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China in the International Segmentation of Production Processes

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CHINA IN THE INTERNATIONAL SEGMENTATION OF PRODUCTION PROCESSES

SUMMARY

The paper analyses China's rise in international trade in the context of globalisation, in the sense of the reorganisation of production on a worldwide basis. Production processes have become internationally fragmented, as firms located in different countries take part in the production of a commodity but at different stages of the value-added chain. The various stages of production correspond to different production functions, and a country tends to specialise in the individual segments of production in which it has a comparative advantage. This vertical division of production implies in-depth specialisation and specific gains.

First, the study focuses on the leading role of international processing activities in China's foreign trade, its causes and consequences. China's trade policy which has granted tariff exemptions to imports used for processing and re-export, has proved very successful in creating export-oriented industries. Processing trade has enabled China to rapidly diversify its manufactured exports towards new sectors (especially electrical machinery) in which China does not master the entire production process. Foreign affiliates play a major role in type of trade.

Processing operations have influenced the geographic pattern of China's trade, as they have meant production sharing with industrialised Asian countries which are the major suppliers of China's imports for processing. By contrast, European firms hold strong positions in China's imports for domestic use and should benefit from the reduction of tariff barriers following China's WTO accession, provided they withstand the intensified competition driven by the improved access to this market.

Second, the analysis of trade by stages of production highlights China's position in the international splitting-up of the value added chain. In most industries, China has a vertical specialisation, *i.e.* its position shifts from comparative advantage to disadvantage depending on the stage of production. Most of its structural deficits are located in intermediate products. Most structural surpluses stem from trade in consumption goods, however in a leading sector such as electrical machinery, China also records structural surpluses in capital goods.

China's trade in intermediate goods is heavily concentrated within Asia, confirming that production sharing is above all a regional process. China is as an assembly country, but while in traditional industry (textile and clothing), China's exports of finished products concern consumption goods and are mainly directed towards Asian markets, in new industries (machinery and electrical machinery), China's exports consist mostly of capital goods and are mainly directed to the European and American markets.

Finally the paper examines how China's specialisation pattern influences technology transfers. High technology products account for 15% of China's imports, and for 9% of its exports, a share which is relatively large, given its level of development. Parts and components are characterised by a high technology content and account for most of China's imports of high-tech products. As a channel of high technology imports, capital goods rank second, far behind.

Asia is the major exporter of high-tech products, through its supplies of parts and components; Western Europe ranks second, and by contrast with Asia, its exports of high-tech products consist of capital goods, confirming the more traditional pattern of trade between Europe and China. America is the third supplier of high tech products, both in capital goods and parts & components.

China's exports of high tech products are mostly directed to Asian countries, and parts and components make up the major part of high-tech exports, suggesting that China has succeeded in becoming not only an assembler but also a producer of high-tech parts and components.

ABSTRACT

This structural analysis of China's foreign trade shows that its outstanding performance in world markets is directly linked to its involvement in the international segmentation of production processes. China's tariff policy in favour of processing activities proved very successful in creating export-oriented industries based on imported inputs. Production sharing with Asian countries has resulted in highly internationalised and competitive industries, while China's traditional export sector has remained sluggish. China displays a strong specialisation in the downstream stages of production processes, associated with large deficits in the upstream stages (semi-finished products and components). This vertical division of production has enabled China to rapidly diversify its exports of consumption goods, and to create strengths in capital goods exports, especially in electrical machinery. Imports of parts and components embody a large share of high technology and represent an important channel for the transfer of technology into China.

JEL Classification: F13, F14, F15, 053

Key Words: China, trade policy, economic integration, specialisation, international segmentation of production processes, technology transfer

LA CHINE DANS LA SEGMENTATION INTERNATIONALE DES PROCESSUS PRODUCTIFS

RÉSUMÉ

Cette étude considère la montée de la Chine dans le commerce international à la lumière de la globalisation qui implique la réorganisation des productions sur une base mondiale. Les processus de production deviennent de plus en plus fragmentés, à mesure que les entreprises, situées dans différents pays, participent à la production d'un produit, mais à des stades différents de la chaîne de valeur ajoutée. Les différents stades de production correspondent à différentes fonctions de production, et un pays tend à se spécialiser dans les stades de production dans lesquels il a un avantage comparatif. Cette division verticale du travail implique une spécialisation en profondeur et des gains spécifiques.

Dans une première approche, l'étude met en évidence le rôle majeur des opérations internationales d'assemblage dans les échanges extérieurs de la Chine, ses causes et ses conséquences. La politique commerciale chinoise a exempté de droits de douanes les importations destinées à être réexportées après transformation, et a ainsi favorisé l'essor accéléré d'industries extraverties. Ce commerce d'assemblage a entraîné une diversification rapide des exportations manufacturières dans des secteurs nouveaux (matériel électrique), où la Chine ne maîtrise pas l'ensemble du processus de production. Les filiales d'entreprises étrangères implantées en Chine ont une part dominante dans ce type de commerce.

Les activités d'assemblage ont conduit à un partage intra-régional régional des productions, dans lequel les pays asiatiques sont les principaux fournisseurs de la Chine en inputs pour ses industries exportatrices. Au contraire, les entreprises européennes ont de fortes positions dans les importations chinoises destinées au marché intérieur et devraient bénéficier de la baisse des tarifs douaniers consécutive à l'entrée de la Chine à l'OMC, pour autant qu'elles résistent à la concurrence accrue qu'entraînera l'ouverture du marché.

Une deuxième approche analyse les échanges par stades de production et précise la position de la Chine dans la décomposition internationale de la valeur ajoutée. Dans la plupart des secteurs la Chine a une spécialisation verticale, c.a.d. passe d'un avantage à un désavantage comparatif selon les stades de production. Elle enregistre ses plus grands déficits structurels dans les produits intermédiaires et ses plus forts excédents dans les biens de consommation, mais aussi dans les biens d'équipement là où ses exportations sont particulièrement dynamiques (matériel électrique).

Le commerce chinois de produits intermédiaires est centré sur l'Asie, confirmant que la segmentation des productions est avant tout intra-régionale. La Chine est un pays d'assemblage, mais alors que dans les industries traditionnelles (textile, habillement) ses exportations de produits finis sont des biens de consommation et sont dirigées principalement sur l'Asie, dans les industries nouvelles (machines et machines électriques),

la Chine exporte essentiellement des biens d'équipement et surtout vers les États-Unis et l'Europe.

Enfin l'étude examine les conséquences de cette spécialisation sur les modalités des transferts de technologie. Les produits de haute technologie représentent 15 % des importations et 9 % des exportations chinoises, soit une part élevée compte tenu du niveau de développement du pays. L'essentiel des importations de haute technologie passe par les pièces et composants, qui ont un contenu technologique élevé. Les transferts de technologie via les biens d'équipement sont beaucoup moins importants.

L'Asie, grâce à ses exportations de composants, est le principal fournisseur de haute technologie importée ; l'Europe vient en second, et à la différence de l'Asie, ses exportations de haute technologie passent essentiellement par les biens d'équipement, confirmant la nature plus traditionnelle des échanges Europe-Chine. L'Amérique vient en troisième position, avec des exportations de haute technologie qui passent par les composants et les biens d'équipement.

Les exportations chinoises de haute technologie sont principalement dirigées vers l'Asie et constituées principalement de pièces et composants, indiquant que la Chine est devenue non seulement un pays assembleur mais aussi producteur de composants technologiques.

RÉSUMÉ COURT

Cette analyse structurelle des échanges extérieurs chinois montre que les performances remarquables de la Chine dans le commerce international sont directement liées à sa participation à la segmentation internationale des processus productifs. Sa politique tarifaire favorisant les activités d'assemblage a puissamment contribué à créer des industries extraverties. En s'insérant dans la division des processus productifs en Asie, la Chine a développé des industries très internationalisées et compétitives, alors que ses secteurs exportateurs traditionnels sont restés plus inertes. La spécialisation chinoise dans les stades aval de production est associée à des déficits structurels dans les segments amont (composants et produits semi-finis) ; cette division verticale du travail lui a permis de diversifier rapidement ses exportations de biens de consommation et de développer ses exportations de biens d'équipement, particulièrement de matériel électrique. Les importations de pièces et composants incorporent une proportion élevée de produits de haute technologie et représentent un canal important de transfert de technologie en Chine.

Classification *JEL* : F13, F14, F15, O53

Mots-clefs : Chine, politique commerciale, intégration économique, spécialisation, division internationale des processus productifs, transferts de technologie

**CHINA IN THE INTERNATIONAL SEGMENTATION
OF PRODUCTION PROCESSES**¹

*Françoise LEMOINE and Deniz ÜNAL-KESENCI*²

INTRODUCTION

Over the last twenty years China's foreign trade expanded at an outstanding pace, and was characterised by a rapid diversification of its manufacturing exports. The aim of this paper is to analyse China's rise in international trade in the light of the globalisation process which has enhanced the reorganisation of production on a world-wide basis. Recent theoretical and empirical studies have put forward the international segmentation of production processes as a major factor underlying trade flows between countries. As a consequence, trade in intermediate products has taken a growing importance and has become a channel of technology diffusion across countries. This analytical framework can be applied to China's case and proves useful to understand its rise in world trade. The method was twofold and used the detailed data available from China's customs statistics. A first approach, based on the analysis of China's trade by customs regimes, highlights the implications of China's selective trade policy: it shows how the preferential treatment granted to international processing activities has fostered production sharing between China and its neighbours and strengthened regional economic integration. China's selective trade liberalisation has thus strongly influenced both the commodity and geographic pattern of its foreign trade. A second approach complements and extends this analysis and considers China's international trade by stages of production. The breakdown of China's exports and imports into five stages of production (primary goods, semi-finished products, parts and components, capital goods and consumption goods) makes it possible to identify its position in the international fragmentation of production in different industries and with different partners. Then the technology content characterising trade flows in each segments allows for the channels of technology transfers to be identified.

**1. GLOBALISATION AND THE INTERNATIONAL SEGMENTATION OF
PRODUCTION PROCESSES**

1.1. Analytical Framework

International production sharing, which has been observed for a long time, was not taken into account in the traditional theories of international trade. In Ricardo's and Heckscher-Ohlin's models, countries specialise in final goods in which they have a comparative advantage. They export these goods and imports products for which they have a

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comparative disadvantage and which they cease to produce. Foreign trade makes it possible to economise factors of production and thus leads to gains relatively to a situation of autarky. In this traditional approach, the domestic production processes are not interrupted by international trade.

The globalisation process, *i.e.* the reorganisation of production on a world-wide basis, has been existing for long, but has deepened since the eighties, giving rise to a rapid growth of trade in intermediate goods. Trade in intermediate products³, which results from the interruption of the domestic production processes, has justified a rewriting of the international trade theory. As production processes have become internationally fragmented, firms located in different countries take part in the production of a commodity but at different stages of the value-added chain. The value-added chain is split-up across different countries and firms, and international trade involves ever more flows of goods belonging to a single industry but at different stages of production. The international segmentation is fostered by the search of cost minimisation and economies of scale which arise through expanding markets.

This evolution results from several factors. First, the possibility of breaking up the production process depends on the techniques of production of industries. The international segmentation of production takes place in industries in which the production process can be broken down into technologically separate and independent operations providing intermediate inputs to be assembled in the final product (*Lassudrie-Duchêne, 1985*). A segment of production is thus defined as the operations which produce a “finished” goods used as an input for the following segment (*Fontagné, 1991*). When the different segments take place in production units (subcontractors or affiliates) which are located in different countries, we are in presence of an international segmentation of the production process. Each segment is characterised by a technique of production which may change over time. As manufactured products are becoming more and more technologically sophisticated, the number of stages of production increases and the productivity at the different stages changes rapidly; in this context a country tends specialise only in individual segments.

Second, trade corresponding to an international segmentation of production process has been enhanced by Multinational firm strategies. Firms have developed sourcing policies which rely on foreign, and even distant suppliers; they have localised the production of components in different countries, with the aim of a better utilisation of different countries comparative advantages. Outsourcing, *i.e.* the import of intermediate inputs (from low-wage countries) by domestic firms (in developed countries) has increased and can be interpreted as a response to import competition (*Feenstra, Hanson 1995 and 1996*). Such strategies are often associated with the rise of intra-firm trade, but this is not always the case: reorganisation of production across counties boundaries often takes place within processing trade operations, subcontracting activities, which do not imply equity relationship between firms involved in the same production process (*Fukasaku and Kimura*

³ The term “intermediate” good will be used for any manufactured goods which are reintroduced into the production cycle and disappears during that cycle.

2001). The international segmentation of production process has led to changes in the structure of international trade and in countries specialisation pattern. “A limited number of standardised semi-assembled goods are produced on a large scale and then combined to produce a large variety of final products” (*Fontagné, Freudenberg and Ünal-Kesenci, 1996*). This splitting-up of the value added chain allows for an ever more in-depth specialisation. The different stages of production correspond to different production functions so that a country may have a comparative in one stage of production and a comparative disadvantage in other stages. It is thus useful to distinguish two types of specialisation: when a country has a comparative advantage in the whole process of production of a given product, from upstream to downstream stages of production, we are in the presence of a so-called “horizontal” specialisation. If comparative advantages can be found only in some stages of production, whereas others are disadvantaged, this is referred to as “vertical” specialisation⁴. This specialisation along the production chain implies specific gains.

Assembly trade is a crucial element in the international segmentation of production process. Assembly may be a rather complex operation or in the contrary a simple operation depending on industries. Its characteristics are likely to change more rapidly than those of other stages of production. Moreover, recent theoretical and empirical studies suggest that trade in intermediate goods is an important channel of the transmission of technology (*Coe and Helpman, 1995; Coe, Helpman, and Hoffmaister, 1995; Keller, 2001*). For emerging economies imports of components for assembly may become the easiest way to acquire high-technology and benefit from technological spillovers which allows for an increase in total factor productivity.

Finally a country’s trade policy may influence its involvement in the international fragmentation of production processes, as the tariff structure influences the degree of effective protection. It has been shown that exemptions or tariff reductions on imported inputs increases the effective protection enjoyed by the assembling activities as it reduces its costs of production. On the contrary a rise in tariff on intermediate goods reduces the protection of the downstream segment of production, as it appears as a duty applied to assembling activities (*Grubel and Johnson, 1971*).

1.2. Case Studies

Empirical studies have analysed international trade in the light of the international segmentation of production processes. They have investigated the pattern by stages of production of foreign trade of major industrialised countries (*Fontagné, Freudenberg, Ünal-Kesenci, 1996*), of Eastern European countries (*Freudenberg and Lemoine, 1999*), of East Asian countries (*Ng and Yeats, 1999*). These studies have put forwards the importance of trade in intermediate goods and the influence of geographic proximity on production sharing between countries. They have provided evidence of important cases of vertical division of labour and of “switches” in comparative advantages along production processes.

⁴ Note that the notions “horizontal” and “vertical” have a different meaning when they refer to product differentiation: the former concerns similar products, *i.e* different varieties, and the latter different qualities.

They found that geographic proximity is a factor enhancing the possibilities of splitting up the value-added chain and hence fostering globalisation, although trade in intermediate goods also shows that vertical specialisation extends well beyond regions.

China provides an interesting case for resorting to this approach. Many studies have put forwards that China's export performance since the mid-eighties was closely connected with the reorganisation of production within Asia (*Naughton, 1997; Breslin, 1999; Lemoine, 1999 and 2000; Sung, 2000; Boillot and Michelon, 2001, Parker and Lee 2001*). China's rise in world trade has been underpinned by export-oriented foreign direct investment and by international processing activities which both reflect the strategies of Asian firms having relocated their industries in the mainland to take advantage of the low level of labour costs. In this context, the notion of vertical *vs* horizontal specialisation, *i.e.* the switches in China's comparative advantage along production processes, is crucial to understand China's trade performance and the evolution of its trade pattern. Moreover, China's trade policy has deliberately favoured assembly and processing operations, through tariff exemption on intermediate goods, and hence can be analysed in the light of the theory of effective protection which shows that a reduction of tariff on intermediate goods increases the effective rate of protection of the final goods using these inputs (as any duty on imported inputs is equivalent to a tax on the process using this inputs).

3. CHINA'S SPECIALISATION IN PROCESSING ACTIVITIES

This section shows how China's selective trade liberalisation has led to an accelerated expansion of international processing activities, which have been the engine of the rapid diversification of its manufactured exports. The effective protection enjoyed by processing activities has favoured strong productive links between China and its Asian partners, as assembly operations have tended to migrate to the mainland. China's integration in the production and trade networks of Asian firms has been at the core of its foreign trade expansion. This analysis suggests that the selective trade policy has skewed the commodity and geographic pattern of China's trade and that these distortions are likely to be alleviated after its WTO accession.

3.1. A Selective Trade Policy in Favour of Processing Activities

Since the beginning of the eighties, China's trade policy has been progressively liberalised but its trade regime has remained dualistic, as Chinese authorities used different policy instruments to promote exports (*Ianchovichina and alii, 2000; Lemoine, 2000*). The first instrument of trade policy was the reduction in tariff and non-tariff barriers. Since 1992 China has substantially lowered its tariff rates which fell from an (unweighted) average of 42.9% in 1992 to 17.5% in 1997. Quota and licences were also reduced (*World Bank, 1997*). The second instrument was duty exemptions granted to selected categories of imports, which aimed at promoting export-oriented industries and at stimulating the inflows of capital and technology through FDI. Intermediate products imported to be used in the production of exports were the most important category of products benefiting from tariff exemptions. Concessionnal import duties were also granted to equipment imported by foreign firms as their contribution to initial investment in affiliates in China. These

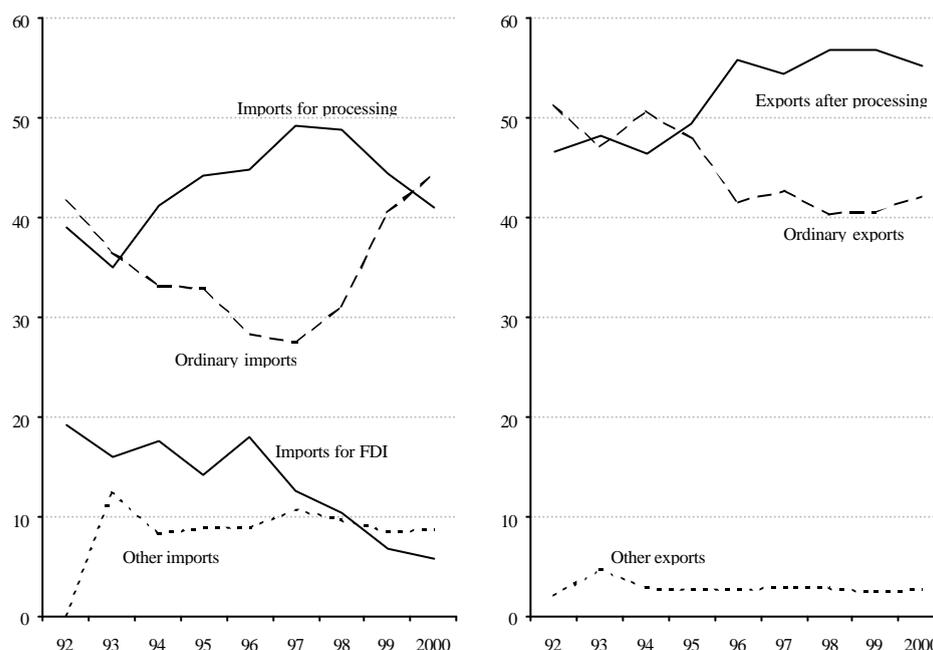
selective tariff exemptions, “new trade liberalisation” instruments (*Ianchovichina and alii, 2000*) resulted in a highly fragmented trade sector. Four broad segments can be distinguished in China’s foreign trade:

- 1) Ordinary trade encompasses imports which are subjected to the general tariff rates, *i.e.* imports aimed at the domestic market (for investment or consumption) and exports mainly based on local inputs.
- 2) Processing trade encompasses imports of goods to be assembled or transformed in China and re-exported, within international assembly and subcontracting operations. These imported inputs (intermediate goods and components) are exempted from custom tariffs. Neither these intermediate imported products, nor the finished goods normally enter China’s domestic market.
- 3) Imports of goods by foreign invested firms as part of their initial investment. These imports are exempted from custom duties and concern mainly equipment and machinery.
- 4) Other exports and imports, which are not subject to the general tariff regime (compensation trade, international aid, warehousing and entrepot trade).

Trade figures corresponding to these different trade segments are available since 1992. Within each category it is possible to identify the respective contributions of domestic (wholly Chinese) firms and of foreign firms affiliates (FFAs) since 1994. China’s customs statistics thus allow for an in-depth investigation of the different components of China’s trade expansion. This makes it possible to evaluate how the trade policy which has aimed at promoting export-oriented industries based on international processing activities has determined the commodity and geographic pattern of China’s trade.

Figure 1 clearly shows that in the nineties China’s foreign trade expansion relied mainly on processing operations. As early as 1992 exports resulting from assembly and processing of imported materials and components made up 46% of China’s exports. This share increased to 55% in 1996, and since then has represented more than half of China’s exports. Exports of processed goods performed much better than other categories of exports (mainly ordinary exports) which slowed down during the Asian crisis (1998-1999). The resilience of China’s processed exports is explained by the fact that due to their high import content they were much less vulnerable to the deterioration of China’s price competitiveness (*Dées and Lemoine, 1999; Déés, 2001*).

Figure 1 – Evolution of China’s Trade by Customs Regimes, 1992-2000
(in % of total trade)

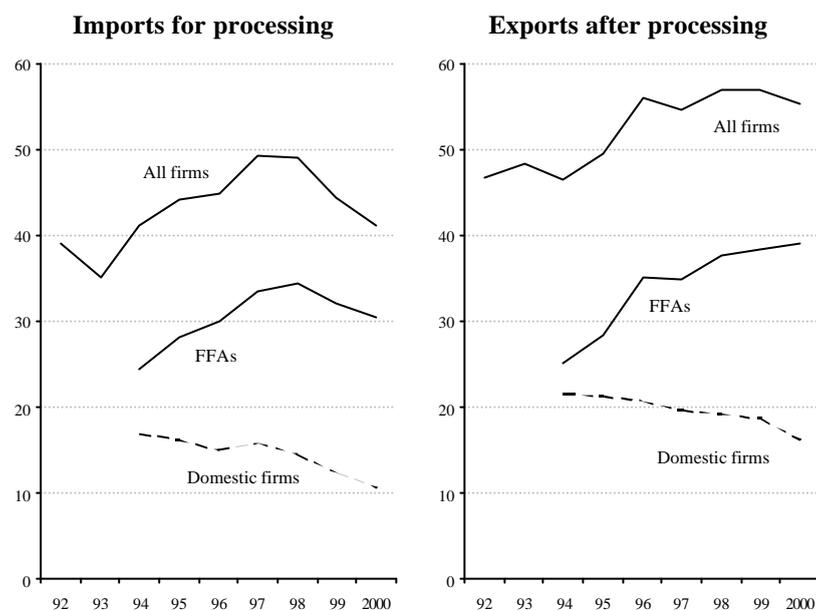


Source: China's Customs Statistics, authors' calculations.

Imports for processing increased rapidly from 1992 to 1997-1998, their share in total imports rising from less than 40% to almost 50%. Since 1998 they have lagged behind ordinary imports, but the recovery of ordinary imports is mainly due to an improved statistical recording by China's customs administration, following the anti-smuggling measures implemented by the government since 1998 (*OECD, 2000*). In 1996-1997 customs data underestimated imports as, according to official investigations, illegal imports represented from 5% to 8% of reported imports (that is 15% to 25% of reported ordinary imports).

Foreign firm affiliates (FFAs) have taken advantage of China's policy in favour of processing trade. Due to their international trade and production networks, they are in better position than Chinese firms to use the mainland as a production base for exports and have played a major role in the expansion of international processing activities. In 2000, FFAs accounted for 70% of China's processed exports (58% in 1994) and for three-fourths of imports for processing (46% in 1994). Motivated by cost considerations, foreign firm affiliates have transferred the downstream, labour intensive stages of production in China, and have been at the core of China's integration in the international segmentation of production process (**Figure 2**).

Figure 2 – FFAs and Domestic Firms in China's Processing Trade
(in % of Total Trade)



Source: China's Customs Statistics, authors' calculations.

Processing activities account for an overwhelming share of foreign trade operations carried out by FFAs: 80% of their exports and 60% of their imports. Presumably, a large part of FFA processing trade corresponds to intra-firm trade, involving affiliates in China and their parent firms abroad, mainly in Asian countries. Although FDI in China has been increasingly driven by market expansion strategies, the attractiveness of China as a production base for exports has remained strong for multinational firms.

Chinese firms are also involved in processing activities through sub-contacting arrangements with overseas firms: 15% of China's exports and 10% of imports are related to processing activities carried out by Chinese firms acting as sub-contractors of firms abroad which supply inputs and control the marketing of the finished products. China's foreign trade thus relies on a highly internationalised manufacturing industry.

3.2. Impact on the Commodity Structure of China's Foreign Trade

Sectoral Changes in Processing Trade

The commodity composition of processing trade shows that its rapid expansion from 1993 to 1999 was associated with large structural changes. **Table 1** presents the evolution of processed exports and of related imports by broad sectors. The following trends can be observed:

- 1) There was a relative decline of processing trade in the most traditional industries (textile and garments, leather and shoes). The share of these sectors declined both on the export and import sides: taken together they accounted for more than 40% of total processed exports in 1993 and for less than 30% in 1999. On the import side the corresponding shares were 35% and 21%.
- 2) The commodity composition of processing trade shifted towards machinery and electrical machinery: the share of these two sectors taken together rose from 24% to 38% of total processed exports and from 24 to 35% of imports for processing. In 1999 electrical machinery became the most important sector in processing trade, both on the export and import sides, overtaking textile and clothing.
- 3) The above mentioned four sectors (leather & shoes, textile and garments, machinery and electrical machinery) made up the bulk of China's processed exports (more than 60%). Chemical products accounted for an important part of imported inputs (18%) but for a small part of exports, indicating that most of imported chemical materials are incorporated in the production of goods belonging to other sectors.

Table 1 – Processing Trade: Sectoral Breakdown in 1993 and 1999

Sectors	Processed exports			Imports for processing		
	1993	1999	1999/93 (%)	1993	1999	1999/93 (%)
Raw Agricultural Products	1	1	136	1	1	139
Food Products	1	1	90	1	1	40
Raw Materials, Mineral & Oil	1	0	79	3	2	71
Chemical Products	5	6	118	17	17	100
Wood, Paper & Printed Books	4	4	115	5	5	86
Leather and Shoes	15	9	57	6	4	61
Fiber, Thread & Cloth Materials	5	4	91	23	16	68
Garments	20	13	62	1	1	102
Construction Materials	1	1	113	1	1	155
Metallurgy	4	4	102	11	10	90
Metallic Articles	1	1	89	1	0	71
Machinery	6	14	246	3	7	189
Electrical Machinery	18	25	136	17	29	168
Vehicles	1	1	97	1	0	45
Other Transportation Equip.	1	3	256	0	0	104
Precision Instruments	5	5	98	4	3	78
Toys, Various Manuf	12	9	74	4	3	71

Note: See **appendix 6.2** for sectors' classification.

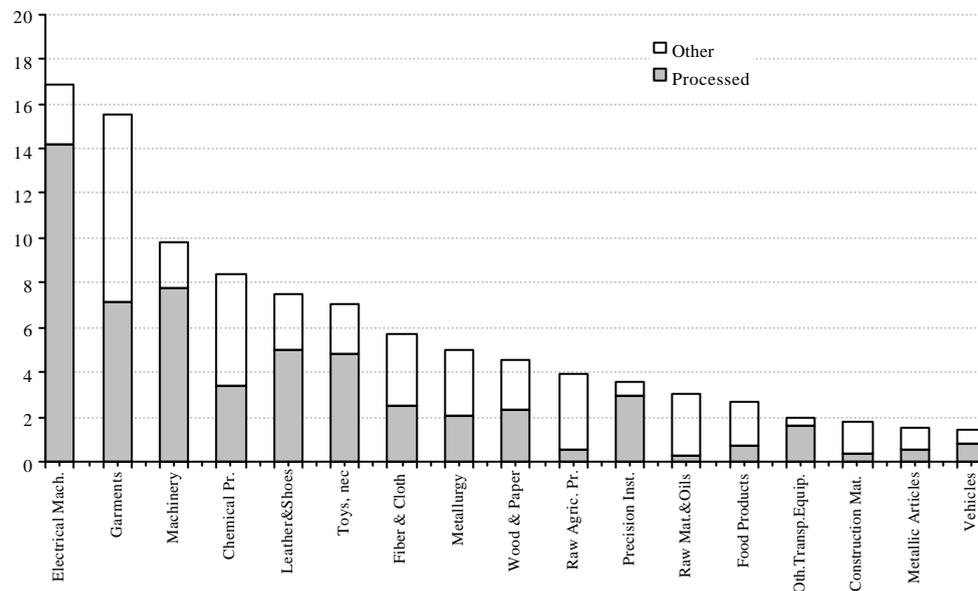
Source: China's Customs Statistics, International Trade Center, Comtrade data base, United Nations, authors' calculations.

International production sharing thus expanded at an accelerated pace in new industrial sectors, as partners with more industrialised economies transferred to China the assembly operations in which they were losing their comparative advantage.

As processing trade took an increasingly dominant part in total trade, its structural changes have strongly influenced China's overall trade pattern. The diversification of China's exports towards more technologically advanced products with rapidly expanding markets (electrical machinery, instruments) was achieved through a specialisation in processing and assembly. China does not master the entire production process in these industries but has established its specialisation in the labour intensive stages of production (**Figure 3** and **Figure 4**).

The contribution of processed exports to sectoral export growth from 1993 to 1999 was outstandingly large in sectors machinery and electrical machinery, other transportation equipment and instruments. In 1999, four-fifths of China's total exports in these sectors depended on processing activities. Changes in the sectoral composition of processing trade are mainly responsible for the shift in overall export structure away from the traditionally largest exporting sector, textile industry, and in favour of machinery and electrical machinery.

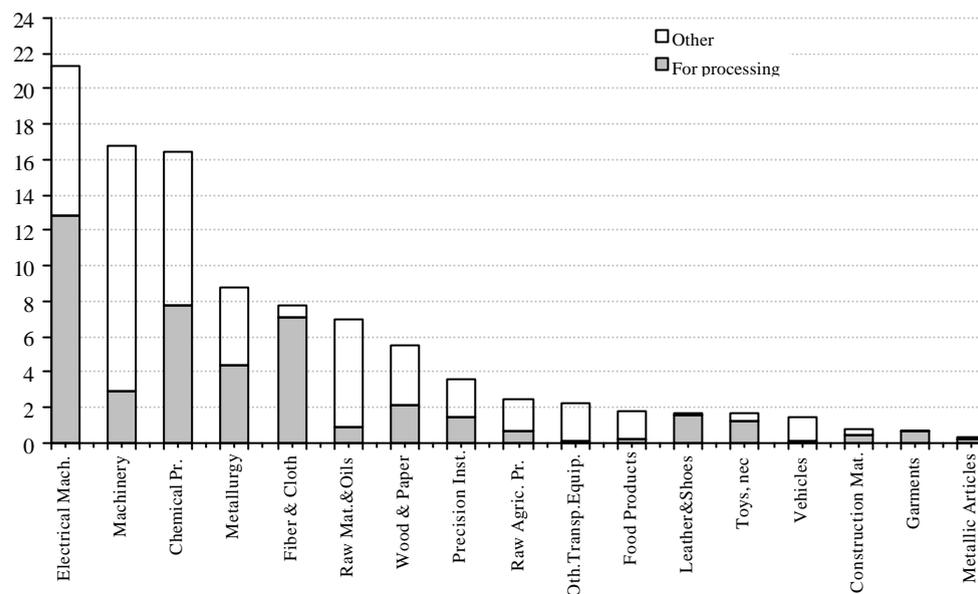
Figure 3 – Share of Processed Goods in Total Exports by Sector, 1999 (in %)



Note: 17 top export sectors, ranked by their share in total exports descending order

Source: Comtrade data base, United Nations; authors' calculations.

Figure 4 – Share of Imports for Processing in Total Imports by Sector, 1999 (in %)



Note: 17 top import sectors, ranked by their share in total imports, descending order.

Source: Comtrade data base, United Nations; authors' calculations.

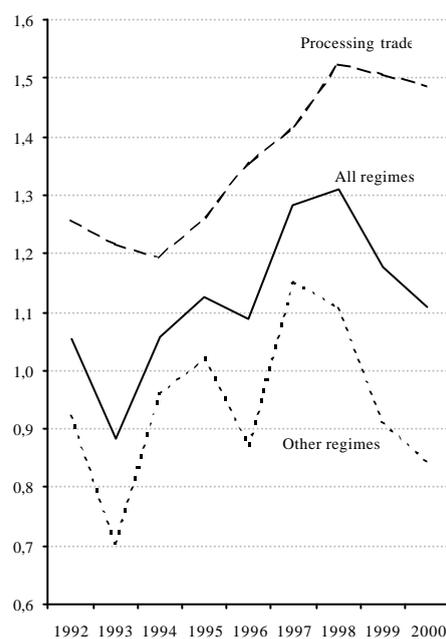
The relationship between export performance and processing operations is confirmed by the observation that the traditional sectors (textile and apparel, leather and shoes) which lagged behind average export performance are characterised by a below-average dependence on processing activities. There are however sectors which registered a fast increase of their exports despite a relatively low dependence on processing activities: this is the case of chemicals and metallurgy-metal products.

Increased Local Content

Since 1994, processing trade has been responsible for a growing part of China's trade surplus. The ratio of exports after processing to import for processing steadily increased, from 1.20 to 1.50 from 1994 to 1998-2000 (**Figure 5**). This trends reflects the increasing local content of processed exports. Several factors may explain this outcome. First, the share of profit margin and/or wage costs may have increased more rapidly than input costs, especially due to the real appreciation of the Yuan since 1994. Second, the value added realised in China may have also increased as a result of the growing integration of the production process in the mainland: the value-added chain has included more stages of production and related services (packaging, marketing) which used to be made outside. A study of the electric appliance and electronic industry shows that there is an increased integration of production in the mainland, an evolution which mainly reflects the rapid escalation of parts transactions among foreign affiliates (*Maruya, 2000*). The latter have

been switching from imported parts and materials towards procurements from other foreign affiliates located in China. Procurements from Chinese companies remain low and rising local content thus reflects the strategy of foreign investors even more than the upgrading of Chinese firms' production capacities.

Figure 5 – Exports/Imports Ratio by Customs Regimes, 1992-2000



Source: China's Customs Statistics, authors' calculations.

It is possible to calculate the import content of processing exports by broad sectors, considering that at this aggregate level, imported inputs are used in the production process of the sector. In **Table 2** two aggregated sectors were analysed: 1) textile and garments 2) machinery, electrical machinery and instruments. The ratio of processed exports to processed imports has increased rapidly in both sectors since 1993 but is much higher in the second sector than in the textile-garment sector. The local content of processed exports increased from 20% to 30% in textile-garment sector and from 30% to 40% in the machinery-electrical machinery sector. The shift in processing trade in favour of this latter sector thus contributed to raise the local content of overall processing trade during this period.

Table 2 – Processed Exports: Two Sector Cases

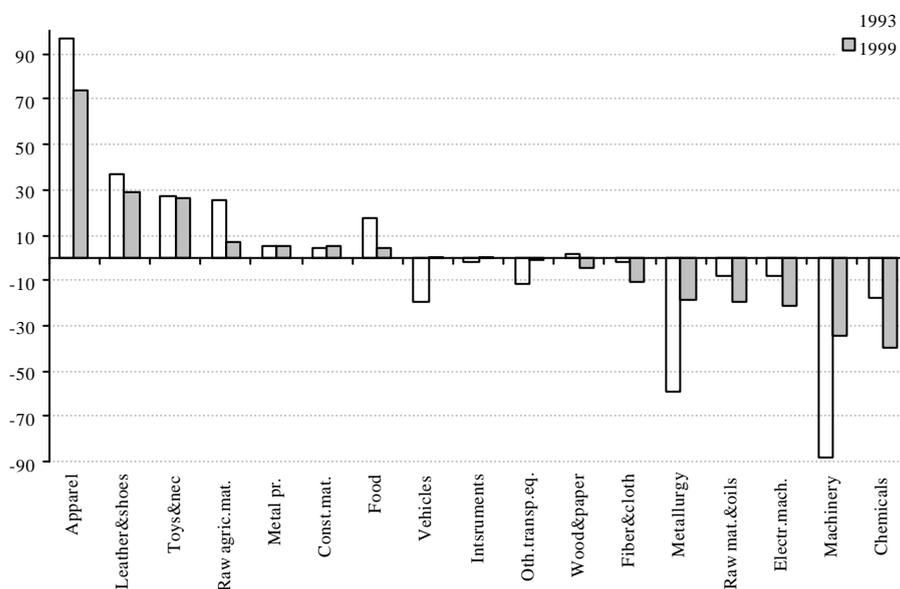
	Coverage ratio		Local content	
	PX/PM		(PX-PM)/PX	
	1993	1999	1993	1999
Textile and garments	1.24	1.48	19.1	32.4
Machinery, electrical mach. & instruments	1.43	1.70	29.9	41.1

Note: P refers to 'processed', X to 'exports' and M to 'imports'.

Source: China's Customs Statistics and International Trade Center, Comtrade data base, United Nations, authors' calculations.

Despite the changes in China's trade structure, China's overall comparative advantages remained located in traditional industries in 1999 (see **appendix 6.5**). Three sectors displayed the largest contribution to China's trade surplus: first apparel, then leather and shoes, followed by toys and miscellaneous manufactured products. Machinery and electrical machinery still had the largest negative contributions to trade balance, mainly due to "ordinary" imports (**Figure 6**).

**Figure 6 – Sectoral Contributions to Trade Balance
(in thousands of total trade)**



Source: China's Customs Statistics and International Trade Center, Comtrade data base, United Nations, authors' calculations.

3.3. Effects on the Geographic Pattern of China's Foreign Trade

The Reorganisation of Production in Asia

The positions of major trade partners in the different trade regimes during the period 1993-1999, show that trade policy in favour of processing trade has stimulated production sharing and the reorganisation of industrial activities within Asia.

Table 3 shows the geographic pattern of China's imports by partners and by customs regimes and provides evidence that the weight of Asian countries in China's total imports is linked with their strong involvement in processing trade⁵. In 1999, Asia was by far the major source of inputs for China's processing activities, providing about two-thirds of these imports: 40% of China's imports for processing came from the Three Dragons, and one-fourth from Japan. Correspondingly, Asian countries' exports heavily depend on this trade segment. Almost 70% of the products exported by the Three Dragons and 55% of Japan's exports are not aimed at Chinese domestic demand but at supplying inputs for exporting industries. The strong intensity of Asian exports to China can thus be explained by the international splitting-up of the value-added chain within the region.

By contrast European and American firms contributed only marginally to the supply of goods for processing: they accounted respectively for 5% and 7% of imports for processing in 1999. Their presence in this fastest growing segment of China's imports was thus weak, which explains their relatively low export intensity to China compared to Asian countries (*Lemoine and Ünal-Kesenci, forthcoming*). Supplies of inputs for processing accounted for a relatively small fraction of their exports: respectively 15% and 27% of China's imports from the US and the EU in 1999.

China's processed exports are much less concentrated on Asia than corresponding imports. Only half of exports after processing is directed to the Three Dragons and Japan in 1999. Moreover this share is overstated since the largest part of processed exports recorded as going to Hongkong is in fact aimed at the US and the European markets (*EC, 1997*). The US and the EU account for a much larger share in China's exports after processing (40%) than in its imports for processing (12%), even though the importance of these "Western" markets is understated due to trade transiting through Hongkong. The pattern of China's processing trade thus reflects the strategies of Asian firms which have expanded production bases in China aimed at world markets. Chinese processed exports have a high content of imported Asian goods: ten dollars of processed exports incorporate five dollars of intermediate goods supplied by Japan and the Three Dragons.

The regional trade balances show that the largest part of China's trade surplus stemming from processing operations is recorded with "Western" partners.

⁵ See **Appendix 6.1** for the geographic breakdown.

Table 3 – Breakdown of China's Trade by Main Partner and Customs Regimes
(in % of total trade and \$ bn)

Imports						
	World	3 Dragons	Japan	EU 15	USA	ROW
1993						
Imports by all custom regimes	100	28	22	15	10	25
China's ordinary imports	37	3	8	8	5	13
Imports for processing	35	18	8	2	2	6
Other custom regimes	28	7	7	6	3	6
1999						
Imports by all custom regimes	100	26	20	15	12	26
China's ordinary imports	40	6	6	9	6	13
Imports for processing	44	18	11	2	3	10
Other custom regimes	15	3	3	4	2	3
Exports						
	World	3 Dragons	Japan	EU 15	USA	ROW
1993						
Exports by all custom regimes	100	29	17	13	18	22
China's ordinary Exports	47	12	10	7	6	13
Processed Exports	48	16	7	7	13	6
Other custom regimes	5	0	0	0	0	4
1999						
Exports by all custom regimes	100	25	17	16	22	21
China's ordinary Exports	41	9	7	7	6	12
Processed Exports	57	16	10	8	15	8
Other custom regimes	3	1	0	0	0	1
Trade Balance						
	World	3 Dragons	Japan	EU 15	USA	ROW
1993						
All custom regimes	-12.2	-2.4	-7.5	-3.5	6.3	-5.1
Ordinary trade	5.2	8.0	0.7	-2.	-0.0	-1.5
Processing trade	7.9	-3.8	-1.3	4.2	9.7	-1.0
Other custom regimes	-25.2	-6.6	-6.9	-5.8	-3.4	-2.6
1999						
All custom regimes	29.2	5.0	-1.4	4.8	22.5	-1.6
Ordinary trade	12.1	7.1	2.7	-1.6	1.1	2.8
Processing trade	37.3	0.9	0.4	12.5	24.6	-1.1
Other custom regimes	-20.2	-3.0	-4.5	-6.2	-3.2	-3.3

Note: See **appendix 6.1** for the geographic breakdown.

Source: China's Customs Statistics and International Trade Center, Comtrade data base, United Nations, authors' calculations.

A Distorted Trade Pattern

It can be argued that the tariff exemptions granted to imports of intermediate products for processing industries has led to a relative discrimination against industries/firms involved in ordinary trade, or producing mainly for the domestic market. In contrast with processing activities which benefited from an effective protection, ordinary exports were affected by

the level of tariffs. At the same time the exemptions on imports for processing may have had a negative impact on the local production of intermediate goods, thus limiting the backward linkages of processing activities.

Table 4 – Structure of Ordinary Trade and Share in Total Trade by Sectors

	Breakdown by sectors				Share in total sectors trade			
	Exports		Imports		Exports		Imports	
	1993	1999	1993	1999	1993	1999	1993	1999
Raw Agricultural Products	12.5	7.9	3.2	4.4	86.0	82.1	70.4	71.8
Food Products	6.0	4.3	1.5	3.6	57.9	64.9	39.2	82.3
Raw Materials, Mineral & Oil	10.3	6.3	14.9	13.8	91.5	85.1	79.1	80.1
Chemical Products	9.6	11.6	10.1	18.2	62.6	56.4	34.4	44.8
Wood, Paper & Printed Books	4.7	5.4	3.6	7.0	55.3	48.4	36.1	51.5
Leather and Shoes	3.8	5.1	0.0	0.1	18.9	27.6	0.6	3.2
Fibber, Thread & Cloth Materials	12.6	7.6	1.4	1.2	70.0	54.1	5.7	6.4
Garments	20.1	20.2	0.0	0.0	47.4	52.9	1.6	2.8
Construction Materials	2.4	3.4	0.4	0.6	77.4	78.3	25.7	32.8
Metallurgy	3.5	7.0	21.4	8.8	45.8	57.3	50.3	40.8
Metallic Articles	2.0	2.3	0.2	0.3	65.2	63.5	18.4	31.1
Machinery	3.8	4.6	20.1	18.2	38.4	18.8	33.1	43.9
Electrical Machinery	3.2	6.1	10.3	15.8	14.4	14.7	30.7	30.1
Vehicles	1.1	1.5	4.6	2.5	39.9	42.1	31.5	70.8
Other Transportation Equipment	0.5	0.4	5.0	1.8	29.7	8.2	59.1	33.8
Precision Instruments	0.8	1.4	3.0	3.3	12.9	16.5	34.2	37.9
Toys and Various Manuf.	3.1	5.0	0.4	0.2	20.6	28.7	8.1	5.8
Total Ordinary Trade	100.0	100.0	100.0	100.0	47.1	40.6	36.6	40.5

Source: China's Customs Statistics and International Trade Center, Comtrade data base, United Nations, authors' calculations.

In contrast with processing trade, the commodity structure of ordinary exports shows relatively limited changes over the nineties (**Table 4**). Garments still remained by far the most important sector, followed by chemicals products. In both sectors, more than half of China's exports in 1999 relies on production using mainly domestic inputs. Although ordinary exports of machinery and electrical machinery increased they remained quite marginal in 1999.

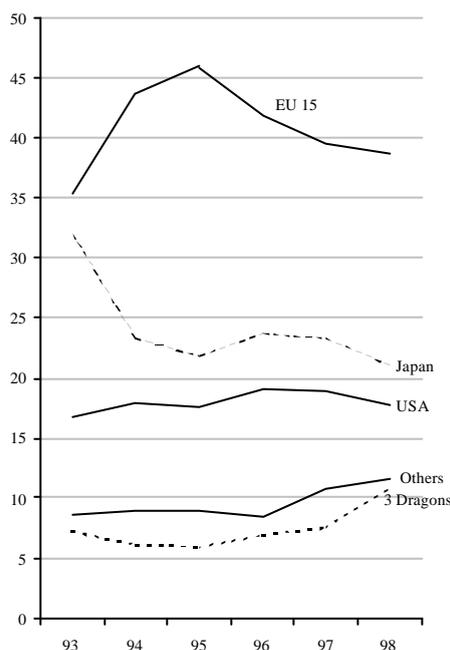
On the import side, machinery, electrical machinery and chemical products represented by far the most important categories. Only a relatively small fraction of these sectors total imports was aimed at the domestic market. In the sector of machinery, the breakdown of imports by customs regimes was the following: ordinary imports accounted for 44%, imports linked to equity investment by FFAs accounted for 30%, and imports for processing accounted for 17%. In electrical machinery, ordinary imports accounted for 30%, and imports for processing amounted to 60%. In these two sectors, the largest part of imports was not used for the modernisation of indigenous production capacities, but was driven by processing activities and direct investment by foreign firms.

This suggests that Chinese firms supplying the domestic market were at a disadvantage compared to export-oriented firms and foreign firm affiliates located in China. This can help explain their relatively poor performance in world markets. The reduction of tariffs resulting from WTO accession will reduce this distortion. While the reduction in tariffs will increase competition in the domestic market, it will give domestic firms a better opportunity to modernise through imports of foreign technologies and equipment, and will level the playing field between different categories firms.

The Potential Impact of Further Trade Liberalisation

Up to now, China's trade policy had an unequal impact on its different partners depending on their positions in the different import segments. This explains why its foreign trade pattern reveals still important obstacles to trade, when these are measured through an indicator of trade discrimination (G. Gaulier, 2001).

Figure 7 – Share of Major Suppliers in China's Ordinary Imports of Machinery*



* Machinery and electrical machinery (HS 84 + 85).

Source: China's Customs Statistics and International Trade Center, authors' calculations.

China's trade liberalisation following its accession to WTO will have no direct effect on processing imports but should induce a rise in imports for domestic use, either consumer or

equipment goods⁶. Its potential impact on the positions of major suppliers will depend on their respective involvement in the different trade segments.

Asian countries already took advantage from China's selective trade liberalisation during the nineties, as the largest part of their exports already entered China without import duties in 1999. As cuts in tariff rates should lead to accelerated growth of ordinary imports, countries having strong positions in this trade regime should benefit the most from the rise of China's domestic demand for imported products, but at the same time, these exporters will face stronger competition since more suppliers will be able to enter the domestic market, when the costs of entry are lower.

In contrast with Asian countries, EU and US exports are mainly directed to the Chinese domestic market (**Table 3**). Almost 60% of China's imports from the EU and 50% of its imports from the US are ordinary trade. The EU remained by far the most important supplier on this trade segment, accounting for 22% of China's ordinary imports, well ahead Japan (13.5%) and the three Dragons (9%). This tends to indicate that European firms have a competitive edge in the categories of products corresponding to China's domestic demand. The important part taken by European suppliers in China's ordinary imports of machinery over the period (almost 40%, **Figure 7**) confirms their adaptation to China's needs in investment goods, however since 1995, their position has weakened as other suppliers enlarged their market shares (the Three Dragons and the rest of the world).

The hypothesis that European firms are likely to benefit from China's further trade liberalisation tends to be confirmed by the results of a recent study which investigates the potential increase of EU trade with different partners that would result from the elimination of all sorts of trade barriers (*G. Gaulier and S. Zignago, forthcoming*). They show that EU share in China's trade would significantly increase if all China's trade barriers would be eliminated.

4. CHINA'S INVOLVEMENT IN THE INTERNATIONAL DIVISION OF PRODUCTION PROCESSES

The above section has shown that the migration of assembly operations from neighbour, more industrialised Asian economies, has been a major factor explaining China's rise in world trade. In order to provide a more in-depth understanding of the current position of China in the international splitting-up of the value-added chain, the following section analyses the structure of its foreign trade by stages of production.

The analysis of China's foreign trade by stage of production was based on the United Nations' Broad Categories (BEC, see **appendix 6.3**). The classification adopted was the following:

⁶ However, as China's economy becomes more open, the propensity of foreign firms to locate stages of their production processes in the Mainland will increase and processing trade may thus indirectly benefit from China's trade liberalisation.

- 1) Primary goods;
- 2) Intermediate goods, among which a distinction was made between a) semi-finished products; b) parts and components which can be described as “intermediate finished goods”, technologically independent but produced in order to be assembled into final goods;
- 3) Final goods, among which a distinction was made between a) capital goods and b) consumption goods.

This data base made it possible to present an original analysis of China’s trade, which points out China’s specialisation profile by stage of production, the geographic and sectoral dimensions of this specialisation, and finally its implications for technology transfers.

4.1. China’s Specialisation Profile by Stage of Production

China’s exports and imports by stage of production in 1997-1999, confirm a strong specialisation in consumption goods, associated with large structural deficits in intermediate goods. Within this well entrenched specialisation pattern, some changes can be observed in the nature of final goods exports and of intermediate goods imports.

China’s *imports* are heavily dominated by intermediate products which amount to almost two-thirds of its total imports (**Table 6**). Within this category, semi-finished products make up the most important part (42% in 1999), but parts and components constitute the most dynamic part (23%): they are responsible for the accelerated growth of whole imports in intermediate goods from 1997 to 1999. Due to this overwhelming share of intermediate goods, the share of capital goods (19%) may appear unexpectedly small, given China’s level of development and rapid economic growth.

Table 6 - China's Trade Pattern and Comparative Advantage by Stage of Production, 1997-1999

	Breakdown of Imports		Breakdown of Exports		Contribution to Trade Balance	
	1997	1999	1997	1999	1997	1999
Primary Goods	10.6	8.7	5.1	3.3	-27	-27
Intermediate Goods	62.3	64.7	32.3	33.0	-148	-157
<i>Parts & components</i>	18.2	23.1	8.0	11.0	-50	-60
<i>Semi-finished goodsI</i>	44.1	41.6	24.3	22.0	-98	-97
Final Goods	23.4	24.1	61.4	62.7	187	192
<i>Consumption Goods</i>	4.4	4.8	48.9	47.2	219	211
<i>Capital Goods</i>	19.1	19.3	12.5	15.4	-32	-19
NEC	3.6	2.6	1.2	1.0	-12	-8
Total	100.0	100.0	100.0	100.0	0	0

Source: Comtrade data base, United Nations, authors' calculations.

On the export side, final goods are by far the most important category (63%), within which consumer goods take an overwhelming share (47%), but capital goods are rising more rapidly (from 12% in 1997 to 15% in 1999). While the proportion of final goods in China’s

exports remained high and steady, a shift occurred away from consumption goods towards capital goods, which suggests that China is upgrading its export capacities towards more technology-intensive products. Intermediate products keep a relatively stable share (32%) but within this category the composition is shifting towards parts and components (11%) and away from semi-finished products, which still remain more important (22%).

China's comparative advantage by stage of production displays a clear-cut pattern which confirms a strong involvement in the international division of production processes. Its structural deficit in intermediate goods stems mainly from semi-manufactured products but the deficit in parts and component tends to widen. It also records a structural deficit, although much smaller, in capital goods and in primary goods.

This makes it clear that China's participation in the international division of production is not based on the transformation of raw materials, but takes place in technologically advanced sectors, in which China specialises in processing and assembly semi-finished products and components. The rapid increase in exports, imports and deficit of parts and components indicates a deepening participation in the international division of production processes. This finding is in line with the conclusions of a recent study on production sharing in East Asia (*Ng and Yeats, 1999*), showing that trade in components has been the most dynamic part of East Asian trade since 1985 and that they made up 18% of imports and 21% of exports of East Asian countries in 1996. Following the distinction proposed by the authors between the producers of components (countries having a positive trade balance in components) and the assembly countries (countries having a negative trade balance in components), China clearly stands as an assembly country, a position similar to that of other low-wage Asian countries (Indonesia, Thailand, Malaysia).

4.2. The Geographic Dimension of China's Specialisation by Stage of Production

Section 3 underlined that China's processing trade was characterised by a strong geographical asymmetry, with most of inputs coming from Asia, while exports being more equally distributed. The geography of China's trade by stage of production provides further insights into the importance of production sharing between China and Asian countries (**Table 7**).

This importance is first evidenced by the role of intermediate products in China's trade with Asian countries. With all major zones China register *a comparative disadvantage in intermediate goods*, but its structural deficits are the largest with Asia. The latter is by far its largest supplier of intermediate goods (60% of such imports). It is also its largest market for intermediate products (accounting for more than two-thirds). The importance of intermediate products in trade with Asia, both on export and import sides, confirms that production sharing is above all a regional process. Intermediate products originating from Europe and America have a marginal, although rising share in total China's imports. Once again this finding is in line with the conclusion of the above mentioned study (*Ng and Yeats 1999*) which underlined that most Asian trade in components was intra-regional and that the trends towards regionalisation has increased since the mid-eighties. This study found that

in 1996 almost 50% of East Asian trade in components took place within the region. The present study shows that in China's case, the dependence on regional trade for imports of components is above this average (more than 60%).

Table 7 – China's Trade Pattern by Regions and Stages of Production, 1999

	Primary Goods	Semi-finish. Goods	Parts and components	Capital Goods	Consumption Goods	n.e.c.	Total
Comparative Advantage							
World	-27	-97	-60	-19	211	-8	-0
Asia-Oceania	-2	-79	-39	-8	95	-5	-38
Western Europe	-3	-0	-15	-14	32	-1	-1
Others	-14	-12	-2	-0	17	-2	-13
Export Breakdown							
World	3.3	22.0	11.0	15.4	47.2	1.0	100.0
Asia-oceania	2.5	12.9	6.8	6.6	21.9	0.8	51.5
Western Europe	0.4	3.5	1.4	3.5	7.2	0.0	16.0
America	0.3	4.0	2.3	4.5	14.3	0.0	25.5
Others	0.1	1.6	0.6	0.8	3.7	0.1	7.0
Import Breakdown							
World	8.7	41.6	23.1	19.3	4.8	2.6	100.0
Asia-Oceania	2.9	28.8	14.7	8.1	2.8	1.8	59.2
Western Europe	1.0	3.6	4.3	6.4	0.8	0.2	16.3
America	1.8	5.3	2.9	3.9	0.8	0.2	15.0
Others	2.9	4.0	1.1	0.8	0.4	0.4	9.5

Source: Comtrade data base, United Nations, authors' calculations.

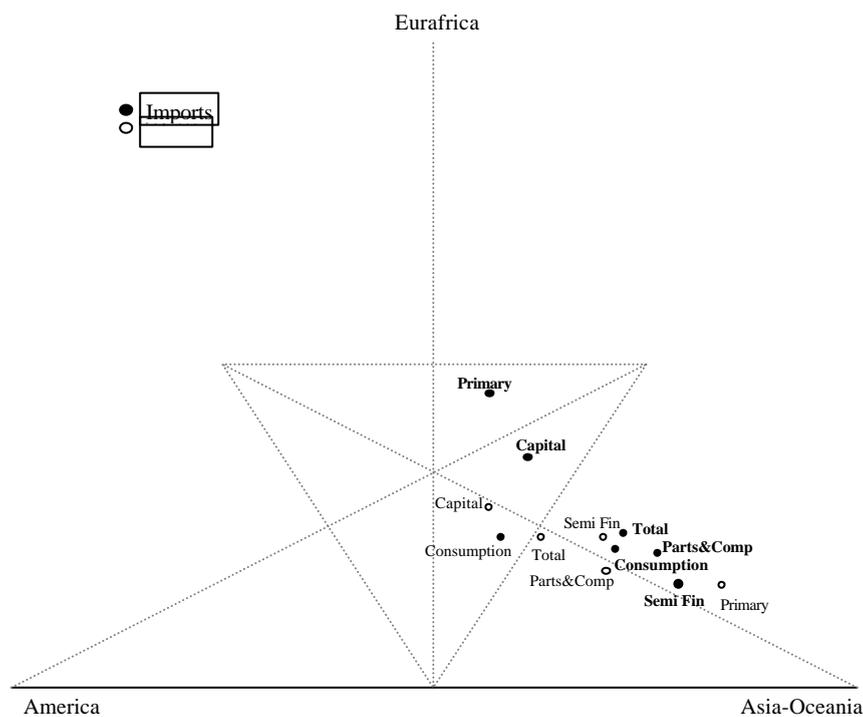
With all major zones, China records a *comparative advantage in consumption goods*, but the magnitude of its trade surpluses differ among partners. It is especially large with Asia, still very significant with America, but much smaller with Western Europe. Asian countries absorb the largest share of China's consumption goods exports, although the importance of Asian markets dropped between from 52% to 46% from 1997 to 1999, presumably because of the regional economic crisis; America is the second largest market of Chinese consumption good exports, twice larger than the European market.

China's trade in capital goods by major zones shows some outstanding features. First, China records its *largest structural deficit in capital goods with Western Europe*, and a much smaller one with Asian countries. This is linked to the fact that Europe holds a relatively high share in China's total imports of capital goods (33%), which confirmed the observation made in **section 3** that Europe was the main supplier of machinery imported for the domestic market. Second, China registers a *structural surplus in capital goods with America, in fact with the US*. Its trade switched from a deficit to a surplus from 1997 to 1999, due to the rapid rise of its exports to America (mainly the US) which received almost 30% of its total capital goods exports in 1999. Given the fact that capital goods are generally considered as intensive in capital, skills and technology, and given the respective

factor endowments of China and the US, China's comparative advantage is not in line with the theoretical assumptions of the neo-classical theory of international trade. Although China's comparative advantage in capital goods may reflect an upgrading of its manufacturing capacity, it is more likely to reflect China's specialisation in the final stages of production (assembling/processing) which are labour intensive. As a result of the international splitting-up of the value-added chain China, exports capital goods which embody imported technology and capital and skill-intensive components.

The geographical asymmetry of China's trade by regions and stages of production can be summarised as follows (**Figure 8**):

Figure 8 – The Geography of China's Trade by Stage of Production



Note: For each stage of production, the triangle represents the breakdown of China's trade flows between the three major partner zones: Asia-Oceania, America and Eurafrica (see **appendix 6.1** for the geographical classification). The closer a point is to one partner zone (summit) the heaviest is the weight of this partner in the corresponding Chinese trade flow. For instance, in primary goods, China exports mainly towards Asia-Oceania in 1999 (76% against 16% to Eurafrica and 8% to America).

Source: Comtrade data base, United Nations, authors' calculations.

China's trade in intermediate products is strongly concentrated on Asian partners. This is also the case of China's imports of consumption goods.

This geographic concentration on Asia is less pronounced in the case of China's imports of capital goods, as European suppliers have a relatively important place.

The concentration on Asia is also less pronounced in the case of China's exports of consumption goods and capital goods, which are relatively more directed towards America.

4.3. China's Trade by Sector and Stage of Production

Turning to the composition by stage of production of China's trade flows by sectors makes it possible to identify the sectors in which China has developed a vertical specialisation, in which its position shifts from a comparative advantage to a disadvantage, depending on the stage of production. The analysis is made at the level of 17 sectors resulting from the aggregation of the 98 items of HS classification (see **appendix 6.2**).

A first observation is that China enjoys *a comparative advantage in consumption goods in all sectors*. As could be expected, the largest structural surpluses are registered in traditional labour intensive sectors: clothing, leather and shoes, toys and miscellaneous manufactured products. But China records also significant surpluses in this stage of production in electrical machinery, instruments and vehicles, sectors more intensive in technology and characterised by a strong international demand (**Table 8**).

A second observation is that in most sectors, China registers *a comparative disadvantage in primary goods as well as in intermediate products*. There are four exceptions: clothing because intermediate products are recorded in the textile sector, construction materials, metallic articles, toys and miscellaneous articles.

The third observation is that China displays *a comparative advantage in capital goods in three sectors*: electrical machinery, metallic products and other transport equipment.

As a result, in most sectors (13 out of 17) China's pattern of comparative advantage is characterised by a vertical specialisation, *i.e.* switches from a comparative advantage to a comparative disadvantage depending on the different stages of production. The reversal of comparative advantage along the production process corresponds to different specialisation profiles:

- 1) In traditional industries (food, textile, leather and shoes) China has an overall comparative advantage, resulting from large structural surpluses in the final stage of production process (consumption goods) which more than compensate its structural deficit in intermediate products.
- 2) In other sectors, China has an overall comparative disadvantage, but has built up structural surpluses in some stages of production. In electrical machinery, which led its export growth in the nineties, China records a deficit in parts and components and a

surplus in consumption as well as in capital goods. In chemical and metallurgy it records a large deficit in semi-finished goods but a small surplus in consumption goods. In machinery its major deficit stems from capital goods as well as from parts and components while small surplus is recorded in consumption goods.

Table 8 – Contribution to Trade Balance by Sector and Stage of Production, 1999

Sectors	Stages of production				NEC	Total	
	Primary	Intermediate goods Semi- finished	Parts and components	Final goods Capital Consump.			
Raw Agricultural Products	-1	0		-0	8	-0	7
Food Products	0	-6			10		4
Raw Materials, Oil	-14	-2				-4	-20
Chemical Products	-1	-47	2		6	-0	-39
Wood, Paper	-5	-12	-0	-0	13	-0	-5
Leather and Shoes	-1	-5	0		35		29
Fibber, Cloth Materials	-1	-11	-0		1		-10
Garments	0	1			73		74
Construction Materials		1			4		5
Metallurgy	-3	-18	0	0	3		-19
Metallic Articles		2	0	2	2		6
Machinery		-0	-13	-23	2	0	-35
Electrical Machinery		1	-44	6	16	-0	-22
Vehicles			-1	-1	2	0	-0
Other Transportation Equip.	-0		-2	1	0	-0	-1
Precision Instruments		-3	-1	-4	8		-0
Toys and Miscel. Manuf.	-1	2		-0	29	0	30
NEC						-4	-4
Total	-27	-97	-60	-19	211	-8	-0

Source: Comtrade data base, United Nations, authors' calculations.

The international splitting-up of the value-added chain which helped China to enhance its position in world market first in traditional sectors has been extended to new industries *i.e.* machinery and electrical machinery. In these new industries, the pattern of China's exports by stage of production radically differ from what is observed in other sectors. They consist mainly of capital goods as well as of parts and components, while consumption goods have a small share (see **Table 16, appendix 6.6**). In electrical machinery, parts and components make up more than two-thirds of China's imports, indicating that international production sharing plays an especially outstanding role in this sector. In machinery imports capital goods still play a dominant part, reflecting more traditional complementarities between China and its partners. As these two categories of products are expected to be characterised by a relatively high technology content, the pattern of imports by stage of production suggests that the imports of components for electrical machinery are an important channel of technology transfers into China (one sixth of China's total imports); another channel is the imports of capital goods belonging to the machinery sector (one tenth of China's total imports).

4.4. The Splitting-up of the Value-Added Chain Between China's and its Partners in Selected Sectors

We will now analyse China's pattern of trade by stage of production with its major partners in sectors which are the most important ones in China's foreign trade: electrical machinery, machinery, textile and apparel.

Electrical Machinery (HS 85)

As mentioned above, electrical machinery has become the most important product category in China's trade, both on the export and import sides. In this sector, China's records a global comparative disadvantage, resulting from large deficits in intermediate goods, and smaller although substantial surpluses in final goods. China's trade pattern with major partners shows some contrasted features: China has an overall comparative disadvantage in this sector with Asian countries, Western Europe, but a comparative advantage with North America (see **Table 17, appendix 6.6**).

With all its major partners (Japan, the Three Dragons, ASEAN, Western Europe and America), China is involved in a vertical division of production: it records structural deficits in parts and components, and structural surpluses in consumption goods.

With most of these regions China also records surpluses in capital goods, excepted with Japan and Western Europe. Its participation in the segmentation of production processes thus enabled China to build strengths in capital goods.

Trade in components plays a major role as they account for 70% of China's imports in this sector in 1999. Most of these imported components originate from Asia (half of total electrical machinery imports are Asian components). Interestingly, in 1999, the Three Dragons had slightly overtaken Japan as the major supplier of components, while ASEAN countries were far behind. This amply shows that not only Japan, but also the first tier of New Industrialised Asian Economies have become producers of electrical components to be assembled in China. Asia is also the main market for China's exports of electrical components, with the Three Dragons receiving most of the components exported by China. This confirms the existence of an in-depth intra-regional specialisation in electrical components. Europe and North America come far behind Asia as suppliers as well as markets for components.

The geographic distribution of China's exports of electrical machinery shows that Europe and America are the main markets for electrical consumption goods exported by China, by far overtaking Japan, the Three Dragons and ASEAN. For China's exports of electrical capital goods the most important markets are the Three Dragons (with Hongkong presumably re-exporting a substantial share of its imports) and North America. The Japanese market appears to be relatively closed to China's exports of final goods. This suggests that Japanese firms have transferred to China their production capacities mainly in order to supply the world markets.

Machinery (HS 84)

As mentioned above, in 1999, machinery ranks second among China's import sectors and third among its export sectors. It is responsible for China's largest structural deficit, the bulk of which is recorded with Japan and the EU.

The geographic pattern of China's comparative advantage shows that China's structural deficit in the machinery sector is located mainly in capital goods, and is concentrated in trade with three regions: Japan, the EU and the Three Dragons (**Table 18, appendix 6.6**). The deficit in this sector also stems from trade in parts and components, mainly with Japan, the EU, and to a lesser extent with ASEAN and North America.

China has small structural surpluses in consumption goods with all partners, and records small structural surpluses in capital goods with several regions, among which North America.

Trade with major partners thus shows that China has developed a vertical specialisation, although this does not generate large reversals in comparative advantage along the production processes. Vertical specialisation is less entrenched in this sector than in electrical machinery.

The structure of imports confirms that China's trade in machinery remains characterised by traditional forms of division of labour: in this sector China's imports are dominated by capital goods, for which the major suppliers are the EU followed by Japan, the Three Dragons and North America (**Table 18, appendix 6.6**). In contrast with what is observed in electrical machinery, imports of parts and components are quite evenly distributed among main partners and there is no strong bias in favour of Asian sourcing: in 1999 North America is the first supplier of components, followed by the Dragons, the EU, and finally Japan. This indicates that in this sector the splitting-up of the value-added chain does not rely mainly on Asian firms' strategies and that most partners have engaged in production sharing with China. This may explain the geographic distribution of China's exports in machinery, which shows that America is the first market. In capital goods exports, which accounts for the bulk of China's exports, the importance of non-Asian markets stands out: North America and the EU receive half of China's exports, while East Asian countries receive less than one-third.

Textile and Clothing Industry

To analyse China's trade by stages of production and regions in textile and clothing industry, we aggregated trade flows in fibbers, cloth materials and garments.

This sector remains China's major comparative advantage with all major zones (**Table 19, appendix 6.6**). Trade with Japan and the Three Dragons accounts for the largest part of China's huge structural surplus in consumption goods, and generates almost all the deficit in intermediate products. Trade surpluses with North America and the EU are much smaller.

Trade with Asia shows clearly the splitting-up of the value-added chain, with Asian countries providing four fifths of China's imports of intermediate goods and receiving almost two thirds of China's exports of consumption goods. By contrast, North America and Western Europe, receive only respectively 17% and 11% of China's exports of final goods. The geographic pattern of China's exports in the downstream segment of textile industry thus appears much more biased in favour of Asian markets than in the cases of machinery and electrical machinery. There are three possible explanations for this. The first is that trade transiting through Hongkong may hide the actual export flows directed to Europe and North America. The second is related to the strategies of exporting firms. The largest part of China's exports in machinery and electrical machinery is in the hand of foreign invested firms located in China which have world-wide trade networks enabling them to have a better access to distant markets. China's textile exports rely mainly on domestic firms which marketing capacities are more limited. The third explanation is that MFA quota in fact contribute to limit China's access to Western markets, while Japan has no import quota. The numerous studies simulating the impact of WTO accession on China's trade conclude that its clothing exports will benefit from the phasing out of MFA, and increase significantly their share in world markets (*Avisse and Fouquin, 2001; Li Shantong and Zhai Fan, 2001; Fan and Zheng, (2000); Walmsley and Hertel, 2000; Wang, 1999; DRC, 1998*).

Summing up

The main findings derived from the analysis of China's trade by stage of production in these three major sectors can be summarised as follows:

- China's participation in the international division of production processes has led to its specialisation in the final stages of the value-added chain, as shown by its comparative advantages in consumer goods in all sectors. It also helped China to build up some strong points in capital goods, especially in electrical machinery.
- Trade between China and Asian countries is dominated by the splitting up of the value-added chain, as evidenced by the importance of trade in intermediate goods. Asian countries play a dominant part both in China's exports and imports of intermediate goods, especially in textile industry and electrical machinery. Trade between China and "Western" partners (North America, Europe) still remains characterised by traditional forms of division of labour: imports of investment goods, exports of final goods. The consequences of regional production sharing can be observed in the upgrading of China's exports to America and Europe which now include a significant share of capital goods. In the machinery sector, trade in parts and components indicates that a division of production process has been engaged between these two regions and China.
- In China's imports, the predominance of intermediate products has dwarfed the importance of investment goods. The diversification of China's export capacities seems to have relied much more on imported intermediate products than on imported investment goods.

4.5. China's Trade in High Technology Products

The following analysis which focuses on the technological content of China's trade combines three dimensions: technological intensity, the level of transformation of traded goods and the geographic directions of trade.

The analysis uses the CEPII high-tech product classification based on OECD and Eurostat studies (see **appendix 6.4**) which makes a distinction between products with high technology content and other products at a detailed level of classification (HS, 6 digits).

**Table 13 – The Pattern of China's Trade
by Technology Content and Production Stages, 1999**

Production Stages	Imports			Exports		
	High-tech	Other	Total	High-tech	Other	Total
Primary Goods	0	9	9	0	3	3
Semi-Finished	1	42	43	1	21	22
Parts&Components	9	15	24	4	7	11
Capital Goods	5	15	20	3	12	16
Consumption	0	5	5	0	47	48
All Stages	15	85	100	9	91	100

Source: Comtrade data base, United Nations, authors' calculations.

Table 13 presents the pattern of China's trade by technology content and stages of production. As could be expected given its level of development, China's imports have a higher technology content than its exports. In 1999, imports of high-technology products accounted for 15% of China's imports and for 9% of its exports. High-tech products represented on average 11% of China's total trade (exports plus imports). This figure is higher than the share of high-tech products in European Union total flows calculated by Fontagné, Freudenberg and Ünal-Kesenci (1999)⁷. The relatively large share of hightech products in China's exports can be explained by the composition of its high-tech imports: the bulk of China's imports of high-tech products consist of parts and components, presumably to be incorporated in exports. Almost 40% of imports of components have a high technology content. Capital goods imports are characterised by a lower high-technology content (25%). China's exports of high-tech products are more equally distributed between parts and components and capital goods.

Table 14 highlights the composition of China's high technology trade by sectors. China's imports of high-technology parts and components are heavily concentrated in the sector of electrical machinery (up to 65%), providing evidence that the inflow of technology into China's industry is closely linked with its involvement in the international division of production in this sector. Imports of high-tech capital goods also take place mainly in the

⁷ Using the same high-tech product classification, Fontagné, Freudenberg and Ünal-Kesenci have calculated that the share of these products amounts to 9,3% of imports in EU-15 and 9,5% of exports in 1996 (9,4% in average).

sector of electrical machinery as well as in transport equipment (aeronautics). The effects of technology diffusion can be observed on the export side: electrical machinery (components as well as capital goods) contributes to half of China's exports of high-tech goods, while the rest is made up by machinery parts and components (one fourth) and instruments (one tenth).

Table 14 – Breakdown of China's Trade in High Technology Products by Production Stages and Sectors, 1999

Stages	Imports										Total
	Harmonised System Sectors (2 digits)										
	29	30	32	38	39	84	85	88	90	93	
Semi-Fin.	1	0	1	1	1		0		1		5
Parts&Comp.						19	39	0	1		60
Capital Goods						3	15	10	7		35
Consumption		1						0	0	0	1
All Stages	1	1	1	1	1	22	54	10	10	0	100

Stages	Exports										Total
	Harmonised System Sectors (2 digits)										
	29	30	32	38	39	84	85	88	90	93	
Semi-Fin.	22	3	1	4	3	0	0		1		11
Parts&Comp.						24	22	0	1		47
Capital Goods						0	25	1	10		37
Consumption		0					4	0	1	0	6
All Stages	3	1	4	3	0	24	51	1	13	0	100

Note: The titles of HS 2 digits items are following: (29) organic chemicals; (30) pharmaceutical products; (32) tanning/dyeing/pigmenting; (38) miscellaneous chemical products; (39) plastics; (84) nuclear reactors; (85) electrical machinery equipment; (88) aircraft/spacecraft; (90) optical/precision; (93) arms/ammunition (see **appendix 6.2**).

Source: Comtrade data base, United Nations, authors' calculations.

The geographic distribution of high-technology products (**Table 15**) shows that Asian countries are by far the most important suppliers of high-tech products (accounting for 57% of the total), which does not come as a surprise since they are the main suppliers of electrical components. Electrical components imported from Asian countries conveys more than 40% of China's total imports of high-tech goods. This confirms that production sharing with Asian countries has a major role in the technological upgrading of China's industry. Western Europe is the second most important source of high-tech products (almost one fifth of China's high-tech imports). In contrast with Asia, Western-Europe's exports of high-tech products are mostly capital goods, underlining that these transfers of technology to China follows a more traditional pattern. China's imports of high-tech products from America are evenly distributed between capital goods and parts & components.

The geographic pattern of China's high-tech exports shows that Asia is also the most important market for China's high-tech exports (57%), America ranks second (with one fourth), far ahead Western Europe (14%). Parts and components make up the major share

of high-tech exports, suggesting that China has succeeded in becoming not only an assembly but also a producer of high-tech parts and components.

Table 15 – Breakdown of China’s Trade in High Technology Products by Production Stages and Major Zones, 1999

	Imports				
	Asia- Oceania	Western Europe	America	Others	World
Semi-Finished Products	3	1	1	0	5
Parts & Components	43	7	9	0	59
Capital Goods	10	15	9	1	35
Consumption Goods	0	0	0	0	1
All Stages	56	23	19	1	100
	Exports				
	Asia- Oceania	Western Europe	America	Others	World
Semi-Finished Products	6	2	2	1	11
Parts &Components	30	5	10	2	47
Capital Goods	20	5	10	1	37
Consumption Goods	2	1	3	0	6
All Stages	57	14	25	4	100

Source: Comtrade data base, United Nations, authors' calculations.

5. CONCLUSION

China’s outstanding performance in world markets over the nineties can be traced back to its increased involvement in the international segmentation of production processes, which has been deliberately encouraged by a selective trade policy granting preferential tariff treatment to assembling and processing activities. The final stages of production in Asian matured economies have tended to migrate to China, enhancing its export capacities and the regional integration. China’s strong specialisation in the downstream segments of production is associated with large structural deficits in upstream segments (parts and components, semi-finished goods) and this vertical specialisation has enabled China to rapidly diversify its exports of consumption goods and to build strengths in exports of equipment goods. This is most remarkable in the electrical machinery sector. Moreover the technology content of trade shows that parts and components have been a major channel for China’s imports of high technology. The Chinese case thus fits the theoretical and empirical framework which puts forwards the gains that can be derived from vertical specialisation and from trade in intermediate goods. However this strategy has led to a dichotomy between highly internationalised and competitive industries on the one hand and a more traditional exporting sector, based on domestic inputs, which is lagging behind, on the other hand.

The reduction in tariffs that will follow China's WTO accession will alleviate the distortions between the different trade regimes. This will trigger imports aimed at the domestic market and thus enhance the role of more traditional complementarities as a determinant of China's foreign trade. European and American firms which enjoy strong positions in this market segment will probably benefit from this evolution. The opening of China's domestic market also means that they will face more competitors. For Chinese domestic-based firms, trade liberalisation is a two-edge sword as they will face an increased competition from imported goods and at the same time will have a better access to foreign technology and equipment which up to now have been mostly imported by the internationalised sector.

Textile and clothing is expected to be the Chinese sector which will benefit the most from WTO accession, as the phasing out of MFA quota up to 2005 will enable China to enlarge its share in world market. It is worth stressing that clothing exports are dominated by Chinese firms (not FFAs). World trade liberalisation in this sector may slowdown the structural trend observed in China's exports over the nineties, which shifted away from textile-clothing products towards more high-tech products (electrical machinery). However, in the latter industries, production sharing with developed Asian countries will continue to underpin the upgrading of China's exports. As they are both member of the WTO, China and Taiwan will intensify their economic links and cross-Strait productive network will expand. China's trade will thus continue to expand on the basis of strong complementarities with Asian developed economies.

6. APPENDICES

6.1 Geographical Classification

Major zone	Zone	Country	Major zone	Zone	Country
World			EU Periphery	Central Europe	Albania
Asia-Oceania	Japan				Bulgaria
	3 Dragons	Hong-Kong S. Korea Taiwan			Czech Rep.
	ASEAN	Indochina Indonesia Malaysia Philippines Singapore Thailand			Hungary
	Australia-N. Zeal.	Australia N.Zealand			Poland
	India				Romania
	Other Asia				Slovakia
Western Europe	UE	Austria Belgium-Lux. Denmark Finland France Germany Greece Ireland Italy Netherlands Portugal Spain Sweden United Kingdom			
	Other West. Eur.	Norway Other EFTA Switzerland			Ex-USSR
					Ex-USSR
					Ex-Yugoslavia
					Ex-Yugoslavia
					Mediterranean
					Algeria
					Arab. méd.
					East Medit.
					Egypt
					Israel
					Morocco
					Tunisia
					Turkey
					Gulf
					Other Africa
					Africa nda
					Burk. Faso
					C. Ivoire
					Gabon
					Ghana
					Mali
					Nigeria
					Tanzania
					Uganda
					Zaire
					South Africa
					South Africa
			America	NAFTA	USA
					Canada
					Mexico
					Mercosur
					Argentina
					Brazil
					Paraguay
					Uruguay
					Other South America
					Chile
					Colombia
					Equator
					Other America
					Peru
					Venezuela
					NES

6.2. Branch and Sector Classification

SECTORS	HS2		
Raw agricultural products	01	Live animals.	
	02	Meat and edible meat offal.	
	03	Fish & crustacean, mollusc & other aquatic invertebrate	
	05	Products of animal origin, nes or included.	
	06	Live tree & other plant; bulb, root; cut flowers etc	
	07	Edible vegetables and certain roots and tubers.	
	08	Edible fruit and nuts; peel of citrus fruit or melons.	
	10	Cereals.	
	12	Oil seed, oleagi fruits; miscell grain, seed, fruit etc	
	13	Lac; gums, resins & other vegetable saps & extracts.	
	14	Vegetable plaiting materials; vegetable products nes	
	Food products	04	Dairy prod; birds' eggs; natural honey; edible prod nes
		09	Coffee, tea, mat- and spices.
		11	Prod mill indust; malt; starches; inulin; wheat gluten
15		Animal/veg fats & oils & their cleavage products; etc	
16		Prep of meat, fish or crustaceans, molluscs etc	
17		Sugars and sugar confectionery.	
18		Cocoa and cocoa preparations.	
19		Prep of cereal, flour, starch/milk; pastrycooks' prod	
20		Prep of vegetable, fruit, nuts or other parts of plants	
21		Miscellaneous edible preparations.	
22		Beverages, spirits and vinegar.	
23		Residues & waste from the food indust; prepr ani fodder	
24	Tobacco and manufactured tobacco substitutes.		
Raw materials & fuels	25	Salt; sulphur; earth & ston; plastering mat; lime & cem	
	26	Ores, slag and ash.	
	27	Mineral fuels, oils & product of their distillation;etc	
Chemical products	28	Inorgn chem; compds of prec met, radioact elements etc	
	29	Organic chemicals.	
	30	Pharmaceutical products.	
	31	Fertilisers.	
	32	Tanning/dyeing extract; tannins & derivs; pigm etc	
	33	Essential oils & resinoids; perf, cosmetic/toilet prep	
	34	Soap, organic surface-active agents, washing prep, etc	
	35	Albuminoidal subs; modified starches; glues; enzymes.	
	36	Explosives; pyrotechnic prod; matches; pyrop alloy; etc	
	37	Photographic or cinematographic goods.	
	38	Miscellaneous chemical products.	
	39	Plastics and articles thereof.	
40	Rubber and articles thereof.		
Wood and paper products	44	Wood and articles of wood; wood charcoal.	
	45	Cork and articles of cork.	
	46	Manufactures of straw, esparto/other plaiting mat; etc	
	47	Pulp of wood/of other fibrous cellulosic mat; waste etc	
	48	Paper & paperboard; art of paper pulp, paper/paperboard	
	49	Printed books, newspapers, pictures & other product etc	
94	Furniture; bedding, mattress, matt support, cushion etc		

SECTORS	HS2	
Leather and shoes	41	Raw hides and skins (other than furskins) and leather.
	42	Articles of leather; saddlery/harness; travel goods etc
	43	Furskins and artificial fur; manufactures thereof.
	64	Footwear, gaiters and the like; parts of such articles.
Fibber and cloths	50	Silk.
	51	Wool, fine/coarse animal hair, horsehair yarn & fabric
	52	Cotton.
	53	Other vegetable textile fibres; paper yarn & woven fab
	54	Man-made filaments.
	55	Man-made staple fibres.
	56	Wadding, felt & non woven; yarns; twine, cordage, etc
	57	Carpets and other textile floor coverings.
	58	Special woven fab.; tufted tex fab; lace; tapestries etc
	59	Impregnated, coated, cover/laminated textile fabric etc
	60	Knitted or crocheted fabrics.
Wearing Apparel	61	Art of apparel & clothing access, knitted or crocheted.
	62	Art of apparel & clothing access, not knitted/crocheted
	63	Other made up textile articles; sets; worn clothing etc
Building materials	68	Art of stone, plaster, cement, asbestos, mica/sim mat
	69	Ceramic products.
	70	Glass and glassware.
Metallurgy	72	Iron and steel.
	73	Articles of iron or steel.
	74	Copper and articles thereof.
	75	Nickel and articles thereof.
	76	Aluminium and articles thereof.
	78	Lead and articles thereof.
	79	Zinc and articles thereof.
	80	Tin and articles thereof.
	81	Other base metals; cermets; articles thereof.
	Metal products	82
83		Miscellaneous articles of base metal.
Machinery	84	Nuclear reactors, boilers, mchy & mech appliance; parts
	93	Arms and ammunition; parts and accessories thereof.
Electrical machinery	85	Electrical mchy equip parts thereof; sound recorder etc
Motor Vehicles	87	Vehicles other than railw/tramw roll-stock, pts & accessories
Other transport equipment	86	Railw/tramw locom, rolling-stock & parts thereof; etc
	88	Aircraft, spacecraft, and parts thereof.
	89	Ships, boats and floating structures.
Precision instruments	90	Optical, photo, cine, meas, checking, precision, etc
	91	Clocks and watches and parts thereof.
	92	Musical instruments; parts and access of such articles
Toys & miscellaneous manuf. products	65	Headgear and parts thereof.
	66	Umbrellas, walking-sticks, seat-sticks, whips, etc
	67	Prepr feathers & down; arti flower; articles human hair
	71	Natural/cultured pearls, prec stones & metals, coin etc
	95	Toys, games & sports requisites; parts & access thereof
	96	Miscellaneous manufactured articles.
	97	Works of art, collectors' pieces and antiques.
	98	Special Classification Provisions

6.3. BEC Classification

The classification by Broad Economic Categories (BEC) of the United Nations reclassifies the Standard International Trade Classification (SITC, Rev. 3) headings on the basis of the principal use of the products. It converts foreign trade data into categories of final or intermediate use, such as capital goods, intermediate goods or consumer goods, following the usage in the System of National Accounts (SNA). In this study on China trade, BEC categories are aggregated as following:

3 stages	5 stages	Code BEC	Title BEC
Primary goods		111	Food and beverages mainly for industry
		21	Industrial supplies, n.e.s., primary
		31	Fuels and lubricants, primary
Intermediate goods	Semi-finished goods	121	Food and beverages, processed, mainly for industry
		22	Industrial supplies, n.e.s., processed
		322	Fuels and lubricants, processed
	Parts & components	42	Of capital goods, except transport equipment
		53	Of transport equipment
Final goods	Capital goods	41	Capital goods except transport equipment
		521	Other industrial transport equipment
	Consumption goods	112	Food & bev., primary, mainly for household consumption
		122	Food & bev., primary, processed, for house. consumption
		51	Passenger motor cars
		522	Other non-industrial transport equipment
		53	Parts and accessories of transport equipment
		61	Durable consumer goods n.e.s.
		62	Semi-durable consumer goods n.e.s.
63	Non-durable consumer goods n.e.s.		

The data on China's imports and exports come from China's customs statistics. These data which were available at a very disaggregated level (Harmonised System, six digits), were aggregated according to the BEC classification of production stages.

6.4. The CEPII's List of High-Tech Products

The definition of high-tech products used in CEPII studies comes from Fontagné, Freudenberg and Ünal-Kesenci (1999). They derived a list of 252 products at the 6 digits level of the Harmonised System from a joint list published by Eurostat and the OECD.

Originally, OECD (1980, 1983) used to classify *sectors* according to a U.S. list. Then OECD (1984) decided to measure the *direct* content in R&D for each sector and published a list entailing three levels of technology (high, medium, low): this classification identified 6 sectors of high-technology: aerospace, office machinery, pharmaceuticals, electronic and telecommunications, precision tools, and electric machinery. This classification has been extensively used in order to examine the high-technology sector over 1970-1980. More recently, the OECD (1995) issued a new classification, according to the *direct and indirect* technological content. This classification is based on the ISICrev2, and is articulated with trade data using the SITC rev3.

This classification of sectors being done, OECD considers *products* belonging to the high-technology and medium-technology sectors, minus the automobile industry, plus weapons. Inside these sectors, the Fraunhofer Institut selected a list of products having a high content in R&D at the 3-digit level of the SITC. These positions of the SITC 3-digit account for 230 products at the 5-digit level of the same nomenclature (a list here referred to as OECD-1995-product). Hence, there is no correspondence between the high-technology *sector* (as referred to in OECD publications) and the list of high-technology *products* here defined. It has to be noted that this methodology introduces a slight selection bias, since it examines whether products are of a high-technology nature or whether they are not, only in sectors that themselves are considered high-technology: potentially existing high-technology products in non technological sectors do not figure in the OECD-Eurostat list, and are thus implicitly considered as non-technological.

In order to launch a joint list with Eurostat, it was necessary to go further in detail in order to match 5-digit SITC positions with 6-digit HS ones. However, compared to this joint list, both Eurostat and OECD then made a certain number of modifications. Some 6-digit items of HS, belonging to 5-digit items of the SITC, cannot be considered as high-technology, and were thus excluded of the 6-digit HS list by Eurostat. In total, there is a joint list, a modified Eurostat list, and a modified OECD list.

Fontagné, Freudenberg and Ünal-Kesenci (1999) decided to define high-technology products as those belonging at least to one of these latter lists, yielding 279 items of HS 6 digits. But, each year, at such a level of desegregation, items appear and disappear: as a result, 26 items in the joint list plus 1 over the 7 added by Eurostat are without any observation in 1996. Hence, since they use a nomenclature corresponding to the year 1995, only 252 over the 279 items of the joint list correspond to trade data in 1996. Finally, these 252 products at the 6-digit level of HS are disaggregated into about 500 items at the 8-digit level of the CN, under the assumption that all 8-digit positions belonging to a "high-tech" 6-digit one are also high-technology products.

6.5. Indicator of Contribution to Trade Balance

To measure China's revealed comparative advantages, we used the indicator of "contribution to the trade balance" (Lafay, 1994). The idea is to measure comparative advantages (*largo sensu*) under an assumption of balanced trade.

$$CTB_{ij}^k = 1000 * \left[(X_{ij}^k - M_{ij}^k) - \sum_k \sum_j (X_{ij}^k - M_{ij}^k) \left(\frac{X_{ij}^k + M_{ij}^k}{\sum_k \sum_j (X_{ij}^k + M_{ij}^k)} \right) \right]$$

with i for the declaring country (China), j for its partner and k for the products.

If there were no comparative advantage or disadvantage for any product k , then the country's total trade balance (surplus or deficit) should be distributed across all industries according to their share in total trade. The "contribution to the trade balance" is the difference between the observed and this theoretical balance. Here, these "contributions" are weighted by total trade of the China.

A positive contribution is interpreted as a "revealed comparative advantage" for that industry. By definition, the sum over all industries and partners is zero. The indicator is additive: thus the values for products or industries can be aggregated to any desired level.

Contribution to the trade balance is a structural indicator which tries to eliminate business cycle variations -by comparing an industry's performance to the overall one- and, unlike many other indicators, a symmetrical indicator in the sense that it focuses not only on exports, but also on imports.

6.6. China's Trade by Sectors and Stages of Production

Table 16 – China's Trade by Sectors and Stages of Production in 1999

Sectors	IMPORTS					NEC	Total
	Primary	Stages of production		Final goods			
		Intermediate goods Semi- finished	Parts and components	Capital	Consump.		
Raw Agricultural Products	1.4	0.0		0.0	1.1	0.0	2.5
Food Products	0.1	1.4			0.3		1.8
Raw Materials, Oil	4.4	0.9				1.6	7.0
Chemical Products	0.2	15.1	0.1		1.0	0.0	16.3
Wood, Paper	1.0	4.2	0.0	0.0	0.2	0.1	5.5
Leather and Shoes	0.2	1.2	0.0		0.2		1.7
Fibber, Cloth Materials	0.3	7.4	0.0		0.0		7.7
Garments	0.0	0.0			0.7		0.7
Construction Materials		0.8			0.0		0.8
Metallurgy	0.6	8.0	0.0	0.0	0.0		8.7
Metallic Articles		0.2	0.1	0.0	0.0		0.4
Machinery		0.0	6.1	10.6	0.1	0.0	16.8
Electrical Machinery		0.9	14.9	4.8	0.6	0.0	21.3
Vehicles			0.9	0.2	0.3		1.4
Other Transportation Equipment	0.1		0.5	1.6	0.0	0.0	2.2
Precision Instruments		1.0	0.5	1.9	0.2		3.6
Toys and Miscel. Manuf.	0.2	0.4		0.0	0.2	0.0	0.8
NEC						0.8	0.8
Total	8.7	41.6	23.1	19.3	4.8	2.6	100.0

Sectors	EXPORTS					NES	Total
	Primary	Stages of production		Final goods			
		Intermediate goods Semi- finished	Parts and components	Capital	Consump.		
Raw Agricultural Products	1.3	0.0		0.0	2.6	0.0	3.9
Food Products	0.1	0.3			2.3		2.7
Raw Materials, Oil	1.6	0.6				0.8	3.0
Chemical Products	0.0	5.6	0.4		2.3	0.0	8.4
Wood, Paper	0.1	1.7	0.0	0.0	2.8	0.0	4.6
Leather and Shoes	0.0	0.2	0.0		7.2		7.5
Fibber, Cloth Materials	0.2	5.2	0.0		0.2		5.7
Garments	0.0	0.1			15.4		15.5
Construction Materials		1.0			0.7		1.7
Metallurgy	0.0	4.3	0.0	0.1	0.6		5.0
Metallic Articles		0.5	0.1	0.4	0.5		1.5
Machinery		0.0	3.4	5.9	0.5	0.0	9.8
Electrical Machinery		1.1	5.9	6.1	3.8	0.0	16.9
Vehicles			0.7	0.1	0.6		1.4
Other Transportation Equipment	0.0		0.2	1.7	0.0	0.0	1.9
Precision Instruments		0.4	0.3	1.1	1.7		3.5
Toys and Miscel. Manuf.	0.0	0.8		0.0	6.1	0.0	6.9
NEC						0.1	0.1
Total	3.3	22.0	11.0	15.4	47.2	1.0	100.0

Source: Comtrade data base, United Nations, authors' calculations.

**Table 17 – China's Trade in Electrical Machinery
by Stage of Production and Geographic Zone, 1999**

	Contribution to Trade Balance				
	Semi Fin. Goods	Parts & Compon.	Capital Goods	Consump. Goods	All Stages
Japan	-0.1	-16.9	-0.6	1.4	-16.1
3 Dragons	-0.5	-10.5	4.7	1.6	-4.8
ASEAN	0.0	-3.5	0.9	0.2	-2.3
Australia-N. Zealand	0.0	-0.1	0.1	0.4	0.5
India	0.0	0.1	0.0	0.0	0.2
Other Asia	0.1	0.1	0.3	0.1	0.6
Western Europe	-0.0	-8.0	-2.9	4.1	-6.9
Other Europe & Ex-USSR	0.0	0.1	0.1	0.3	0.4
Mediterranean	0.1	0.2	0.1	0.4	0.8
Africa & Gulf	0.2	0.3	0.4	1.1	2.0
North America	0.7	-3.4	4.2	6.0	7.6
Mercosur	0.1	0.2	0.2	0.3	0.7
Other South America	0.1	0.1	0.1	0.3	0.5
NES	-0.2	-3.1	-1.5	-0.2	-5.0
World	0.5	-44.3	6.0	16.0	-21.7
	Exports				
	Semi Fin. Goods	Parts & Compon.	Capital Goods	Consump. Goods	All Stages
Japan	1.2	6.5	5.0	2.5	15.2
3 Dragons	1.5	14.4	10.5	2.8	29.3
ASEAN	0.4	4.5	2.4	0.7	8.1
Australia-N. Zealand	0.1	0.1	0.3	0.5	1.0
India	0.1	0.1	0.1	0.0	0.3
Other Asia	0.1	0.1	0.3	0.2	0.8
Western Europe	0.9	3.6	6.2	5.4	16.1
Other Europe & Ex-USSR	0.0	0.2	0.2	0.3	0.7
Mediterranean	0.1	0.4	0.3	0.5	1.4
Africa & Gulf	0.2	0.4	0.5	1.3	2.4
North America	1.4	4.5	9.6	7.8	23.3
Mercosur	0.1	0.2	0.2	0.3	0.8
Other South America	0.1	0.1	0.1	0.3	0.7
NES					
World	6.2	35.1	35.9	22.7	100.0
	Imports				
	Semi Fin. Goods	Parts & Compon.	Capital Goods	Consump. Goods	All Stages
Japan	1.0	21.1	4.5	0.7	27.4
3 Dragons	1.7	21.4	4.0	0.7	27.8
ASEAN	0.3	6.9	1.1	0.4	8.6
Australia-N. Zealand	0.0	0.1	0.1	0.0	0.3
India	0.0	0.0	0.0	0.0	0.0
Other Asia	0.0	0.0	0.0	0.0	0.0
Western Europe	0.7	10.4	7.7	0.5	19.3
Other Europe & Ex-USSR	0.0	0.1	0.1	0.0	0.2
Mediterranean	0.0	0.1	0.2	0.0	0.3
Africa & Gulf	0.0	0.0	0.0	0.0	0.0
North America	0.4	6.7	3.7	0.5	11.3
Mercosur	0.0	0.0	0.0	0.0	0.0
Other South America	0.0	0.0			0.0
NES	0.2	2.9	1.4	0.2	4.7
World	4.5	69.8	22.8	2.9	100.0

Source: Comtrade data base, United Nations, authors' calculations.

**Table 18 – China's Trade in Machinery
by Stage of Production and Geographic Zone, 1999**

	Contribution to Trade Balance				
	Semi Fin. Goods	Parts & Compon.	Capital Goods	Consump. Goods	All Stages
Japan	-0.1	-6.2	-10.1	0.1	-16.3
3 Dragons	-0.1	-0.5	-5.7	0.7	-5.5
ASEAN	0.0	-1.6	-1.1	0.1	-2.6
Australia-N. Zealand	0.0	0.1	0.2	0.0	0.4
India	0.0	0.0	0.1	0.0	0.2
Other Asia	0.0	0.2	0.5	0.0	0.7
Western Europe	0.0	-4.7	-9.0	0.2	-13.5
Other Europe & Ex-USSR	0.0	0.2	0.0	0.0	0.2
Mediterranean	0.0	0.2	0.4	0.1	0.7
Africa & Gulf	0.0	0.5	0.8	0.2	1.5
North America	0.0	-1.1	0.7	0.9	0.4
Mercosur	0.0	0.1	0.2	0.0	0.4
Other South America	0.0	0.1	0.1	0.0	0.3
NES	-0.0	-0.7	-0.7	-0.0	-1.5
World	-0.1	-13.5	-23.5	2.3	-34.7
	Exports				
	Semi Fin. Goods	Parts & Compon.	Capital Goods	Consump. Goods	All Stages
Japan	0.0	3.9	4.3	0.4	8.7
3 Dragons	0.1	7.9	8.8	1.5	18.3
ASEAN	0.0	5.1	4.1	0.2	9.4
Australia-N. Zealand	0.0	0.3	1.0	0.1	1.3
India	0.0	0.1	0.2	0.0	0.4
Other Asia	0.0	0.4	1.0	0.1	1.5
Western Europe	0.0	5.4	16.7	0.5	22.6
Other Europe & Ex-USSR	0.0	1.0	0.6	0.0	1.6
Mediterranean	0.0	0.5	1.0	0.1	1.6
Africa & Gulf	0.0	1.0	1.9	0.3	3.3
North America	0.0	8.2	19.6	1.8	29.7
Mercosur	0.0	0.2	0.7	0.1	1.0
Other South America	0.0	0.3	0.3	0.1	0.7
NES	-	-	-	-	-
World	0.2	34.2	60.2	5.3	100.0
	Imports				
	Semi Fin. Goods	Parts & Compon.	Capital Goods	Consump. Goods	All Stages
Japan	0.1	9.8	14.7	0.1	24.6
3 Dragons	0.1	5.1	12.0	0.1	17.3
ASEAN	0.0	4.9	3.7	0.0	8.7
Australia-N. Zealand	-	0.1	0.3	0.0	0.3
India	-	0.0	0.0	-	0.0
Other Asia	0.0	0.0	0.0	-	0.0
Western Europe	0.0	8.8	20.5	0.0	29.4
Other Europe & Ex-USSR	0.0	0.4	0.3	0.0	0.7
Mediterranean	-	0.0	0.1	0.0	0.1
Africa & Gulf	0.0	0.0	0.1	0.0	0.1
North America	0.0	6.1	10.7	0.0	16.8
Mercosur	0.0	0.0	0.1	0.0	0.1
Other South America	-	0.0	0.0	-	0.0
NES	0.0	0.9	0.8	0.0	1.8
World	0.2	36.1	63.3	0.3	100.0

Source: Comtrade data base, United Nations, authors' calculations.

**Table 19 – China's Trade in Textile and Clothing Industry
by Stage of Production and Geographic zone, 1999**

Contribution to Trade Balance					
	Primary Goods	Semi Fin. Goods	Parts & Compon.	Consump. Goods	All Stages
Japan	0,1	-6,0	-0,0	23,2	17,2
3 Dragons	0,3	-7,5	-0,0	18,5	11,3
ASEAN	0,2	0,7	0,0	1,6	2,6
Australia-N. Zealand	-1,3	0,0	-0,0	2,3	1,1
India	0,0	-0,0	0,0	0,0	0,0
Other Asia	-0,0	1,0	0,0	0,7	1,7
Western Europe	0,0	1,1	-0,0	8,4	9,5
Other Europe & Ex-USSR	-0,1	0,4	0,0	3,5	3,8
Mediterranean	-0,0	0,7	0,0	1,0	1,6
Africa & Gulf	-0,0	1,8	0,0	2,2	3,9
North America	-0,0	0,2	-0,0	10,5	10,7
Mercosur	-0,0	-0,0	0,0	0,4	0,4
Other South America	0,0	0,7	0,0	2,0	2,8
NES	-0,0	-3,0	-0,0	-0,1	-3,1
World	-0,8	-9,9	-0,1	74,2	63,4
Exports					
	Primary Goods	Semi Fin. Goods	Parts & Compon.	Consump. Goods	All Stages
Japan	0,1	1,7	0,0	22,9	24,7
3 Dragons	0,3	12,3	0,0	19,5	32,2
ASEAN	0,2	1,8	0,0	1,6	3,6
Australia-N. Zealand	0,0	0,3	0,0	2,2	2,6
India	0,0	0,4	0,0	0,0	0,5
Other Asia	0,0	2,0	0,0	0,8	2,8
Western Europe	0,1	2,0	0,0	8,0	10,1
Other Europe & Ex-USSR	0,0	0,4	0,0	3,3	3,7
Mediterranean	0,0	0,7	0,0	0,9	1,6
Africa & Gulf	0,0	1,7	0,0	2,0	3,8
North America	0,1	1,0	0,0	10,0	11,1
Mercosur	0,0	0,1	0,0	0,4	0,6
Other South America	0,0	0,8	0,0	1,9	2,7
NES	0,0	0,0	0,0	0,0	0,0
World	0,9	25,3	0,1	73,7	100,0
Imports					
	Primary Goods	Semi Fin. Goods	Parts & Compon.	Consump. Goods	All Stages
Japan	0,0	18,7	0,1	2,2	21,0
3 Dragons	0,1	49,1	0,1	4,8	54,0
ASEAN	0,0	2,8	0,0	0,1	2,9
Australia-N. Zealand	3,0	0,8	0,0	0,1	3,9
India	0,0	1,1	0,0	0,0	1,1
Other Asia	0,1	2,9	0,0	0,2	3,2
Western Europe	0,2	2,4	0,1	0,2	2,9
Other Europe & Ex-USSR	0,1	0,1	0,0	0,0	0,2
Mediterranean	0,0	0,0	0,0	0,0	0,1
Africa & Gulf	0,1	0,1	0,0	0,0	0,2
North America	0,2	2,0	0,1	0,1	2,3
Mercosur	0,1	0,4	0,0	0,0	0,5
Other South America	0,0	0,1	0,0	0,0	0,1
NES	0,0	7,2	0,0	0,2	7,4
World	4,0	87,6	0,4	8,0	100,0

Source: Comtrade data base, United Nations, authors' calculations.

6.7. Breakdown of China's Trade in High Technology Products

Table 20 – Geographical Breakdown of China's Imports in High Technology Products
Parts of Components (41), Capital goods (42), Transport equipment (521)
(High-tech Products in BEC 41, 42 and 521=100 and Partner Region=100)

	BEC			BEC				BEC		
	41	42		41	42	521		41	42	521
Asia-Oceania	100	100	EU-15	100	100	100	NAFTA	100	100	100
Japan	52	41	Austria	0	1	0	USA	84	93	100
Hong-Kong	11	8	Belgium-Lux.	0	1	0	Canada	16	6	0
S. Korea	11	8	Denmark	1	0	0	Mexico	0	2	0
Taiwan	17	22	Finland	15	8	0				
Indochina	0	0	France	9	24	96				
Indonesia	0	1	Germany	22	26	4				
Malaysia	2	4	Greece	0	0	0				
Philippines	1	2	Ireland	0	1	0				
Singapore	3	9	Italy	5	5	0				
Thailand	0	5	Netherlands	1	2	0				
Australia	1	0	Portugal	0	0	0				
N.Zealand	0	0	Spain	1	1	0				
India	0	0	Sweden	30	19	0				
Other Asia	0	0	United Kingdom	16	10	0				

Source: Comtrade data base, United Nations, authors' calculations.

Table 21 – Breakdown of China's High Technology Trade by SH Categories
Capital Goods Except Transport Equipment (BEC 41)
(High-tech products in BEC 41=100 and Asia-Oceania=100)

	Imports					Exports			
	SH-84	SH-85	SH-90	Total		SH-84	SH-85	SH-90	Total
Japan	11	24	17	52	Japan	0	10	8	19
Hong-Kong	0	6	4	11	Hong-Kong	0	48	9	57
S. Korea	0	9	2	11	S. Korea	0	4	1	5
Taiwan	6	7	5	17	Taiwan	0	2	0	2
Indochina		0	0	0	Indochina	0	0	0	0
Indonesia	0	0	0	0	Indonesia	0	3	0	3
Malaysia	0	2	0	2	Malaysia	0	2	0	2
Philippines		1	0	1	Philippines	0	0	0	0
Singapore	0	2	1	3	Singapore	0	5	1	6
Thailand	0	0	0	0	Thailand	0	1	0	1
Australia	0	0	0	1	Australia	0	1	0	1
N.Zealand		0	0	0	N. Zealand		0	0	0
India		0	0	0	India	0	0	0	0
Other Asia	0		0	0	Other Asia	0	2	0	2
Asia-Oceania	18	52	30	100	Asia-Oceania	0	78	21	100

Source: Comtrade data base, United Nations, authors' calculations.

**Table 22 – Breakdown of China’s High Technology Trade by SH Categories
Parts and Components of Capital Goods, Except Transport Equipment (BEC 42)
(High-tech products in BEC 42=100 and Asia-Oceania=100)**

	Imports					Exports			
	SH-84	SH-85	SH-90	Total		SH-84	SH-85	SH-90	Total
Japan	9	31	1	41	Japan	7	7	1	14
Hong-Kong	1	7	0	8	Hong-Kong	17	27	0	45
S. Korea	2	7	0	8	S. Korea	1	5	0	7
Taiwan	5	17	0	22	Taiwan	4	5	0	9
Indochina	0	0		0	Indochina	0	0	0	0
Indonesia	1	0	0	1	Indonesia	1	0	0	1
Malaysia	1	3	0	4	Malaysia	1	1	0	2
Philippines	1	1	0	2	Philippines	0	1	0	2
Singapore	6	3	0	9	Singapore	10	5	0	15
Thailand	4	1	0	5	Thailand	3	1	0	5
Australia	0	0	0	0	Australia	0	0	0	0
N.Zealand	0	0	0	0	N. Zealand	0	0	0	0
India	0	0	0	0	India	0	0	0	0
Other Asia	0	0		0	Other Asia	0	0	0	0
Asia-Oceania	29	70	1	100	Asia-Oceania	45	54	1	100

Source: Comtrade data base, United Nations, authors' calculations.

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