Chinese nationals resident in the technologically advanced sectors of the United States and their compatriots back home.

4.2.1 *Traditional cost advantages are fading away*

The largest and most prominent characteristic in the composition of Chinese production factors is the high redundancy of the labour force factor. The substantial redundant labour force has attracted multinationals to continue to move the processing and manufacturing links on the global value chain to China. Over more than 20 years of reform and opening, Chinese labour costs have remained nearly unchanged, land-use cost was almost zero, and pollution and other environmental damage could be overlooked. Such extremely low costs, plus taxation preferences and incentives, turned mainland China into an ideal destination for the congregation of labour-intensive industries and the processing and manufacturing links.

But a series of changes since the beginning of the new century imply that the traditional advantage of low cost has started to fade out. The shortage of migrant workers is spreading in coastal regions, revealing the rise in Chinese labour costs. The shortage is actually an expression of the structural changes that have taken place in the supply of Chinese labour. First, with the continuous intensification of industry supporting agriculture and cities supporting the countryside, the income of farmers has increased steadily and the ranks of labour flooding into the secondary and tertiary industries have slowed down their pace. Second, with the sustained development of the national economy and the state's continuous investment in education, the education and quality of the new labour force have been enhanced in general, so that both skilled and low-skill workers are in relative shortage. Therefore, although the comparative advantage of the Chinese labour force will remain unchanged for a considerable period of time to come, changes have indeed taken place to the low wages and low labour rights that have existed since long before the inception of reform and opening; in short, the age of inexhaustible low-cost labourers is gone. In fact, the increased wages are universal and are not limited to migrant workers. Statistics show that since 2005, the national nominal wages have gone up at an average annual rate in the double digits, especially in the eastern coastal regions. Any link in the global industrial chain that was placed in mainland China has keenly felt the momentum of this change, which is set to increase with the enactment of the new Labour Contract Law and other policies.

In the meantime, as a result of the China's efforts to change its economic growth mode, the policy adjustments covering land, resources and environmental protection will push up the related operating costs, so that the comprehensive operating costs of China's portion of the global value chain will gradually climb. A consequent concern is that such a continuous increase in operating costs will compress the already narrow profit space of "Made in China." The traditionally advantageous industries, such as the textile and apparel industry, have already fully felt the pinch caused by this cost increase. In the Pearl River delta, processing enterprises will see 3 to 5 per cent of their average profit vanish in the next few years.

In essence, rapid economic growth is bound to bring increased incomes, resource savings and environmental beautification. That day is just a bit slow in coming for China, a country with a large population in the process of industrialization. Meanwhile, a changed mode of economic growth is also an active reaction to the increasingly more austere constraints on resources and the environment brought about by the existing extensive economic growth. Can a new profit space be opened before the existing profit space has disappeared? In other words, can new competitive advantages be built up while the traditional comparative advantages are fading out? This is the most practical and pressing concern confronting the upgrading of the Chinese manufacturing industry.

4.2.2 The downside of the localization strategy is becoming more and more apparent

An ideal route for late-coming countries to take toward industrial development on the global value chain is to integrate with the global value chain, starting from the lowest end and the simplest processing and assembly, then gradually accumulating capital and technical advantages, and finally upgrading toward the middle- and high-end links, targeting both intermediate products of high added value and core products. The Asian "Four Small Dragons" once did quite well on this route, and China also hopes to use it to excel. But against the new background of globalization, the configuration of the global value chain has changed. When the low-end links of the global value chain began to transfer to China, direct foreign investment became the carrier for the transfer, and enterprises from developed countries and the "Four Small Dragons" set up factories directly in mainland China. The affiliated upstream and downstream enterprises flocked in to quickly form industrial clusters and create large-scale development in local places with foreign-funded enterprises as mainstays. This caused the holistic transplantation and embedded development of the external industrial chain in China.

Such transplantation and development of the external industrial chain aims only to leverage cheap, local essential resources, but gives a very small space to local enterprises for integrated development. China is a country in transition; its state-owned enterprises lack vigour and its private economy is weak. This has further consolidated the dominant position of foreign-funded enterprises, which account for over 60 per cent of the export volume of China's high-tech industry and the lion's share of the export volume from the processing trade. This stance is gradually being beefed up even more (see figures 4.1 and 4.2). The processing trade pursued by foreign-funded enterprises accounts for 98 per cent of the processing trade in the city of Shenzhen (Shenzhen Bureau of Trade and Industry, 2005) and 75 per cent of that in Guangdong Province (Department of Foreign Trade and Economic Cooperation of Guangdong Province, 2005, p. 134). The dominant position of foreign-funded enterprises in the processing trade is a universal phenomenon throughout the country. Moreover, the surveys and research show that even if there are Chinese investment enterprises that can team up with foreign-funded enterprises, most of them are concentrated on the low-end links, where they do simple processing of lower added value.

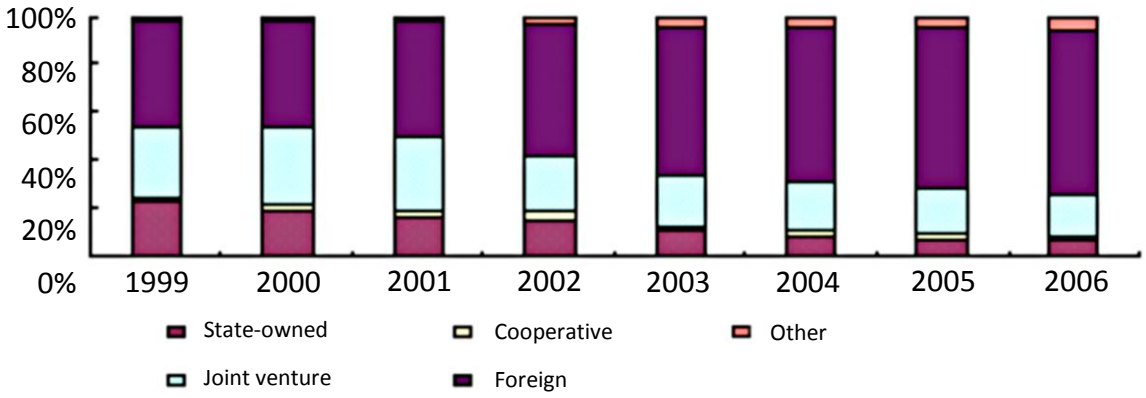

Figure 4.1 Proportions of exports of high-tech products, by ownership of the exporting enterprise. Source of data: Scientific and Technological Statistics of China, www.sts.org.cn/sjkl/gjscy/index.htm.

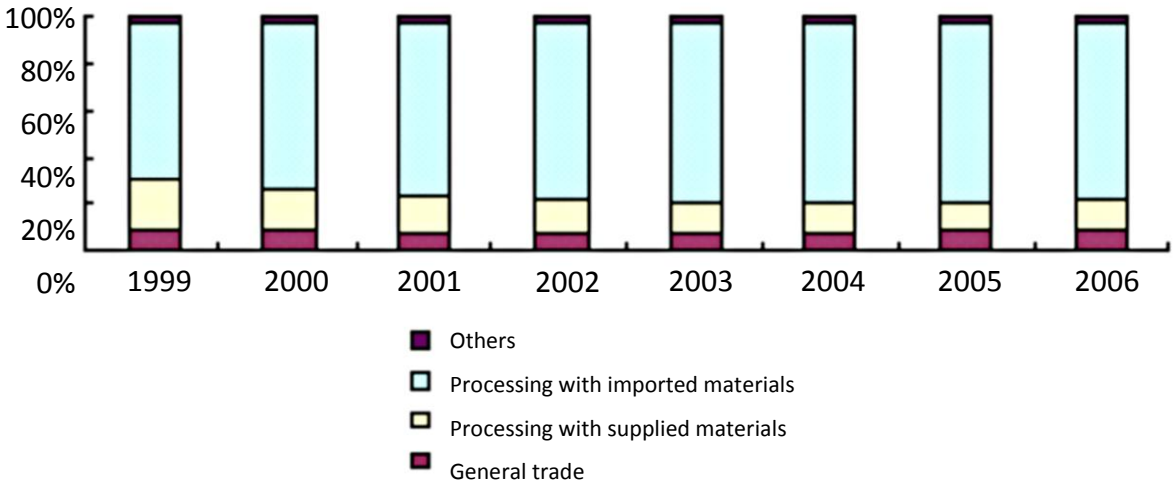

Figure 4.2. Proportions of exports of high-tech products, by source of material. Source of data: Scientific and Technological Statistics of China, www.sts.org.cn/sjkl/gjscy/index.htm.

The dominant position of foreign-funded enterprises in the part of the global value chain that has been transplanted into China is the root cause of many problems. The high rate of growth of trade, a high trade surplus, late development of domestic capability to match foreign innovations, low rates of local procurement, and unsatisfactory levels of technological transfer are all closely related to the clustered development of foreign-funded enterprises. The growth and structural upgrading of "Made in China" are more often than not composed of expansion and restructuring of the foreign-funded enterprises in China, and the continuation and extension of the domestic industrial chain of the processing trade are more often than not the result of follow-up investment by foreign-funded enterprises in the respective upstream and downstream enterprises. Compared with foreign-funded enterprises' own booming development in China, they have only very limited positive spillover effects and are a relatively small driving force for the native economy and native enterprises.

The dominant position of foreign-funded enterprises in "Made in China" has enabled people to see China's economic prosperity and swelling exports, but has covered up the fact that China is still in a disadvantageous position in this new international division of labour and concealed the risks posed by this "enclave economy" of foreign-funded enterprises. More importantly, in the international transfer of the labour-intensive or capital- and technology-intensive links in the industrial chain, most multinationals deem China the best destination for deployment of labour-intensive links. The dominant position of foreign-funded enterprises in many of China's industries and their role in defining mainland China may keep "Made in China" fastened onto the chain at a level of low added value for so long that independent upgrading may be hard to attain.

In the early days of reform and opening, China seized hold of the historical opportunity for international industrial transfer and unveiled a plan for high-speed economic growth. To accommodate this transfer is a wise choice that China made after sizing up the situation, and the country's emergence into the global value chain has made tremendous contributions to the Chinese economy. However, a series of factors has caused Chinese native enterprises to fail to really integrate into the global value chain and to remain on its perimeter. With the gradual weakening of China's traditional advantages, the pressure for industrial upgrading has gradually increased, and the negative effects of localization are getting more and more conspicuous. Therefore, in order to upgrade, the Chinese manufacturing industry needs to solve the important issue of how to motivate more native enterprises to develop processing trades and integrate with the global value chain for gradual expansion.

4.2.3 Resource availability and environmental concerns are becoming more of a constraint

With China's rapid economic growth, especially the accelerated development of heavy and chemical industries, resources are becoming a greater and greater constraint on China's economic

development. China's farmland per capita is less than 40 per cent of the world average. By 2006 one-tenth of the country's farmland had suffered industrial pollution, 37 per cent of the territory had experienced soil erosion and land resources had further intensified as a constraint on industrial development. China lacks adequate water resources, which are distributed unevenly across regions, and the deficiency worsens each year. The disparity between supply and demand is especially striking in the north and in the coastal cities. Meanwhile, the discharge of liquid waste and pollutants and the unplanned and excessive exploitation of water resources have caused the pollution of water bodies, further exacerbating the deficiency of water resources.

Because of rapid economic development and the international transfer of a large number of manufacturing industry chains, China has become one of the world's largest consumers of energy sources and mineral resources. The country's reliance on imports of these resources has skyrocketed in recent years. China's possession of major mineral resources on a per capita basis is less than 50 per cent of the world average, and that of such important mineral resources as iron ores, copper and aluminum is 42, 18 and 7.3 per cent, respectively, of the world average. In 2002 China could meet only 69, 57.6 and 56 per cent, respectively, of the domestic demand for iron ores, copper and aluminum. For decades to come, it will remain difficult to meet the domestic demand for minerals, including iron, manganese, chromium, bauxite, copper, gold, silver and sulphur (DRCNet, 2006). The International Energy Agency predicted in 2004 that given China's current energy consumption, the country's reliance on imported oil would rise to 74 per cent by the year 2030. Since oil imports mainly rely on maritime transport and the route used for such transport is fixed, the stable supply and security of energy is becoming an increasing concern.

China has paid a very high environmental price for its industrial development. In 2003, 90 per cent of the rivers flowing through cities were seriously polluted, 75 per cent of the lakes were eutrophic, nearly 300 million rural residents drank substandard water, one-third of the urban population lived in seriously polluted air, acid rain affected one-third of the country, one-half of urban wastes received no treatment and the disposal rate for industrial hazards reached only 32 per cent (Zhao, 2004). The worsening environment caused by pollution is demonstrated not only in the increase of the total amount of pollutants discharged and the expansion of ecological damage but also in the overall functional downgrading of various ecological systems. Moreover, in certain regions and valleys, especially in developed coastal areas, interaction of the pollution of the atmosphere, water bodies and soil has already occurred (CASS, 2007, p. 133). Serious environmental problems have become an important factor that restrains China's healthy economic and social development.

Although the consumption of resources is increasing rapidly and the gap between resource supply and demand is broadening, China has a very low resource utilization rate compared with other countries, which is the root cause of its problems concerning resources and the environment. According to reports, for every US$1 increase in GDP, China consumes three times as much energy

as the world average for the same increase, 4.7 times as much as the United States, 7.7 times as much as Germany and 11.5 times as much as Japan. The Chinese output efficiency of every ton of standard coal is equal to only 10.3 per cent of that of Japan, 16.8 per cent of that of the European Union and 28.6 per cent of that of the United States; the output efficiency of every cubic metre of water is equal to only 2.2 per cent of that of Britain, 3.6 per cent of that of Japan and 3.9 per cent of that of Germany (CASS, 2005, p. 66). At present, China's energy utilization efficiency is about 30 per cent, nearly 10 percentage points lower than that of developed countries. The unit product energy consumption—that is, the energy required to produce one unit of GDP—of China's major energy-using products is 25 to 90 per cent higher than that of developed countries, and the weighted average is about 40 per cent higher (Wang & Yang, 2004). The low resource-utilization rate is a typical characteristic of China's extensive growth, which features "high investment, high consumption and high discharge."

The first reason for the relatively low resource-utilization rate is the relative backwardness of the technological level of the manufacturing industry. Therefore, the key to improving resource utilization lies in the progress of industrial technology. In this sense, the constraints posed by resources and the environment are important motivators for industrial upgrading. As a country in transition, China can attribute the protracted existence of its problems with resources and the environment to another, even more important factor: institutional deficiencies in the use of resources and protection of the environment, which are in urgent need of correction and improvement. The high externalization of the cost of resources and environmental damage is the institutional cause for China's problems in these areas. Since the beginning of the new century, China has entered a stage of accelerated development of heavy–chemical industries. Meanwhile, the transfer of the global manufacturing industry into China continues. China will provide global consumers with more high-quality, competitively priced products. This development momentum of "Made in China" will undoubtedly further increase China's consumption of resources. Past practices indicate that the large-scale and low-efficiency use of resources, which characterizes extensive growth, has exceeded the carrying capacity of China's resources and environment, and it will be hard for China to continue on this path. Therefore, how to speed up technological innovation and institutional change to form a long-term mechanism that saves resources and is environmentally friendly is a crucial issue that China needs to solve for the upgrading of its manufacturing industry.

4.2.4 Technological innovation, though impressive to date, must accelerate

Technological innovation is the central component of China's industrial upgrading and the ultimate way to build up new competitive advantage and overcome the bottleneck posed by resources and the environment. Since the onset of reform and opening, through international competition and cooperation China has witnessed remarkable enhancement of its capability for technical innovations in its industries and great progress in technology. But as a whole, subject to the common restraints

of macro and micro factors, China still falls far behind developed and rising industrialized countries and regions in terms of the technical innovations of its manufacturing industry, with a shortage of core technologies for various industries, especially those that are capital and technology intensive. The large amount of technical equipment needed for industrial production, especially of high-end products, relies mainly on imports. The emphasis placed on imports rather than on integration and absorption of technologies still plagues the upgrading progress of many industries; the status quo in technical innovation is obviously insufficient.

At the macro level, the insufficient state investment in R&D resources and the low efficiency of resource allocation are the crucial problems that constrain China's technical innovation. Since the 1990s, with the rapid development of the Chinese economy, the proportion of R&D spending to GDP has increased continuously, reaching 1.49 per cent in 2007. This is up from 0.71 per cent in 1990, though it is noticeably lower than that of the developed countries in Europe and North America as well as the rising industrialized countries such as South Korea. This low R&D intensity is more prominent in China's manufacturing industries, especially in high-tech industries (Table 4.1). Accompanying the insufficient investment in research and development is the low efficiency of resource allocation. The deficiencies in state innovation mechanisms and systems have clamped down on the growth of returns on R&D investment.

Table 4.1 R&D intensity of manufacturing and high-tech industries, various countries and years. R&D intensity is the ratio between R&D expenditures and the added value of the industry. Source of data: Statistics of China's High-Tech Industries, www.sts.org.cn.

	China (2005)	USA (2003)	Japan (2003)	Germany (2002)	France (2002)	Britain (2003)	Italy (2002)	South Korea (2003)
Manufacturing	3.2	8.5	10.1	7.7	7.4	7.2	2.3	7.5
High-tech	5.6	29.0	25.7	24.2	28.6	27.6	11.0	18.2

Governments at all levels have yet to straighten out the relationship between economic growth and scientific and technological development, lack systematic research on and unified planning of the policies supportive of industrial innovations, and have a long way to go before they can provide decent services for industrial innovation. Interdepartmental discordance and low efficiency of utilization of government funds have led to serious repetition and waste. Additionally, the separation of scientific research from production that came into being under the planned economy has not yet been eradicated, so enterprises have not yet established independent positions in technical innovation and a road has not been created for industrialization of the fruits of scientific research. According to one study (DRCNet, 2007b), enterprises find themselves in a secondary position in the current combination of "production, learning and research." State R&D funds focus on supporting institutions of higher learning and scientific research, which generally suffer from insufficient innovative capability and unresponsive innovation mechanisms that are hard to correct in the short term. As a result, these institutions' R&D results often lack marketability and are hard to translate

into products. Furthermore, both productive enterprises and commercially oriented scientific research institutes are focused on economic benefits and do not attach enough weight to the crucial, forward-looking technological research that would promote national competitive power and the long-term interests of enterprises. In addition, teaching in higher education institutions is getting more and more out of step with industries' development needs. While a large number of university graduates face difficulty finding jobs, there is a shortage of both the high-tech R&D personnel and mechanics essential for industrial development.

At the micro level, the core problems that curb technical innovation are the insufficient motivation and capability of Chinese enterprises for technical innovation.

Despite the advantageous resources they own for technical innovations, state-owned enterprises have a serious shortage of motivation for innovation. According to 2005 statistics from the State Statistics Bureau, the R&D investment of the 500 largest enterprise groups ranked in terms of sales income, most of which are state owned or state controlled, accounted for only 0.78 per cent of sales income, a proportion that has been dropping over the past four years. Also in 2005, the R&D investments of central enterprises accounted for around 1.5 per cent of sales income (2 per cent for industrial enterprises), far below the international level (Chinese Entrepreneur Survey System, 2006). The research carried out by the Development Research Centre of the State Council (DRCNet, 2007a) shows that state-owned enterprises do not rank as highly as their non-state-owned counterparts in enthusiasm for and levels of investment in research and development, developing new products and introducing them into the market, and they still have some serious problems, such as facile work and formalism. They participate in innovative activities for prize evaluation, not for market rewards. Additionally, the talent mechanism and scientific research programs in state-owned enterprises still bear evident traces of the planned economy, and they have wasted substantial resources that could have been used for independent innovations.

The private economy provides the fresh blood for technical innovation in Chinese industry, but these companies' innovative activities have run into one restraint after another. The first of these is scale and strength; most private enterprises are not that aware of independent innovations. The majority of China's private economy belongs to small and medium-sized enterprises, which struggle for survival on the fringe of the market, sandwiched between large state-owned or foreign-funded enterprises, leaving basically no time for considering technical progress and innovation. On the global value chain, most private enterprises are located at the labour-intensive, low-end links, where competition within the industry is fierce and profits are marginal, so that they can barely survive, let alone dare to cherish the wild wish for technical innovation.

The shortage of talent and funds has also seriously hindered the innovative activities of private enterprises, especially private technology enterprises. In Jiangsu Province, 72 per cent of private

technology enterprises lack senior technical staff, and 35 per cent lack senior technical workers (Jiangsu Provincial Federation of Industry & Commerce, 2007, p. 147). A large gap in needed funding and difficulty obtaining financing are a common sight in private economy. Restricted by funds, China's private technology enterprises have seen a year-over-year decline in the proportion of their funds dedicated to research and development, which was 11.5 per cent in 1993, dropped to 2.77 per cent in 2000 and rebounded to 3.63 per cent in 2005 (Investigation and Research Group of All-China Federation of Industry & Commerce, 2007, p. 11).

Finally, less-than-satisfactory effects of policies and a non-standardized market environment have also fettered the independent innovative activities of enterprises. Long-established mindsets, modes of action, and even rules and regulations that value state-owned enterprises to the neglect of the private economy have maintained considerable inertia in many fields, weakening the effects of government policies that encourage technical innovation. In the meantime, the lack of standardization in market competition has interrupted the technical progress of the entire industry, and inadequate intellectual property rights protection has dealt a heavy blow to enterprises' enthusiasm for technical innovation.

In short, lack of motivation and capability, insufficient investment and low efficiency in technical innovations are all problems that have haunted China's economic transformation and industrialization process for a long time. They are fundamentally subject to the stages of China's economic growth and the processes of its system changes. A look at this process reveals that the above problems are developing in a direction that gives cause for optimism. How to speed up such development through changes in the decision-making, management and enterprise systems is the core issue for us to boost the upgrading of the Chinese manufacturing industry.

4.3. The risks of the status quo and the case for reform

Investigations into "Made in China" have revealed the links between industrial chains and the upgrading of products within an industry. Some industries and enterprises have completed the successful transition from original equipment manufacturing to original design manufacturing and even original brand manufacturing on the same industrial chain. But it will be some time before development can lead China's industry toward occupying the strategic links and role change can be accomplished. The development of "Made in China" has once again brought to light the strategic significance for backward countries of merging into the global industrial chains in order to accelerate the development of their manufacturing industries. Thanks to upgrading and development on the global value chain, "Made in China" has built up one after another industrial cluster having global competitive force. These clusters cover a wide spectrum of fields, from garments, toys, home appliances, automobiles, steel, petrochemical engineering and pharmaceuticals to information technology. "Made in China" has also fostered large enterprise groups that have a strong

international competitive force. Their results of upgrading on the global value chain give cause for upbeat expectations for the sustainable development of "Made in China."

Three factors are playing a prominent role in the upgrading of "Made in China." Unlike other rising industrialized countries or regions in East Asia, China boasts a huge domestic market for its industrial development, so that inherent factors such as the upgrading of the domestic consumer structure are the primary impetus for industrial upgrading. More importantly, the huge domestic market can also provide sufficient room for industrial growth. Many national industries and domestically or foreign-funded enterprises have gone through the development journey of leveraging the domestic, low-end market for development and expansion first before competing with multinationals for the high-end market.

Unlike other industrialized countries whose growth preceded China's, China has developed its industries, especially the heavy and chemical industries, against the background of globalization. The global industrial chain has provided Chinese industry with a new upgrading route, and the desire to merge into the global chains for competition and collaboration is an important impetus for industrial upgrading. Therefore, China's industrialization displays marked characteristics of the synergy of internal and external markets and the common progress of heavy and chemical industries and technology-intensive industries, such as the electronic information industry. Meanwhile, the government plays an important role in industrial upgrading. To spur the upgrading with sustainable development, the central government and local governments at all levels have implemented a series of policy adjustments, including labour, environmental, trade, taxation and industrial policies. Practices show that these policy adjustments have strongly boosted the structural upgrading process in the Chinese manufacturing industry.

"There's no such thing as a free lunch." The emergence into the global value chain for survival and development has also forced China to pay a non-negligible price. The first part of this price is the environmental damage brought by international industrial transfer. According to the findings of China's third national industrial survey, among all foreign-invested industrial enterprises, foreign-invested enterprises in pollution-intensive industries and sectors (industries that will create large quantities of untreated pollutants directly or indirectly in the course of production) account for around 40 per cent of total recorded measures of pollution. It is an established fact that foreign-invested enterprises have transferred polluting industries to China. In essence, on the global value chain, the sections with the most intensive consumption of labour, land, raw materials, energy, and resources are all concentrated on the links of processing and manufacturing. The process whereby multinationals have continually transferred the manufacturing links of the global value chain to China through direct investment and production outsourcing is, therefore, also the process of accelerated consumption of energy and resources and damage to the environment in China. The more "Made in China" processes and manufactures for the rest of the world, and the more

resources China exports in the form of commodities, the heavier will be the environmental load China bears and the cost in resources and environmental damage it pays.

The second part of the price China is paying for its emergence in the global market comes from the economic frictions that arise from its acceptance of the international industrial transfer. According to WTO statistics, from 1995, when the WTO was established, through the first half of 2007, China was involved in 551 antidumping cases, ranking first among all WTO members and accounting for 17.79 per cent of all antidumping cases in the world. China has outstripped any other country in terms of the high frequency and intensity of the antidumping frictions its products have suffered on the world market. Furthermore, Chinese products also face threats from antisubsidy and safeguard measures on the world market, limitations from countless technological trade barriers, and intellectual property rights accusations. The yuan is also under heavy pressure to appreciate. These international economic and trade frictions, which are becoming increasingly fierce, are an objective reflection of the dizzying growth of Chinese exports on the world market. But they are the necessary outcome of the continuous transfer of international industrial chains to China. As global multinationals vie with each other to transfer the links of processing and manufacturing to mainland China, and as the products processed and manufactured in mainland China are sold back to European and American markets, the surplus of Chinese trade with Europe and America has kept increasing. Therefore, the more industrial chains are transferred, the greater the benefits received by European and American consumers, the more handsome the profits gained by the multinationals, the more fierce the trade frictions confronting China and the more prominent the negative impact to the domestic economy caused by the excessive growth of foreign exchange reserves.

The third factor is the imbalance of the proceeds from the division of labour on the global value chain. On the global value chain, which is driven by multinationals, developed countries focus on research and development and sales links with high added value, and they place the production and processing links, with their high consumption of materials and energy, in developing countries. Through the innovations in industrial technology and system changes initiated by developed countries, the share of total added value attributed to the processing and manufacturing links of the value chain has fallen continuously. Meanwhile, cutthroat competition among developing countries for the low-end links has aggravated the fall in added value on the processing and manufacturing chains. Therefore, as a developing country that is the largest undertaker of the chain of the global manufacturing industry, China takes on the risks of an internal and external economic imbalance, with the price of high energy consumption and pollution and under the heavy pressure of unfair trade, but also has to face the reality of reduced proceeds from the division of labour on the global value chain and the shrinking profits. Although the so-called sweatshop and crisis of confidence of "Made in China" are admittedly the necessary outcome of manufacturers' greed, they are signs that the profit space of the processing and manufacturing links on the global value chain have been squeezed so hard by the multinationals as to be unbearable (Stern, 2007).

"Made in China" is in urgent need of changing its low-added-value position on global value chains and upgrading toward the upstream and downstream industrial elements of these chains. The rising costs of production and operations, and the worsening problems surrounding resources and the environment, have added to the necessity and urgency for "Made in China" to realize "clean" upgrading. In its development of the past 30 years, "Made in China" has increased the benefits available to global consumers through lower prices and greater choice, brought high returns to global investors, and set up a model for developing countries by way of its development on the global value chain. In the future, it will be the clean development of "Made in China" that provides the global market with finished products as well as having irreplaceable significance for global economic and social development.

5.0 Systems of upgrading: the experience of other countries

The purpose of this section is to examine whether any lessons from international experience are applicable to the potential upgrading of Chinese industry. Different countries face different circumstances, not the least of which is the historical trajectory of a nation's development path, so we must take care in seeing lessons for China in another country's experience. Moreover, corporate managers as well as state measures have a bearing on the pace of upgrading by a firm or industry. Indeed, it is an interesting question whether private sector incentives and market forces provide more of a jolt for upgrading than do state measures. Of course, there is also the question of which state measures and which form of private incentives matter, and under what circumstances.

Broadly speaking, there are two distinct perspectives on the factors that can advance upgrading by firms over time. In what follows, we present the central principles of both perspectives even though ultimately, given the other stated goals of China's government and, in particular, their manifestation in employee-employer relations, the second perspective may well be more attractive to a Chinese policy-making audience. Still, the contrast between perspectives may clarify a difference from what might be characterized as the traditional Anglo-Saxon approach.

The dynamics of international competition in industrialized economies, with their emphasis on innovation and upgrading, have been thoroughly studied by professor Michael Porter in his 1990 study, *The Competitive Advantage of Nations.*[13] Central to this perspective is the dual role that companies and the national business environment play in determining the capacity of a nation's firms to compete on international markets, upgrade and innovate. On the balance between the firm and the national level, Porter argues: "Competitive advantage ultimately results from an effective combination of national circumstances and company strategy. Conditions in a nation may create an environment in which firms can attain international competitive advantage, but it is up to a company to seize the opportunity" (Porter 1990, p. 5). This statement suggests that while there may be much that the Chinese government can do to promote upgrading through improvements in the national business environment, such measures are no guarantee of success. It is the fusion of the right policies and the right entrepreneurship that matters.

Also at the core of Porter's perspective is the importance of competition among firms. He argues that an important prerequisite for international commercial success is stringent competition in domestic markets from other viable domestic rivals. Such competition provides the incentives to upgrade and exposes firms to stimuli that are conducive to innovation, such as very demanding customers and suppliers interested in upgrading their product mix too. Incentives from competition are sharper, however, when there is a discernible price of failure, including the possible bankruptcy

[13] A succinct and useful summary of this perspective can be found in Porter (1990).

of a firm and the laying off of staff. Consequently, Porter takes a very dim view of measures to protect domestic firms from national and international rivals. In the Chinese context, then, this perspective would call for the adoption and implementation of a national competition policy that kept barriers against foreign imports low, did not seek to limit or condition foreign direct investment and tackled state and private sector anticompetitive practices.

But promoting competition is not enough. In Porter's view governments should take steps to develop the following four elements of the national business environment, which he has labelled the "diamond":

1. Access to resources (human and otherwise) that is not unduly expensive. This includes sufficiently high-quality and specialized inputs. The national transportation and communication infrastructure must be in place to deliver such resources.
2. Encouragement of the use of meritocratic incentive systems that, along with competition and access to finance, stimulate and facilitate investments and R&D activities.
3. Nurturing of sophisticated and picky national segments of demand; these customers push domestic firms to improve their product and service offerings. Such demand segments can be created and influenced by government regulation, including regulation covering environmental matters.
4. Encouragement of the development and co-location of innovative and competitive firms all along the supply chain, thereby promoting the development of specialized pools of talent and suppliers and the co-invention of products, processes and services by buyers and their suppliers.

In Porter's schema, while the elements of the diamond may differ in their importance across sectors of the Chinese economy, the four components feed off one another, so any deficiencies in one element constrain the overall performance of firms and the national economic system. From this perspective, then, government must seek to improve all the relevant elements of the diamond at the same time, and not tackle them sequentially. Policy prioritization does not follow naturally from this particular framework, though it might be possible to identify a number of sectors, and elements of the Chinese business environment central to those sectors' performance, that could be the target of government policy-making at first.

With respect to "clean upgrading," over the years Porter has argued that improved environmental regulations and their enforcement as an opportunity for business rather than a constraint. Porter has argued that regulatory upgrading may provide a strong spur for the innovative activities of firms, and so long as the regulatory environment remains predictable and is applied even-handedly, it can provide plenty of profit opportunities for firms that most quickly adapt to the new circumstances. These profit opportunities are in addition to any other corporate payoff from being seen to have more environmentally friendly activities. "Clean upgrading," then, from this perspective is not an oxymoron.

While Porter's schema holds a number of prescriptive lessons for policy-making, a large number of analysts do not feel that it adequately captures the manner in which innovation and upgrading take place in many industrialized economies, in particular those economies not associated with the Anglo-Saxon tradition. Consequently, in recent years a group of analysts have emphasized that there are a variety of capitalisms whose operation may differ in subtle and important ways.[14] While some of these analysts are no doubt motivated by a desire to argue that one form of capitalism is better than another, for our purposes it may be useful to consider alternative formulations of policies and circumstances that promote the upgrading of firms.[15] In particular, this perspective distinguishes between what are termed the liberal market economies (LMEs) and the coordinated market economies (CMEs).[16] The former economies are associated with the arm's-length transactions between parties and the apparently limited government intervention and business-government linkages of the Anglo-Saxon countries (the United States, the United Kingdom, Canada, Australia, Ireland and New Zealand.) The latter refer to those successful capitalist societies where business-government-union linkages tend to be stronger and where finance is allocated more through banks than through stock markets. Consequently, the latter refer to Japan, Korea and the continental European economies. Because competition and arm's-length transactions and financing are core to the characterization of LMEs, as they are in Porter's schema, we focus here on the CMEs.

An important feature of the CMEs is that objectives other than productivity and economic growth are privileged by national governments and the populations they represent. Stability, reducing and sharing the burdens of adjustment, limiting risk to employees and maintaining high levels of social cohesion and employment are also accepted as legitimate societal objectives. These objectives have been imposed on to the national economic systems of the CMEs, and managers and company owners have had to find ways to maximize profits under circumstances that some in Anglo-Saxon countries would find unnecessarily restrictive. The fact that the CMEs have produced internationally successful companies and that some CMEs (such as Germany, Japan and Korea) are export powerhouses and have maintained their primary position in a number of manufacturing industries suggests that the pursuit of non-growth objectives does not automatically result in economic underperformance.

[14] The canonical reference in this literature is Hall and Soskice (2001), *Varieties of Capitalism*. This volume contains a number of chapters that highlight the different ways in which certain managerial challenges are addressed in different types of capitalist systems. As noted in the main text, some read these chapters as describing "what is" and some as "what should be," which can be two very different matters. Peter Hall has recently discussed the evolution of the types of capitalism in Europe in Hall (2007).

[15] Ritchie (2007) provides a particularly useful overview of the different forms of capitalism in East Asia and compares them to European variants of the coordinated market economies. Table 1 of this paper is particularly instructive in comparing forms of capitalism. Richie argues that East Asian nations face difficulties in technological upgrading and that there are limits on the degree to which foreign institutions can be emulated. He highlights that particular forms of coordination between business and government are effective in facilitating transfer of improvements.

The manner in which firms in CMEs innovate and upgrade has, unsurprisingly, received attention, not least because of the role that these activities play in long-term corporate performance (see Lazonick, 2007, for an overview of innovation in various CMEs, and Casper and Whitley, 2004, and Lane and Probert, 2004, for sectoral studies). Particular attention is given in what follows to three characteristics of CMEs: the long-term relationship between employers and employees brought about by legal restrictions on the former's treatment and termination of the latter, the nature and extent of vocational education, and the degree of acceptable interfirm cooperation. These characteristics depart sharply from what many see as desirable in the LMEs. It has been argued, however, that these characteristics promote a different form of innovation by firms. Rather than winner-takes-all leapfrog innovations, whereby a firm seeks to make obsolete the products of a rival firm, in CMEs innovation and upgrading are best managed on an incremental (and ideally continuous) basis. The effort and expertise necessary to engage in incremental innovations is easier to monitor and assess in longer-term employment contracts with product-development staff and their managers.

Moreover, a strategy of incremental innovation can be designed in such a way that the innovations rapidly accumulate over time, making it hard for rival firms to emulate or copy an entire path of product changes. Under these circumstances customers may be more reluctant to switch away from a firm's products when the prospect of more innovations is in sight. For policy-making purposes, perhaps the greatest significance of this perspective is that it suggests that governments do not have to abandon social and employment objectives when seeking to promote the upgrading of their country's firms. Whether this remains true of environmental objectives has yet to be demonstrated, but the notion of developing a long-term relationship between a firm and its local stakeholders on environmental matters does not seem immediately at odds with the thrust of the literature on CMEs. Another important implication of this approach is that not every good or service may lend itself to incremental upgrading and innovation, and therefore future Chinese manufacturing activities might have to be oriented toward those products and services that are.

6.0 Recommendations for accelerating upgrading in a sustainable trade strategy

On the basis of the evidence on the factors influencing the upgrading of Chinese firms, and recognizing the other important objectives associated with a sustainable trade strategy, the recommendations developed below are based on the following four principles:

1. There is a profound need to accelerate the upgrading of Chinese industry.
2. The upgrading must be "clean" in environmental terms.
3. The upgrading must respect the employment imperatives of current Chinese policy, in particular in light of the need to find 10 to 15 million new jobs for people leaving school and university graduates.
4. Upgrading must be market driven, even if it is government influenced.

Therefore, the objective supported by our recommendations is not the promotion of upgrading per se, but rather upgrading that attains the social (labour-market related) and environmental goals of a sustainable trade strategy. This distinction is important, as it suggests that greater weight be put on one successful form of upgrading over another.

6.1 Fundamental recommendation

While competitive pressures in response to domestic and international market stimuli have played an important part in inducing significant amounts of upgrading by Chinese manufacturing firms, questions arise as to whether this system is consistent with the other goals of a sustainable trade strategy. As we noted earlier, at present innovative firms in China place a low weight on product and process improvements that reduce environmental damage and improve resource use. Plus, much productivity growth at the industry level has been driven by the entry and exit of firms, which in turn results in dislocation for Chinese employees. The passage of a new Chinese labour law in late 2007 signals a desire to reduce the amount of uncertainty faced by workers and to share the benefits of economic progress more widely. In recent months, many have argued that reducing the various forms of uncertainty faced by Chinese workers and families would have macroeconomic payoffs, as savings could fall and consumption increase, remedying some of the demand reduction induced by falling exports.

The policy challenge, then, is whether upgrading can be accomplished without the downsides of labour market dislocation and with a greater premium on environmental improvements. Here the discussion about the varieties of capitalism is particularly important, as it suggests a mechanism

through which upgrading can be encouraged (through better performance in global markets) while limiting the degree of labour market disruption. The longer-term contractual relationships between German firms and their employees offer an interesting alternative to the Anglo-Saxon approach. Germany, still the world's largest exporter, has managed to substantially upgrade its manufacturing products over the past decade and, in recent years, to expand employment considerably. These adjustments rest on a set of labour market and collaborative institutions that foster long-term planning and incremental innovation in particular.

Rather than seeing, for example, the inability to fire an employee as disadvantage, successful German managers see such employment laws as an opportunity to establish a long-term relationship with an employee whereby both the firm and the employee both make repeated investments over time in improving skills and finding better ways of accomplishing goals with fewer resources. German firms also refrain from hiring (or "poaching," as it is often called) employees from their rivals, and with seniority-based pay make clear to an employee that he or she will have a strong incentive to make the long-term relationship work too. Similar considerations apply in the relations between German firms and their suppliers—that is, long-term relationships supplant short-term contracting. While competition in the labour market is deliberately stifled under the German system of innovation, German firms still compete vigorously for customers in world markets. Successful product upgrading and innovation allow German firms to charge premium prices and ride out currency fluctuations and other volatility.

The institutional underpinnings of the German system of innovation extend beyond employment relations in ways that have direct relevance for government policy-making. German governments work closely with their industries to develop and support apprenticeship systems through joint curriculum design, establishing technical skills and providing tax incentives to promote apprenticeships and on-the-job training. Fewer Germans go to college than in many Anglo-Saxon countries; they take apprenticeships instead. Another significant institutional underpinning is that many German firms and their financiers, typically banks, do not face pressure from shareholders to maximize profits on a quarterly basis. This enables such companies to take a longer-term view of their priorities.

A nation's system of corporate governance has important implications for the incentives supplied to managers, including incentives to upgrade and innovate. Should the Chinese authorities decide, therefore, to move toward a more German system of upgrading, it would have implications for Chinese policies toward corporate governance and stock-market development—as well as for the educational system and national labour market, emphasizing how far-reaching any decision to adopt any particular system of upgrading will be.

German firms also face stringent environmental regulation. It has long been recognized that such regulation can act as a spur for innovation and for overseas competitiveness rather than a cost burden. There may be a case for progressive increase in the stringency of environmental regulations, allowing firms to adjust—not least in their innovation strategies. In sum, then, the German model of corporate governance, labour market conventions, and environmental protection offers much of the social stability and environmental improvement that Chinese officials may crave, without diminishing the strong incentives to upgrade products that access to global markets provides.

6.2 A four-point reform agenda to promote upgrading

This section adds further levels of specificity and describes several of the specific steps that the Chinese authorities might consider in their strategy toward upgrading of Chinese firms. These steps complement others suggested in this project, such as developing a high-quality service sector.

6.2.1 Go "all-out" to promote technical innovation

Making full use of domestic and foreign resources to speed up technical innovations and progress in opening will be the core content of a strategy for upgrading "Made in China" on the global value chain. As a newly developing country, China ultimately needs to rely heavily on external forces for its technical innovations and progress. Exogenous technical progress realized through foreign trade and direct investment is still an important route for the technical progress of China. China is a large, rising country and faces increasingly more austere intellectual property right constraints on technology imports. Thus, to accelerate its industrial upgrading, China must inevitably choose an independent innovation strategy and encourage enterprises to do the same.

The technical progress of Chinese industry requires a combination of technology imports and independent innovations, as well as a combination of external resources and fostering of internal resources to eventually overcome reliance on technology imports. Enterprises play a leading role in technical progress and innovations, while the government is an auxiliary force. As a developing country in transition, China especially needs the government to use institutional innovations and policy measures to create an environment of fair competition and build up the leading role of enterprises in technical innovation.

The focus of current and future policy for promoting technical innovations should be the following:

- Continue to vigorously promote R&D investment by multinationals, encourage multinationals to launch higher-level R&D initiatives in China, strengthen and diversify exchanges and cooperation between multinationals and native enterprises, scientific research institutes and institutions of higher learning, and take a variety of policy steps to enhance technology spillover from the R&D initiatives of multinationals.

- Expedite the reform of state-owned enterprises and impel state-owned and private enterprises to establish and improve modern corporate governance structures and form a long-term mechanism conducive to independent innovations. Create effective incentives and supervisory measures to step up the integration and absorption of imported technology by Chinese firms.
- Smash monopoly power, eliminate and avoid restrictive and discriminatory policies for the industrial development and technical innovation of native enterprises, especially private enterprises, and encourage and strengthen fair competition between all types of commercial enterprise.
- Strengthen intellectual property rights protection, raise awareness of the Chinese population for intellectual property rights protection and create an institutional environment that stimulates technical innovation and cracks down on cutthroat competition.[17]
- Further financing for the innovative activities of enterprises, especially small and medium-sized enterprises, by providing monetary support that is timely, sufficient and commensurate with these enterprises' risks and earnings.
- Step up personnel training in a big way. Further promote the reform of the university education system and the establishment and development of the vocational education and training system, and ensure that teaching supply matches market demand. Encourage the return of senior overseas professionals and provide students returning home to start businesses with preferential and more convenient policies and environmental conditions.
- Enhance the efficiency of the state innovation system; tighten the interaction between the production, education and research aspects of innovation; and promote personnel flow. Under the precondition of meeting international practices, provide government support of independent research and development at the links of taxation and finance by increasing R&D investment, setting up a public R&D platform and providing sufficient basic conditions for the advancement of science and technology.

6.2.2 *Promote "clean" industrial upgrading*

A dialectic relationship exists between resources and the environment and industrial upgrading, with the latter being an important route of breaking the bottleneck caused by the former. The progression from low-added-value links to high-added-value links on the global value chain can effectively lower the consumption of materials and energy and enhance the benefits of industrial growth, but the supply of environmental resources is a precondition for industrial upgrading. The sufficient supply of resources and environmental protection has opened up a vast space for the expansion of the heavy and chemical industries. International experience proves that the two are

[17] This will have the additional payoff of protecting those Chinese brands that do develop at home. Organic domestic brand development is a prerequisite for development of international brands, which would allow Chinese firms to command higher prices in international markets for their goods and services.

part of a mutual, virtuous cycle. For "Made in China's" accelerated development of heavy and chemical industries, there is a need to break the current bottleneck of resources and environmental protection through institutional and technical innovations that achieve clean industrial upgrading. This can be accomplished through the following measures:

- Further lift the environmental standards for industrial development. There should be uniform environmental standards for industries of different densities and compositions to prevent new pollution as these industries develop. This is especially true for the heavy and chemical industries and rising high-tech industries.
- Continue to attract foreign investment. This is an important way for China to acquire additional components of the international industrial chain and promote industrial upgrading. China has restricted the importation of resource-based industries with high costs, high pollution and high energy consumption. Moreover, given the transfer of industrial chains from coastal areas to the hinterland, China must strictly control the relocation of such industries to the hinterland for development. Meanwhile, China should prudently scrutinize the catalogue of industries it wishes to invite for investment and give preference to the expansion of technology-intensive industries.
- Attach full importance to technical progress and innovation in clean upgrading. As a newly industrializing country, China has the advantage of being able to use advanced, applicable technology to achieve energy savings and environmental protection. The country must give a strong push to the import of such technologies and promote independent innovations in the same vein, reinforce the popularization and application of these technologies, include energy savings and environmental protection in the important development objectives for industrial upgrading and the measurement indicators for technical progress, and use technologies for energy savings and environmental protection to transform traditional industries and develop rising industries.
- Establish and improve a long-term mechanism for energy savings, emission reductions and environmental protection through institutional innovation and reform. China cannot rely purely on administrative measures to promote energy savings and environmental protection. Instead, the country should leverage continuous institutional reform and policy design to spur energy savings and environmental protection through the integrated utilization of market mechanisms, economic policies and effective supervisory mechanisms.
- Adjust the demand structure to inhibit resource waste and environmental pollution. For a long time China's policies for energy savings and environmental protection have mainly applied to producers, while a mechanism to reward or punish consumers is absent, impairing the effect of these policies. Therefore, China should take all policy measures, especially taxation measures, to encourage technical innovation and applications for energy saving and environmental protection and stimulate the purchase and use of products that promote these goals, so as to gradually promote an energy efficient and environmentally friendly lifestyle.

6.2.3 *Actively promote the localization of the processing trade*

Against the background of globalization, the increasing transfer and outsourcing carried out by multinationals has led to China holding a rising proportion of the international processing trade. The results of current practices have borne out that developing the processing trade is a shortcut for Chinese industries to merge into the global value chain and realize industrial upgrading. Because of the holistic transplantation of external industrial chains and inherited economic structures, the benefits to development and industrial upgrading derived from China's processing trade are low. Therefore, it makes sense to take the following measures to boost the localization of the processing trade:

- Encourage localities to pay attention to the job. Causing the processing trade to "settle down" has always been an important goal for China. For a long time, however, localities have focused more on the quantitative growth of investment and neglected of the problems related to the localization of the processing trade. To solve these problems, localities should regard localization of the processing trade as an important aspect of local economic development and list it as an important indicator for measuring local development.
- Encourage private enterprises to pursue the processing trade. The localization of the processing trade relies mainly on the expansion of private enterprises. China needs to clear up the restrictive and discriminative policies that target the private economy and to provide active guidance and support for private enterprises in the areas of business start-up, financing, technical progress, personnel flow and matching buyers and sellers. This should all be done with the preconditions of meeting international standards, helping the private economy form a rational corporate and industrial organizational structure, and creating a fair environment that facilitates the development of private enterprises.
- Encourage native enterprises to actively take on business outsourced by multinationals. Undertaking such business can enable enterprises to enter into direct business interactions with the leading manufacturers of the industrial chain, which will help native enterprises "learn by doing" and hasten the steps toward technical progress and industrial upgrading. Currently, China should give special encouragement and support to native enterprises that are technology oriented and have independent intellectual property rights so that they can take a direct part in the international division of labour for development of the processing trade. China should also encourage and support native enterprises in speeding up the digestion, absorption and secondary independent innovation of advanced foreign production technology and realizing the development of a processing trade with high added value.
- Improve the system of supportive services for the upgrading of the processing trade; provide enterprises with scientific and feasible informational, organizational and technical services; and improve, through taxation and other policies, the processing trade's alignment with its

upgrading objectives and industrial policies.

- Strengthen personnel training to localize the staff of processing trade enterprises.

6.2.4 Steadily promote overseas investment

Direct overseas investment has strategic significance for China's industrial upgrading. Overseas investment is an effective route whereby enterprises realize the following operational objectives: obtaining advanced technology and using advanced technological resources, dodging trade barriers, expanding overseas markets, transferring superfluous production capacity, improving the competitive edge, realizing the transfer from traditional industry to rising industry, acquiring overseas resources to make up for deficiencies in domestic markets, approaching local markets, and building up international brands and marketing networks. It is therefore an integral part of China's industrial upgrading to steadily promote overseas investment and foster a large number of Chinese multinationals. In recent years China has entered a new phase of its investments overseas, which has begun to rapidly increase. The advantages and disadvantages of Chinese multinationals in overseas operations and development have also come out. This is why China needs to draw on the successful experience of rising countries, fostering native multinationals to steadily boost the development of overseas investment in combination with its own national economic circumstances.

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