
China's Role in Global Production Networks

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Introduction

Vertical specialization is one of the most notable trends in the international organization of production (Hummels, Jun and Yi, 2001; Yi, 2003; Desai, 2009). Thanks to reductions in communication, transportation and other trade costs, multinational firms are slicing up their value chains and are dispersing their production activities across multiple countries. This means that a single final good is often worked on in many countries, with each sequential node in the value chain performed in the location that is most advantageous for the process.

China has been a large beneficiary of this vertical specialization process, with multinational firms integrating the country into their global production networks by offshoring labor-intensive final assembly activities to the country (Branstetter and Lardy, 2006; Amiti and Freund, 2008). However, at least a few questions about China's role in these global production networks are left unanswered. First, in which type of industries is China integrated into global production networks? The answer to this question will be important to understand the driving forces behind the rapid technological upgrading trajectory of China's exports. Second, what factors have driven multinational firms to offshore assembly activities to China? Existing studies generally attribute this to the country's relatively low labor costs and its favorable export promotion policies. But, as we will discuss below, China's heavy reliance on imported inputs for its assembly activities suggests that its geographic location may also have played an important role. Finally, how important is Canada as a supplier to these global production networks?

To address these questions, this paper will exploit a unique data set collected by the General Administration of Customs of the People's Republic of China (in short, *China's Customs Statistics*) that disaggregates China's international trade by customs regime. The data set highlights the large and rising importance of China's processing trade regime throughout the reform period. In the mid-eighties, the Chinese government put this customs regime into place to entice foreign firms to offshore their production activities to China. Under this regime, firms located in China are granted duty exemptions on imported raw materials and other inputs *as long as they are used solely for export purposes*. Since its installment, processing exports has rapidly expanded to more than half of China's overall exports. By the very nature of the processing trade regime, processing trade transactions are conducted by firms that use China as an export-assembly platform of imported inputs. The processing trade data therefore provide a direct measure of imported input flows and exported output flows associated with global production networks in China for the years 1992-2007. This allows us to gain new insights into the structure of global production networks that set up processing activities in China, the role that China plays therein, and the link between Canada and China in these networks.

This paper consists of four Sections. Section 2 will conduct an anatomy of China's processing trade to analyze the type of production networks that use China as a processing location and the role that China plays therein. Furthermore, we will investigate the link between Canada and China within these production networks. In Section 3, we will use insights into China's role in global production networks to reassess China's growing role in world trade. We will demonstrate that it puts into question the empirical evidence that China is rapidly moving up the technological ladder. Furthermore, we will show that it has allowed China to pass on a significant portion of its negative exports demand shock that it faced during the recent economic crisis to its East Asian neighbors. Finally, Section 4 provides concluding remarks.

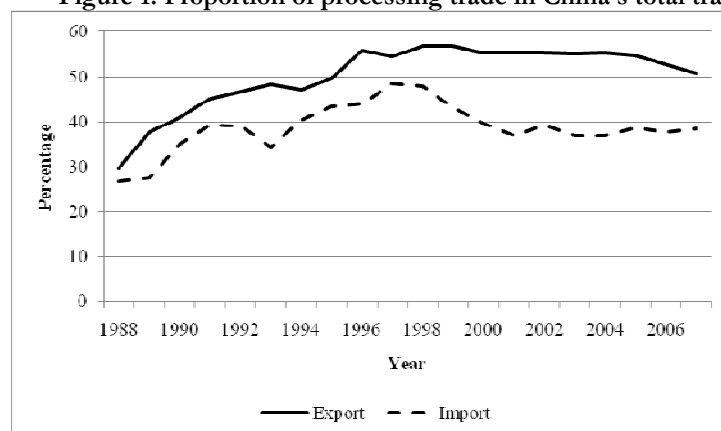
1. China's Role in Global Production Networks

1.1 China's Dualistic Foreign Trade Regime

China's rapid emergence as an export powerhouse has attracted large attention in both academic and policy circles. In the past 20 years, China's exports have grown at an annualized rate of 19 percent, more than twice the rate of growth of world exports. As a result, China's share of world exports has surpassed Japan and the United States to become the world's second largest exporter after Germany.

A key driver of China's export growth has been the success of its processing trade regime (Branstetter and Lardy, 2006; Amiti and Freund, 2008; Dean, Lovely and Mora, 2009; Ma, Van Assche and Hong, 2009). Under this regime, the Chinese government grants firms duty exemptions on imported raw materials and other inputs as long as they are used solely for export purposes. Many firms (including Canadian) have taken advantage of this regime to integrate China in their global production networks by offshoring labor-intensive final-assembly activities to the country. Data provided by China's Customs Statistics show the large and growing importance of the processing trade regime. As it is shown in Figure 1, the share of processing exports (i.e. exports conducted under the processing regime) in China's total exports has risen from 30% in 1988 to 51% in 2007, while the share of processing imports in total imports has increased from 27% to 38% over the same period.

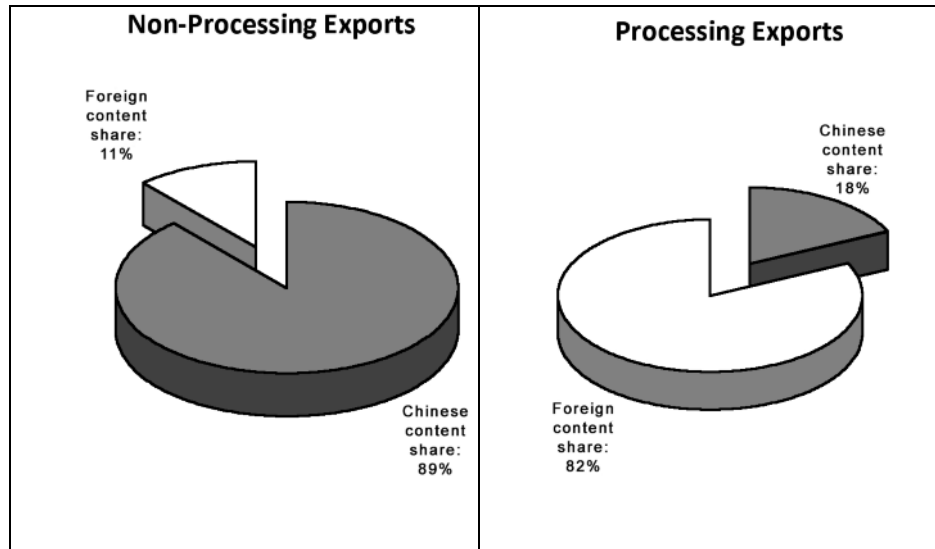
Figure 1: Proportion of processing trade in China's total trade, 1988-2007



Source: Authors' calculations using China's Customs Statistics.

Processing exports differ from non-processing exports in three important ways. First, processing exports rely more heavily on imported inputs than non-processing exports. In a recent paper, Koopman, Wang and Wei (2008) combined the China Customs Statistics trade data with an input-output table for China to estimate the domestic content share of China's processing and non-processing exports. As it is shown in Figure 2, they found that, in 2006, the domestic content share of processing exports was a low 18.1%, implying that the value of imported inputs accounted for 81.9% of the processing export value. Conversely, the domestic content share of non-processing exports stood at a much higher 88.7%, meaning that imported inputs only represented 11.3% of the export value.

Figure 2: Domestic and foreign content share of China's processing and non-processing exports



Source: Koopman, Wang and Wei (2008).

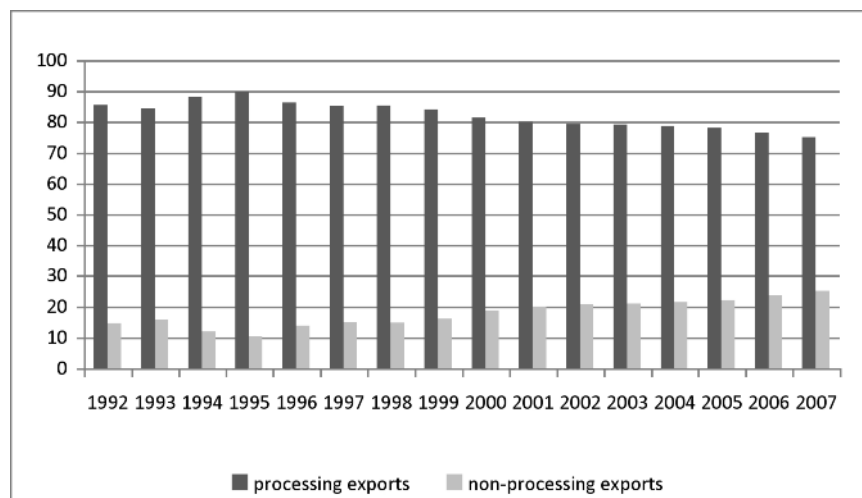
Second, processing exports are predominantly conducted by foreign invested enterprises (FIEs),¹ whereas non-processing exports are largely conducted by local firms. Between 1992 and 2007, the share of processing exports conducted by FIEs has varied from a high of 89.7% in 1995 to a low of 75.0% in 2007 (see Figure 3). Conversely, FIEs' share of non-processing exports has consistently remained below 25%.

Third, processing exports are concentrated in higher technology categories than non-processing exports. To demonstrate this, we have used the Organization of Economic Cooperation and Development's (OECD) technology classification (Hatzichronoglou, 1997) to disaggregate China's exports into four categories: high technology exports, medium-high technology exports, medium-low technology exports and low technology exports. In Figure 4, we depict the share of processing exports in China's total exports for

¹ Foreign-invested enterprises include wholly foreign-owned enterprises, sino-foreign contractual joint ventures with more than 25% foreign ownership, and sino-foreign equity joint ventures with more than 25% foreign ownership. Note that in China's Customs Statistics, companies from Hong Kong, Macau and Taiwan are considered foreign firms.

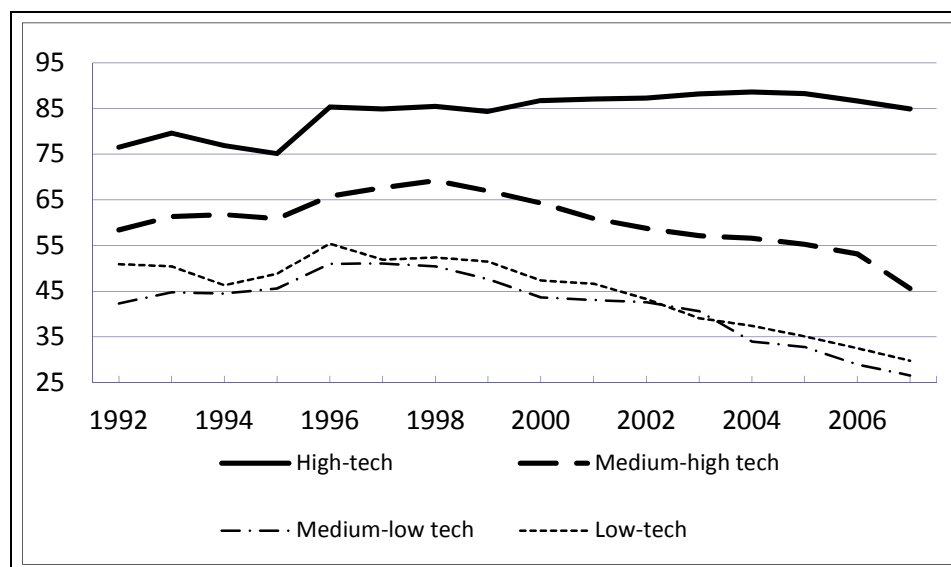
each technology category. Tellingly, processing exports are more important in higher technology categories than in lower technology categories. In 2007, processing exports accounted for 84.9% of high-technology exports; 45.6% of medium-high-technology exports; 26.6% of medium-low-technology exports; and 29.8% of low-technology exports.

Figure 3: Share of China's exports conducted by foreign-invested enterprises, 1992-2007



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

Figure 4: Share of processing exports in China's total exports, by technology level (%)



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

These distinctions between processing trade and non-processing trade suggest that China's foreign trade regime has effectively turned into a dualistic system. In higher technology industries, foreign firms have on a large scale used China's processing trade regime to integrate the country into their global production networks. In these industries, China heavily relies on imported inputs and is primarily responsible for the labor-intensive downstream activities such as assembly. Conversely, in lower technology industries, China is relatively uninvolved in global production networks, with its exports largely conducted outside the processing trade regime by domestic firms that source their inputs locally.

1.2 China as East Asia's Export Platform

The processing trade data from China's Customs Statistics provide a direct view of the structure of the global production networks in which China has been integrated.² For each processing location in China, the data set provides a unique mapping of the source countries where processing inputs are imported from and the destination countries of processed exports.³ This makes it possible to examine the role of both the location's proximity to foreign input suppliers and its vicinity to destination markets on China's attractiveness as a processing location. Such analysis cannot be conducted with regular trade data since imports are not necessarily used solely for export purposes.

An important data issue that needs to be addressed when analyzing the countries of origin of processing imports and the destination countries of processing exports is that transshipments account for about 90% of China's trade with its largest trading partner, Hong Kong (Feenstra, Hai, Woo and Yao, 1999; Feenstra, Hanson and Lin, 2004; Ferrantino and Wang, 2007). To account for these transshipments, we follow Ma, Van Assche and Hong (2009) and link the processing trade data from China's Customs Statistics to a data set from the Hong Kong Census and Statistical Office on Hong Kong re-exports. This allows us to estimate the country of origin of transshipped processing imports and the destination country of transshipped processing exports. A comparison of columns 3 and 4 in Tables 1 and 2 illustrates the impact of adjusting for transshipments through Hong Kong on China's processing trade with its major trading partners. While Hong Kong's role becomes insignificant, it almost doubles the share of processing imports originating from China's other major trading partners and increases by a quarter the share of processing exports destined to these same countries.

On the import side, column 3 of Table 1 shows that China heavily sourced its inputs from its neighboring East Asian countries, with 76.1% of its processing imports originating from within East Asia in 2007. By contrast the United States, EU-19⁴ and Canada contributed relatively little to the supply of processing inputs, together accounting for less than 17% of processing imports in 2007. This asymmetric sourcing pattern of processing inputs has become more pronounced over time. Between 1997 and 2007, the share of processing imports originating from China's most important East Asian trading

² Hanson, Mataloni and Slaughter (2005) used a different data set on intra-firm trade by U.S. multinational firms to analyze the structure of vertical production networks. Our data set has the added advantage that it not only measures intra-firm trade, but also accounts for transactions between firms within the same production network.

³ See Feenstra, Deng, Ma and Yao (2004) for a detailed description of the data.

⁴ The EU-19 include all European Union countries prior to the accession of the 10 candidate countries on 1 May 2004, plus the four eastern European member countries of the OECD, namely Czech Republic, Hungary, Poland, Slovak Republic.

partners has risen from 68.8% to 76.1%, while the share of processing imports originating from non-Asian OECD countries has decreased from 23.8% to 18.1%.

Table 1: Share of China's processing imports by country of origin, 2007 (%)

	Adjusted for Hong Kong transshipments			Unadjusted
	1997	2002	2007	
East Asia	68.8	73.3	76.1	86.6
Hong Kong	-	-	-	47.1
Japan	26.9	26.5	23.7	10.6
South Korea	15.02	14.1	15.7	10.8
Singapore	3.2	3.4	4.3	2.9
Taiwan	16.9	19.0	20.3	9.6
Malaysia	2.2	3.9	4.5	1.5
Thailand	2.0	2.8	2.8	1.3
Philippines	0.2	1.7	3.5	2.1
Vietnam	0.2	0.1	0.2	0.1
Indonesia	1.8	1.3	0.9	0.4
Macau	0.4	0.6	0.3	0.2
Non-Asian OECD	23.8	21.8	18.1	9.3
United States	10.4	9.1	7.7	3.9
EU-19	9.0	9.8	7.9	4.1
Canada	0.7	0.5	0.8	0.5
Australia	2.7	1.3	0.8	0.4
Other OECD	1.0	1.1	1.0	0.4
Rest of the World	7.3	4.9	5.8	4.1

Source: Authors' calculations, using China's Customs Statistics data.

On the export side, an opposite pattern has emerged. The majority of processed goods are destined outside of the East Asian region, and this portion has increased over time. As is shown in Table 2, the share of processing exports destined to non-Asian OECD countries has risen from 54.7% in 1997 to 61.8% in 2007. Conversely, the share of processing exports destined within the East Asian region has declined from 36.0% in 1997 to 29.2% in 2007.

A growing literature attributes this unbalanced processing trade pattern to the reorganization of production in East Asia (Yoshida and Ito, 2006; Gaulier, Lemoine and Ünal-Kesenci, 2007; Haddad, 2007). With rising costs in Japan and the Newly Industrialized Economies (NIEs) – Taiwan, Singapore, South Korea and Hong Kong – East Asian firms are increasingly using China as a lower cost export platform. Instead of directly exporting their final goods to the Western markets, these firms now export high

value intermediate goods to their processing plants in China and then export it on to the West after assembly. As a result, a triangular trade pattern has emerged in global production networks in which China heavily relies on processing inputs from East Asia, while predominantly sending processed goods to the West.

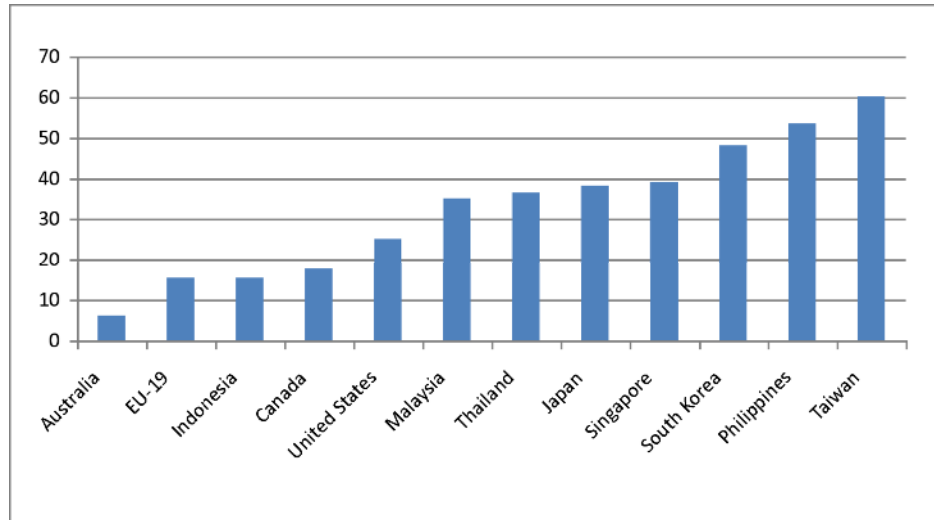
Table 2: Share of China's processing exports by destination country, 2007 (%)

	Adjusted for Hong Kong transshipments			Unadjusted
	1997	2002	2007	2007
East Asia	36.0	33.4	29.2	51.4
Hong Kong	-	-	-	32.8
Japan	18.6	15.9	11.4	7.9
South Korea	5.0	4.8	5.0	3.7
Singapore	3.6	3.6	3.7	2.3
Taiwan	2.4	2.3	2.6	1.5
Malaysia	1.7	2.1	2.0	1.4
Thailand	1.3	1.5	1.3	0.6
Philippines	1.3	1.3	1.1	0.4
Vietnam	0.5	0.5	0.6	0.3
Indonesia	0.9	0.7	0.7	0.4
Macau	0.7	0.6	0.7	0.2
Non-Asian OECD	54.7	59.9	61.8	42.0
United States	28.9	32.4	28.8	20.1
EU-19	20.1	22.1	27.2	18.1
Canada	1.8	1.8	1.8	1.1
Australia	1.7	1.6	1.7	1.1
Other OECD	2.1	2.0	2.4	1.6
Rest of the World	9.4	6.7	9.0	6.6

Source: Authors' calculations, using China's Customs Statistics data.

Data on the bilateral intensity of China's processing trade provide further evidence of this triangular trade structure in East Asian production networks. As it is shown in Figure 5, East Asian countries more intensively supply China with processing inputs than countries outside of East Asia. Except for Indonesia, more than 35% of China's imports from its major East Asian trading partners were processing imports in 2007 (see Figure 5). Almost 40% of its imports from Japan and between 40% and 65% of its imports from the Newly Industrialized Economies (South Korea, Taiwan and Singapore) were aimed at supplying inputs for processing industries. This is a significantly higher share than for Western countries. The share of processing imports in China's total imports from the EU-19, Canada and the United States amounted to 15.4%, 17.6% and 25.0%, respectively.

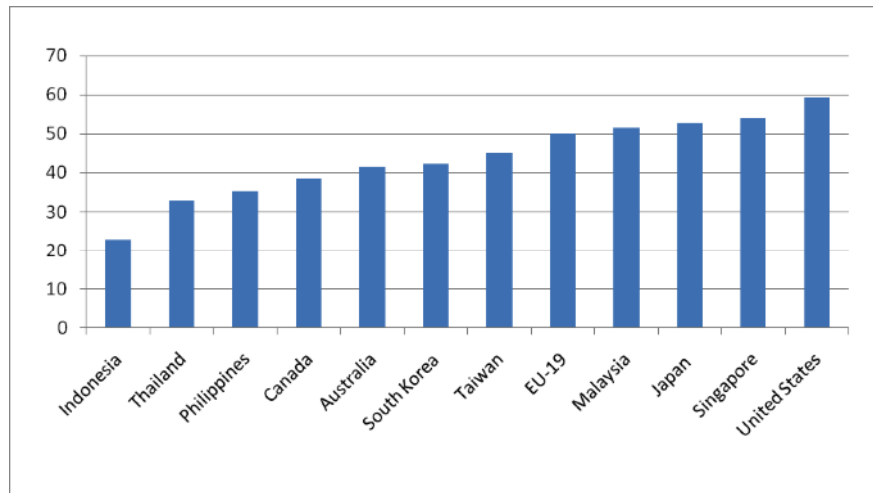
Figure 5: Processing imports as a share of China's total imports, by country of origin, 2007 (%)



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

At the same time, China more intensively supplies processed goods to developed countries than to its East Asian neighbors. As is show in Figure 6, more than 50% of the exports that China sends to the United States, the EU-19 and Japan are processing exports.⁵ For most developing East Asian countries the number is significantly lower.

Figure 6: Processing exports as a share of China's total exports, by destination country, 2007 (%)

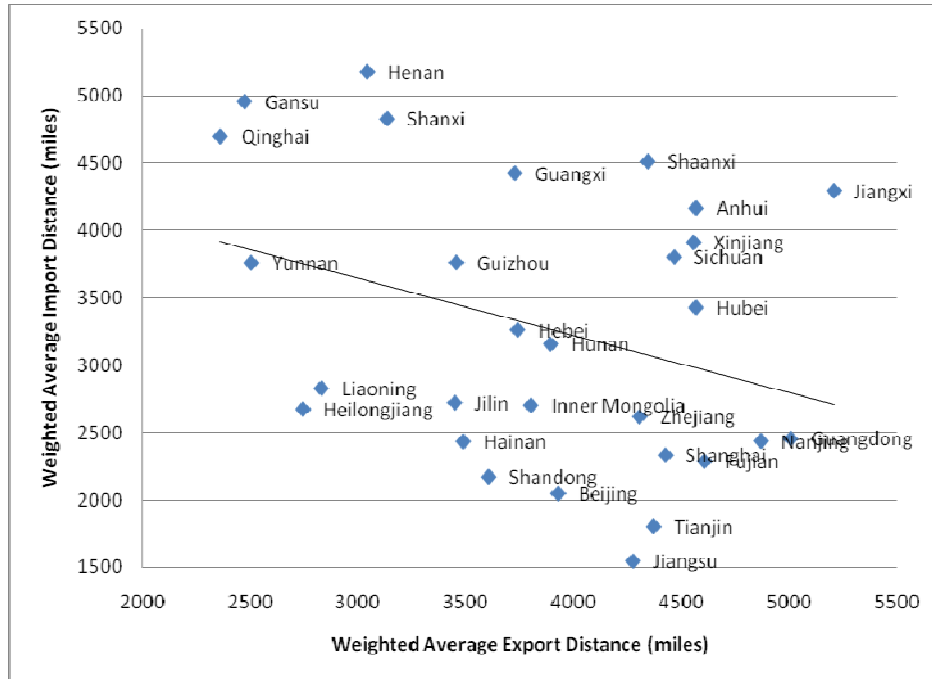


Source: authors' calculations, using China's Customs Statistics

⁵ Canada is an exception. Only 38% of China's exports to Canada are processing exports.

The triangular trade pattern suggests that China is primarily used as an export platform by East Asian firms that sell their goods to Western markets. In a recent paper, however, Ma, Van Assche and Hong (2009) show that China is also used by non-Asian firms that sell their products to East Asian markets. Their analysis was spurred by the observation that, in a cross-section of 29 Chinese provinces, the weighted average distance traveled by processing imports (import distance) has been negatively correlated to the weighted average distance travelled by processing exports (export distance) for all years from 1997 to 2007. In other words, locations in China that import their processing inputs from nearby tend to export their processed goods far away and vice versa (see Figure 7).

Figure 7: Weighted average distance traveled by China's processing exports versus weighted average distance traveled by its processing imports, by province, 2007

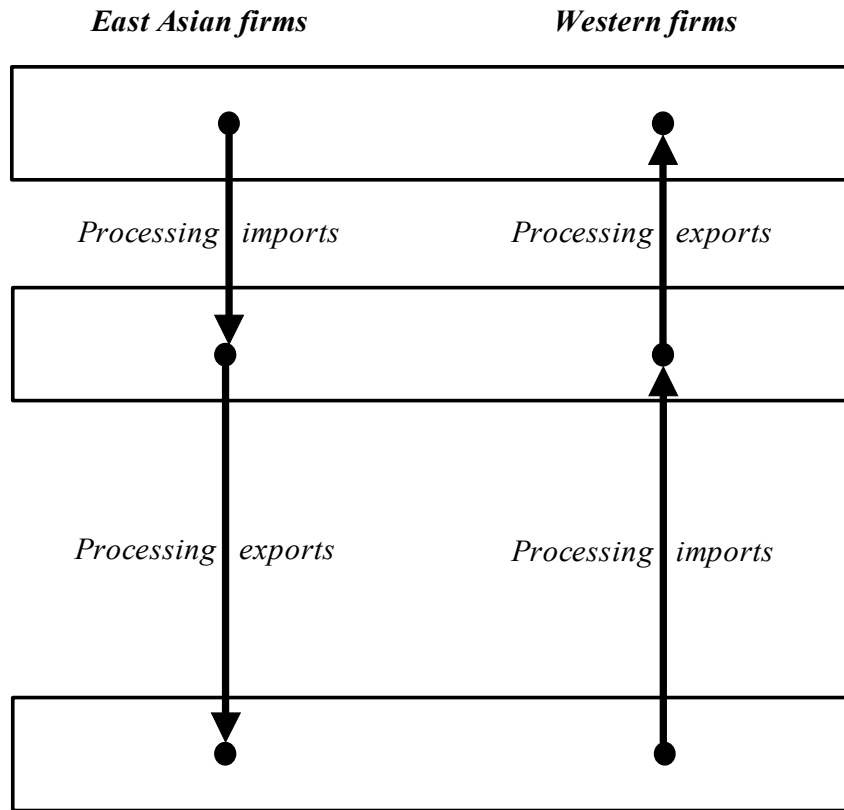


Source: authors' calculations, using China's Customs Statistics

To explain this spatial trend, Ma, Van Assche and Hong (2009) built on a literature of export platform FDI (Ekholm, Forslid and Markusen, 2003; Yeaple, 2003; and Grossman, Helpman and Szeidl, 2006) to develop a theoretical model consisting of three countries: *East* (for advanced East Asian countries), *West* (for Europe and North America), and *China*. In their model, multinational firms from the two advanced regions, *East* and *West*, sell differentiated goods in each other's markets. Each firm can use two modes to serve the other market. It can produce its goods at home and directly export it to the other market. Alternatively, it can indirectly export its goods to the other market by assembling it in the low cost country, *China*. As is shown in Figure 8, since *China* is located in the vicinity of *East*, the model provides an explanation for the negative correlation between

export and import distance for *China's* processing trade: the inputs that *China* imports from nearby *East* are processed into final goods and exported to the far-away *West*. Conversely, the inputs that *China* imports from the far-away *West* are processed into final goods and exported to the nearby *East*.

Figure 8: China as an export platform



Source: Ma, Van Assche and Hong (2009)

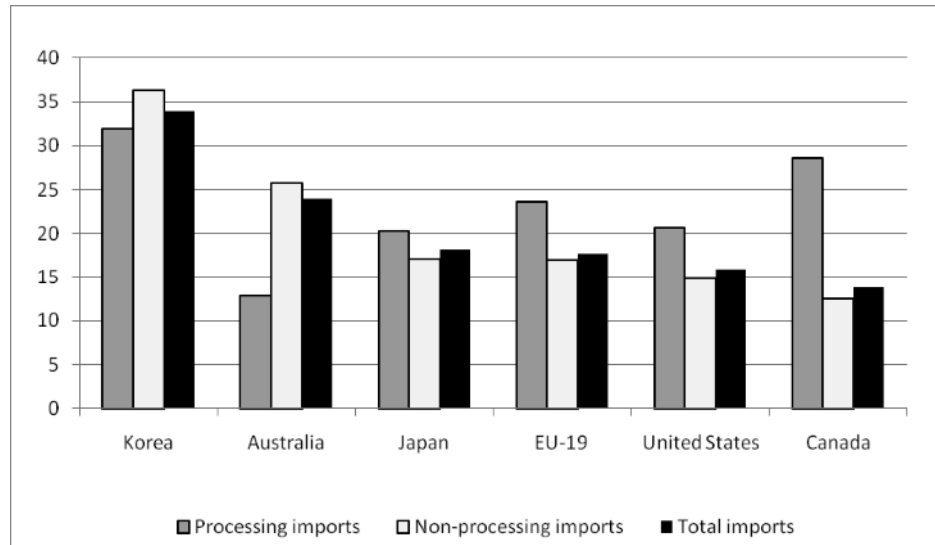
The theoretical model predicts that distance should affect the attractiveness of China as a processing location differently for *Eastern* and *Western* firms. For *Eastern* firms, the key distance factor that determines *China's* attractiveness as a processing location is its vicinity to foreign input suppliers, i.e. import distance. The larger is import distance, the less attractive *China* becomes as a location for processing activities and therefore the less processed goods *China* exports. Conversely, for *Western* firms, the critical distance determinant of *China's* attractiveness as a processing location is its proximity to the East Asian market, i.e. export distance. The larger is export distance, the less attractive *China* becomes as a location for processing activities. Using the China Customs Statistics data on processing trade, the study finds empirical support that processing exports to East Asian countries are more sensitive to export distance and less sensitive to import distance than its processing exports to non-Asian OECD countries.

The empirical evidence suggests that China's attractiveness as a labor-intensive offshoring location is not only due to low labor costs and aggressive export promotion policies, but is also driven by its geographic location. Production networks centered in East Asia consider China's proximity to input suppliers in the East Asian region to be a driving factor of their offshoring decisions. Conversely, production networks centered in the West deem China's vicinity to East Asian markets as a main determinant of their offshoring decisions.

1.3 The Canada-China Nexus in Global Production Networks

Despite its heavy reliance on processing inputs from within East Asia, the large and growing role of China's processing trade regime continues to provide important growth opportunities to Western businesses. As it is shown in Figure 9, over the period 1992-2007, China's processing imports from Canada have grown by a stellar 28.6%, which is more than double Canada's exports growth to China, and almost quadruple Canada's overall exports growth. Processing imports from the EU-19 and the United States have seen similar growth rates of 23.6% and 20.7% respectively.

Figure 9: Growth rates of China's processing imports, non-processing imports and total imports, by country of origin (%)



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

The extent of Western countries' involvement in China's processing trade regime remains nonetheless limited. In 2007, the share of Western countries' exports that were destined for China's processing trade regime varied from 0.15% to 0.62% (see Table 3). In comparison, 2.72% of Japanese exports and 5.34% of South Korean exports were processing inputs destined to China.

Table 3: Share of exports destined to China's processing trade regime (%)

	1992	2007
South Korea	0.41	5.34
Japan	0.35	2.72
United States	0.10	0.62
Australia	0.29	0.53
Canada	0.01	0.20
EU-19	0.04	0.15

Source: Authors' calculations, using China's Customs Statistics and WITS data.

Furthermore, the composition of processing inputs supplied to China varies significantly across Western countries. The processing inputs that Canada supplies to China are decidedly less sophisticated than that of other major Western nations. The import RCA indices presented in Table 4 demonstrate this. Between 1992 and 2007, Canada has acquired a strong specialization in the exports of low-technology and medium-low-technology products to China's processing trade regime. Conversely, Canada is less specialized in the supply of medium-high-technology inputs and especially high-technology components than the rest of the world, and this trend has worsened over time. An important driver of this trend has undoubtedly been the rise in commodity prices between 2003 and mid-2007. Owing to Canada's strong comparative advantage in natural resources, the price rise has led to an explosion in Canada's export value of 'metals' and 'paper and paper products' to China's processing trade regime. Whereas these two sectors in 1992 only accounted for 12% of the processing inputs that China imported from Canada, it has grown to more than 50% in 2007.

Nonetheless, the marginal and declining share that high-technology inputs take in China's processing imports from Canada is a reason for concern. In 2007, high technology inputs accounted for only 4.4% of China's processing imports from Canada. In comparison, high-technology inputs accounted for 48.5% of U.S. processing inputs sent to China, and 34.5% of EU-19 processing inputs sent to China (see Table 5).⁶

Table 4: China's processing imports from Canada, by technology level

	China's processing imports from Canada (US\$mill.)		Growth in processing imports from Canada (%)	Share of Canadian processing imports (%)		Import RCA index*	
	1992	2007		1992	2007	1992	2007
High technology	5.4	73.7	19.1	13.7	4.4	0.96	0.08
Aircraft	4.7	19.7	10.1	11.9	1.2	151.49	14.30
Pharmaceuticals	0.1	0.0	-9.5	0.3	0.0	2.61	0.02

⁶ The EU-19's involvement in China's processing trade regime is underestimated since a large portion of EU-19 high technology exports are intra-regional exports. If intra-regional exports are excluded, the EU-19's degree of involvement would be significantly higher.

	China's processing imports from Canada (US\$mill.)		Growth in processing imports from Canada (%)	Share of Canadian processing imports (%)		Import RCA index*	
	1992	2007	1992-2007	1992	2007	1992	2007
Office and computing machinery	0.1	6.5	33.9	0.2	0.4	0.12	0.09
Radio, TV and comm. Equipment	0.5	34.9	32.8	1.3	2.1	0.15	0.06
Medical, precision and optical ins.	0.0	12.5	74.3	0.0	0.7	0.00	0.06
Medium-high technology	2.3	86.6	27.4	5.9	5.1	0.48	0.35
Electrical machinery	0.8	25.3	26.5	1.9	1.5	0.38	0.22
Motor vehicles	0.0	14.1	74.9	0.0	0.8	0.02	3.31
Chemicals	0.2	11.1	30.0	0.6	0.7	0.22	0.26
Other transport equipment	0.1	1.0	18.7	0.2	0.1	0.45	0.84
Machinery and equipment	1.3	35.1	24.8	3.2	2.1	0.84	0.41
Medium-low technology	3.0	626.7	42.8	7.7	37.1	0.55	3.26
Shipbuilding and repairing	0.0	0.0	-	0.0	0.0	0.00	0.00
Rubber and plastic products	0.2	16.1	34.0	0.5	1.0	0.17	0.52
Petroleum products	0.0	0.1	25.0	0.0	0.0	0.03	0.07
Non-metallic mineral products	0.1	1.7	23.3	0.2	0.1	0.31	0.13
Metal products	2.7	608.8	43.4	7.0	36.0	0.70	4.15
Low technology	18.2	429.5	23.5	46.6	25.4	1.18	3.05
Manufacturing	0.1	1.1	19.8	0.2	0.1	0.07	0.07
Paper and paper products	2.0	312.0	40.2	5.0	18.5	0.95	13.01
Printing and publishing	0.0	1.0	24.5	0.1	0.1	0.68	1.06
Food, beverages and tobacco	0.4	87.5	42.5	1.1	5.2	0.56	6.35
Textiles, apparel and leather	15.7	28.0	4.0	40.2	1.7	1.37	0.32
Other	10.2	474.1	29.2	26.1	28.1	1.29	2.21
Total	39.0	1690.6	28.6	100.0	100.0	1.00	1.00

Source: Authors' calculations, using China's Customs Statistics data.

* The import RCA index is calculated as the ratio of two ratios, the ratio of processing imports from an economy for each subsection to total processing imports from that economy, relative to the ratio of world processing imports for each corresponding section to world total processing imports.

Table 5: Share of China's Processing Imports, by country and technology level, 2007 (%)

	Canada	Australia	United States	EU-19	Japan	South Korea	Total
High technology	4.4	3.2	48.5	34.5	53.8	40.3	52.9
Aircraft	1.2	0.0	0.7	1.6	0.0	0.0	0.1
Pharmaceuticals	0.0	0.0	0.2	1.0	0.0	0.3	0.1
Office and computing machinery	0.4	0.1	2.5	1.1	1.6	1.2	4.4
Radio, TV and comm.							
Equipment	2.1	2.9	41.4	27.0	30.7	29.2	36.3
Medical, precision and optical instr.	0.7	0.2	3.7	3.7	21.5	9.6	12.0
Medium-high technology	5.1	1.9	11.0	39.4	13.2	21.6	14.7
Electrical machinery	1.5	0.6	3.5	11.3	7.2	9.5	6.8
Motor vehicles	0.8	0.3	0.6	1.7	0.5	0.8	0.3
Chemicals	0.7	0.3	2.9	3.9	1.5	3.4	2.5
Other transport equipment	0.1	0.2	0.1	0.1	0.0	0.1	0.1
Machinery and equipment	2.1	0.5	3.9	22.4	4.0	7.9	5.1
Medium-low technology	37.1	33.2	10.9	5.2	12.5	20.1	11.4
Shipbuilding and repairing	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Rubber and plastic products	0.9	0.9	2.1	3.0	3.0	4.0	1.8
Petroleum products	0.0	0.2	0.7	0.3	0.0	0.0	0.1
Non-metallic mineral products	0.1	1.1	0.8	1.9	0.5	1.6	0.8
Metal products	36.0	31.1	7.2	0.0	9.1	14.4	8.7
Low technology	25.4	22.5	14.3	27.6	7.6	9.2	8.3
Manufacturing	0.1	0.0	0.4	1.1	0.4	0.9	0.9
Paper and paper products	18.5	5.7	6.5	5.7	0.5	0.9	1.4
Printing and publishing	0.1	0.0	0.1	0.0	0.0	0.1	0.1
Food, beverages and tobacco	5.2	8.0	1.9	5.6	0.7	0.6	0.8
Textiles, apparel and leather	1.7	8.8	5.3	25.5	5.9	6.7	5.2
Other	28.0	39.2	15.3	21.0	12.8	8.7	12.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculations, using China's Customs Statistics data.

Canada's marginal role in supplying high-technology inputs to China's processing trade regime is further demonstrated in the right-hand panel of Table 6. In 2007, only 0.09% of Canada's high technology exports were destined to China's processing trade regime. In contrast, the United States and EU-19 exported 1.08% and 0.21% of their high-technology products to China's processing trade regime, respectively. This lack of involvement is consistent across high-technology subcategories. In 'Radio, TV and Communications Equipment', for example, a sector in which Canada is considered highly competitive, Canada only exports 0.17% to China's processing trade regime, whereas the United States and the EU-19 export 3.52% and 0.65% respectively. More research is needed to determine the causes of Canadian firms' lack of involvement in the global production networks that use China as a processing location.

Table 6: Share of Western countries' high-technology exports destined to China and to China's processing trade regime, by category (%)

	Share of Canada's exports of category <i>i</i> that is destined for China (%)		Share of Canada's exports of category <i>i</i> destined for China's processing trade regime (%)	
	1992	2007	1992	2007
Aircraft	0.59	0.44	0.07	0.07
Pharmaceuticals	0.22	0.07	0.02	0.00
Office and computing machinery	0.06	0.90	0.00	0.08
Radio, TV and comm. Equipment	0.96	0.94	0.01	0.17
Medical, precision and optical instr.	0.42	1.53	0.00	0.12
High technology	0.54	0.71	0.02	0.09
	Share of US exports of category <i>i</i> that is destined for China (%)		Share of US exports of category <i>i</i> destined for China's processing trade regime (%)	
	1992	2007	1992	2007
Aircraft	2.55	2.46	0.02	0.05
Pharmaceuticals	0.32	0.63	0.02	0.03
Office and computing machinery	0.28	2.49	0.00	0.43
Radio, TV and comm. Equipment	0.36	4.73	0.02	3.52
Medical, precision and optical instr.	1.09	2.46	0.02	0.39
High technology	1.19	3.31	0.02	1.08

	Share of EU-19 exports of category <i>i</i> that is destined for China (%)		Share of EU-19 exports of category <i>i</i> destined for China's processing trade regime (%)	
	1992	2007	1992	2007
Aircraft	0.29	3.21	0.00	0.08
Pharmaceuticals	0.21	0.36	0.00	0.02
Office and computing machinery	0.05	0.56	0.00	0.05
Radio, TV and comm. Equipment	0.41	1.23	0.01	0.65
Medical, precision and optical instr.	0.41	1.44	0.01	0.12
High technology	0.28	1.14	0.01	0.21

Source: Authors' calculations, using China's Customs Statistics and WITS data.

In sum, we have in this section conducted an anatomy of China's processing trade to understand the structure of global production networks that operate processing activities in China. We have identified that a representative global production network that conducts processing activities in China operates in a high technology industries, relies heavily on imported inputs from within the East Asian region, and uses China as an export platform to sell its products in Western markets. But we have also seen that other types of global production networks exist that import components from far to assemble them in China and sell them in East Asian markets. Finally, we have seen that, compared to other Western countries, Canada plays a relatively minor role in supplying China with high-technology processing inputs. Only in the relatively less sophisticated natural resource-intensive industries 'metals' and 'paper and paper products' have they become major suppliers.

3. Implications for China's Role in World Trade

Our analysis of China's role in global production networks allows us to gain new insights into the nature of China's growing role in world trade. First and foremost, it shows that – especially in high technology industries – China's exports do not reflect production activities that have taken place in the country, but also encompasses production activities that have occurred in the countries from which inputs have been imported. As a result, variations in China's export performance may not be due to changes in China's economic environment, but also because of fluctuations in the economic environments of the countries from which China imports its inputs.

Recent studies have relied on this intuition to re-examine the causes and consequences of economic shocks to China's external trade. Amiti and Davis (2009) showed that the source of the rising Chinese export prices between 2006-2008 was not the increase in Chinese wages as had been widely reported, but was rather the surge in the prices of commodities that China heavily imported from abroad. The Congressional Budget Office (2008) argued that the effect of an appreciation of China's currency on China's exports to the United States would likely be muted since it would only affect the dollar price of the domestic content of Chinese exports. It would not affect the portion of the exports' value attributable to the cost of imported inputs unless the countries that supply those inputs allowed their currencies to rise in value as well.

In this Section, we will build further on these insights to reevaluate the technological upgrading trajectory of China's exports and to examine the effect of the recent economic crisis on China's international trade patterns.

3.1 China's Technological Upgrading Path

In Canada, a key public concern related to China's economic rise is that its exports mix is upgrading rapidly from low-end products such as clothing to high-end products such as electronics and telecommunications equipment. This has led to the fear that China is rapidly moving up the technology ladder and becoming competitive in technology-intensive areas where advanced economies such as Canada should have a comparative advantage.

If China's integration into global production networks is not taken into account, the evidence of this technological upgrading of China's exports seems compelling. In Table 7, we have disaggregated China's exports by technology category to analyze its export specialization patterns between 1992 and 2007. To measure a country's intensity of export specialization across technology categories, economists often use revealed comparative advantage (RCA) indices.⁷ An export RCA value that exceeds unity implies that a country has a greater-than-average share of exports in that technology category, thus suggesting that it has a revealed comparative advantage. Conversely, if the export RCA is smaller than unity, it implies that the country has a revealed comparative disadvantage. Between 1992 and 2007, China's export specialization has changed significantly. In 1992, China had a specialization pattern that was consistent with its status as a developing country. With low technology exports accounting for 53.3% of its exports, it only had a revealed comparative advantage ($RCA > 1$) in low technology exports. Between 1992 and 2007, however, China's exports growth has been particularly large in the higher technology categories. High technology exports grew 21.2% per year; medium-high technology exports grew 18.3% per year; medium-low technology exports grew 15.9% per year; and low technology by 8.3%. As a result, by 2007, China's export specialization pattern had upgraded dramatically, with the high technology and medium-high technology exports accounting for more than half of China's exports. As a result, China not only had a revealed comparative advantage in low technology exports, but had also garnered a revealed comparative advantage in medium-low technology exports and high technology exports.

Reflecting these trends in exports, a number of academic papers have estimated that China's export mix has been upgrading more rapidly than one would expect from a developing country. Rodrik (2006) and Hausmann, Hwang and Rodrik (2007), for example, found that the bundle of goods that China exports is similar in sophistication to exports of countries with income levels three times higher than that of China, thus leading Rodrik (2006) to conclude that "China has somehow managed to latch on to advanced, high productivity products that one would not normally expect a poor, labor abundant country like China to produce, let alone export." Using a similar logic, Schott (2006) has used Finger and Kreinin's (1979) export similarity index to demonstrate that China's exports are surprisingly similar to the export structure of OECD countries. This has led

⁷ The export RCA index is calculated as the ratio of two ratios, the ratio of exports for each subsection of exports in an economy to that economy's total exports, relative to the ratio of world exports for each corresponding section to world total exports. The index reveals the pattern of export specialization for an economy relative to worldwide patterns. The greater a sector's RCA, the more an economy specializes in that sector's exports relative to world specialization patterns.

Schott (2006) to conclude that “China's export bundle increasingly overlaps with that of more developed countries, rendering it more sophisticated than countries with similar endowments.”

Table 7: China's Exports, by technology level

	Export share (%)		Growth rate (%)	RCA index	
	1992	2007	1992-2007	1992	2007
High technology	10.4	31.3	21.2	0.6	1.6
Aircraft	0.5	0.2	5.8	0.2	0.1
Pharmaceuticals	1.2	0.7	9.6	0.8	0.2
Office and computing machinery	1.3	12.1	29.8	0.3	3.7
Radio, TV and comm., Equipment	4.7	14.9	21.6	0.8	1.8
Medical, precision and optical instr.	2.7	3.4	14.7	0.9	1.0
Medium-high technology	10.2	21.0	18.3	0.4	0.8
Electrical machinery	3.5	5.9	16.8	1.0	1.5
Motor vehicles	0.7	2.7	22.5	0.1	0.3
Chemicals	1.3	1.3	13.3	0.5	0.5
Other transport equipment	0.7	0.8	14.2	1.6	2.0
Machinery and equipment	3.9	10.3	20.1	0.4	1.1
Medium-low technology	10.2	15.1	15.9	0.8	1.1
Shipbuilding and repairing	0.6	1.0	17.2	1.6	3.1
Rubber and plastic products	2.0	2.5	14.7	0.9	1.1
Petroleum products	0.4	0.3	12.1	0.3	0.6
Non-metallic mineral products	1.9	1.7	12.1	1.4	1.5
Metal products	5.3	9.6	17.4	0.7	1.0
Low technology	53.3	26.5	8.3	2.5	1.7
Manufacturing	7.3	5.6	11.2	2.3	2.1
Paper and paper products	1.8	1.4	11.8	0.5	0.6
Printing and publishing	0.2	0.3	14.8	0.3	0.8
Food, beverages and tobacco	6.4	1.9	4.9	1.1	0.4
Textiles, apparel and leather	37.5	17.2	7.7	4.5	3.2
Other	16.0	6.1	6.5	0.7	0.2
Total	100.0	100.0	13.1	1.0	1.0

Source: Authors' calculations, using WITS data.

This perceived technological upgrading trajectory of China's exports, however, may largely be a statistical mirage. China's exports growth has been concentrated in the higher technology sectors, but these are precisely the sectors in which China's domestic content share is small. As we have seen in Figure 4, 85% of China's high technology exports are in

the processing trade regime, thus implying that they more heavily rely on imported inputs for their exports. Furthermore, Koopman, Wang and Wei (2008, 2009) estimate that the domestic content share of China's exports is especially low in the high-technology industries such as computers, electronic devices, and telecommunication equipment. As a result, China's high technology exports may not reflect the sophistication of the processing activities that take place in China, but rather the technology level of the imported inputs embodied in the processing exports.

We assess this possibility by examining the changing composition of China's non-processing exports.⁸ That is, we exclude any exports that have been classified as processing trade. As we have seen in Figure 2, non-processing exports more accurately reflect domestic production activities, with almost 90% of its export value produced in China. In Table 8, we have disaggregated China's non-processing exports according to their technological intensity. The data in the table suggest that China's specialization pattern is in line with its economic development. In both 1992 and 2007, China had a revealed comparative advantage ($RCA > 1$) in the two lowest technology categories and a revealed comparative disadvantage ($RCA < 1$) in the two highest technology categories. These numbers run counter to the suggestion that China's comparative advantage is rapidly shifting from low-technology to high-technology products.

Table 8: China's non-processing exports, by technology level

	Export share (%)		Growth rate (%)	RCA index	
	1992	2007	1992-2007	1997	2007
High technology	3.9	8.2	22.5	0.23	0.42
Aircraft	0.7	0.0	-2.8	0.30	0.02
Pharmaceuticals	1.8	1.3	14.6	1.28	0.42
Office and computing machinery	0.1	0.4	31.6	0.01	0.14
Radio, TV and comm. Equipment	0.6	5.0	33.8	0.11	0.60
Medical, precision and optical instr.	0.7	1.4	22.2	0.23	0.41
Medium-high technology	8.0	21.4	24.4	0.31	0.84
Electrical machinery	2.3	5.3	23.3	0.62	1.34
Motor vehicles	0.4	3.3	33.2	0.04	0.35
Chemicals	1.1	1.3	18.2	0.45	0.52
Other transport equipment	0.5	1.3	24.2	1.11	3.13
Machinery and equipment	3.7	10.2	24.6	0.39	1.10
Medium-low technology	12.0	23.1	21.9	0.91	1.69
Shipbuilding and repairing	0.1	0.2	20.5	0.37	0.65
Rubber and plastic products	0.6	1.9	25.3	0.28	0.85
Petroleum products	2.0	0.7	9.3	1.41	1.15
Non-metallic mineral products	3.1	3.1	16.9	2.22	2.75

⁸ Amiti and Freund (2008) estimated that between 1992 and 2005, there has been no change in the skill content of China's non-processing exports.

	Export share (%)		Growth rate (%)	RCA index	
	1992	2007	1992-2007	1997	2007
Metal products	6.1	17.2	24.8	0.78	1.84
Low technology	48.5	38.2	15.3	2.24	2.51
Manufacturing	2.8	5.7	22.3	0.88	2.08
Paper and paper products	2.7	2.2	15.7	0.78	0.94
Printing and publishing	0.2	0.2	17.1	0.27	0.63
Food, beverages and tobacco	9.7	3.1	8.9	1.62	0.68
Textiles, apparel and leather	33.2	27.0	15.5	3.98	5.06
Other	27.5	9.2	9.3	1.23	0.35
Total	100.0	100.0	84.0	1.00	1.00

Source: Authors' calculations, using China's Customs Statistics data.

This empirical finding has been confirmed by Van Assche and Gangnes (2010), who have relied on electronics production data compiled by Reed Electronics Research rather than international trade data to measure the degree of sophistication of China's production activities. The data set provides for 51 countries the value of domestic electronics production for 13 electronics subcategories between 1992 and 2005.⁹ While this data set has the limit that it focuses solely on electronics, it has the benefit that it circumvents the problem with trade data by capturing the type and magnitude of production activities that take place in a country. Van Assche and Gangnes (2010) find that when the same methodology as Rodrik (2006) and Hausmann, Hwang and Rodrik (2007) is used on the electronics production data set, there is no evidence that China has production activities similar to that of much richer countries.

In sum, once China's role in global production networks is taken into account, there is little evidence that China is rapidly moving up the technology ladder and becoming competitive in technology-intensive areas where advanced economies such as Canada should have a comparative advantage.¹⁰ Rather, China's production activities have remained consistent with its comparative advantage in labor-intensive production activities (Lin and Wang, 2008).

This of course does not mean that Canadian policymakers should ignore the rising sophistication of China's exports. Indeed, if the high-technology components that are embodied into China's exports are increasingly sourced from within the East Asian region instead of from Canada, or if the global production networks that are responsible for China's high technology exports are gaining a competitive edge against the global production networks that rely on Canadian high-technology components, this should be a concern to both Canadian policymakers and Canadian high-technology businesses. But to verify if this is the case, analysis should move beyond China's exports. A deeper understanding would be needed of the structure of the global production networks that

⁹ See Reed Electronics Research (2007) for a description of the data.

¹⁰ The results of the analysis do not imply that China's production activities are not upgrading. Rather, it suggests that China's production activities are upgrading in line with its economic development.

both Canada and China are integrated into, and how they have been changing over time. This provides a rich agenda for future research.

3.2 Business Cycle Pass-Through in Global Production Networks

An in-depth understanding of China's role in global production networks is also important to comprehend the impact of the recent economic crisis on China's international trade patterns.¹¹ When the crisis unraveled in the second half of 2008, some China observers worried that China's export-led growth model has rendered its economy excessively dependent on the business cycles of advanced economies. Two factoids about China's exports have spurred this apprehension. First, China's export dependence had risen rapidly over the reform period, with its export-to-GDP ratio rising from 15% in 1988 to 42% in 2007. This figure is much higher than for other large economies such as the United States, European Union and Japan which in 2007 had export-to-GDP ratios of 12%, 12% and 18% respectively.

Second, the composition of China's exports has rapidly shifted towards high ticket-item durables such as electronics (see section 2.1). These exports are more sensitive to foreign business cycles since, in times of recession, households and companies in advanced economies tend to hold off first and foremost their purchases of durable goods, and especially larger ticket-item goods including electronics products. This not only reflects the fact that tightening budget constraints in times of crisis render high ticket-item goods unaffordable for some, but also that consumers and firms in such uncertain times want to wait with their purchases of long-lasting goods until it is known with more certainty whether and when the economic climate will improve. A recent study by Engel and Wang (2008) indeed finds that U.S. durable goods imports are more sensitive to business cycles than nondurable goods imports. Furthermore, Aziz and Li (2008) demonstrate that China's increasing specialization in electronics exports has led to an overall rise in the income elasticity of China's exports.

In the first quarter of 2009, demand for China's exports indeed experienced a stunning contraction of 20.0% compared to the previous year, from US\$304 billion to US\$243 billion (see Table 9). As predicted, the drop in exports was primarily driven by a contraction of higher technology exports. In the first quarter of 2009, China's high technology exports were down 24.1% compared to the same quarter of the previous year, whereas medium-high technology exports, medium-low technology exports and low technology exports were down 22.0%, 21.5% and 8.9% respectively.

Despite the sharp decline in exports, China's economy escaped the crisis relatively unscathed. In the first and second quarter of 2009, China's GDP has expanded at an annualized rate of 6.1% and 7.9%, respectively. This resilience of China's economy is generally attributed to its government's massive economic stimulus package and its banking sector's aggressive credit expansion. An additional explanation, however, is that China's integration into global production networks has allowed it to rapidly pass on the negative export demand shock to its input suppliers through a reduction in demand for processing inputs. This business-cycle pass-through effect implies that the sharp export declines should not have a big effect on China's overall economic performance.

¹¹ See also Ma and Van Assche (2009a, 2009b).

Table 9: China's Exports in Crisis, by Technology Level

	Total Exports (US\$ billion)		Total export growth (%)	Processing export growth (%)	Non- processing export growth (%)
	08Q1	09Q1	08Q1/ 09Q1	08Q1/09Q1	08Q1/09Q1
High technology	94.6	71.8	-24.1	-26.9	-11.2
Aircraft	0.5	0.4	-20.0	8.6	-48.1
Pharmaceuticals	2.6	2.6	0.0	-3.3	3.6
Office and computing machinery	32.1	25.4	-20.9	-22.4	17.0
Radio, TV and comm. Equipment	48.1	35.7	-25.8	-27.7	-18.0
Medical, precision and optical ins.	11.4	7.6	-33.3	-40.9	-9.5
Medium-high technology	70.0	54.6	-17.4	-26.9	-17.4
Electrical machinery	19.4	15.3	-11.1	-29.4	-11.1
Motor vehicles	8.6	4.7	-36.2	-59.4	-36.2
Chemicals	4.7	4.0	-11.9	-18.4	-11.9
Other transport equipment	2.8	2.2	-24.1	-9.5	-24.1
Machinery and equipment	34.5	28.3	-15.1	-21.0	-15.1
Medium-low technology	44.9	35.2	-28.0	-5.1	-28.0
Shipbuilding and repairing	3.9	5.9	5.4	57.5	5.4
Rubber and plastic products	7.2	6.2	-1.9	-21.5	-1.9
Petroleum products	1.5	0.4	-77.3	-14.7	-77.3
Non-metallic mineral products	5.1	4.5	-8.7	-31.1	-8.7
Metal products	27.2	18.3	-32.6	-34.3	-32.6
Low technology	73.8	67.2	-6.4	-14.6	-6.4
Manufacturing	17.1	15.4	-3.6	-16.9	-3.6
Paper and paper products	4.1	3.2	-19.5	-29.0	-19.5
Printing and publishing	0.6	0.6	6.7	-1.3	6.7
Food, beverages and tobacco	4.4	5.0	-12.8	2.5	-12.8
Textiles, apparel and leather	46.4	43.0	-5.4	-13.5	-5.4
Other	20.5	14.4	-29.9	-42.3	-26.4
Total	303.8	243.2	-20.0	-23.7	-16.2

Source: Authors' calculations using China's Customs Statistics

There are a number of indications that such a business cycle pass-through effect indeed took place in the realm of the recent economic crisis. First, when the crisis hit, the drop in China's exports was especially pronounced for processing exports, with processing exports contracting 23.7% and non-processing exports declining 16.2% (see the right-

hand panel of Table 9). Except for some smaller industries, this tendency was uniform across sectors.

Table 10: China's Imports in Crisis, by Technology Level

	Total Imports (US\$ billion)		Total imports growth (%)	Processing Imports growth (%)	Non- processing imports growth (%)
	08Q1	09Q1	08Q1/ 09Q1	08Q1/09Q1	
High technology	77.2	54.9	-28.8	-36.6	-17.4
Aircraft	2.3	2.5	9.5	-17.8	10.9
Pharmaceuticals	1.4	1.7	23.0	24.0	23.4
Office and computing machinery	9.1	6.6	-28.0	-32.5	-25.1
Radio, TV and comm. Equipment	44.6	32.4	-27.5	-31.9	-18.7
Medical, precision and optical ins.	19.8	11.8	-40.4	-49.8	-24.5
Medium-high technology	48.7	37.5	-23.0	-27.9	-21.0
Electrical machinery	11.8	9.0	-23.4	-30.7	-14.9
Motor vehicles	7.2	5.1	-30.0	-35.0	-29.9
Chemicals	5.4	4.0	-26.8	-32.9	-22.8
Other transport equipment	0.4	0.5	18.7	-13.1	27.0
Machinery and equipment	23.8	18.9	-20.5	-22.0	-20.1
Medium-low technology	27.4	20.2	-26.1	-43.8	-15.7
Shipbuilding and repairing	0.3	0.3	19.8	377.6	7.7
Rubber and plastic products	3.4	2.3	-31.4	-31.5	-31.3
Petroleum products	0.9	1.0	13.3	395.9	-3.6
Non-metallic mineral products	1.3	0.8	-35.6	-44.5	-27.4
Metal products	21.5	15.8	-26.9	-48.7	-14.4
Low technology	16.8	12.7	-24.7	-28.7	-22.0
Manufacturing	1.3	1.1	-16.2	-27.7	0.0
Paper and paper products	4.7	3.4	-28.0	-44.0	-22.1
Printing and publishing	0.2	0.2	5.6	-13.3	18.2
Food, beverages and tobacco	5.4	3.7	-31.7	-29.5	-32.0
Textiles, apparel and leather	5.3	4.4	-17.7	-23.8	-2.6
Other	90.9	54.4	-40.1	-41.8	-39.9
Total	260.9	179.8	-31.1	-36.2	-28.5

Source: Authors' calculations using China's Customs Statistics

Second, despite relatively robust economic growth, China's imports dropped an even larger 31.1% in the first quarter of 2009 compared to a year later (see Table 10). Commodity price declines in the second half of 2008 played a role in the contraction of imports (Petri and Plummer, 2009) but, just like on the export side, the imports decline was more pronounced for processing imports than non-processing imports. Processing imports dropped by 36.2%, while non-processing imports dropped 28.5%.

The accentuated drop in processing imports is clearly demonstrated in the case of Canada. As it is shown in Table 11, in the first quarter of 2009, China's processing imports from Canada dropped 47.8% compared to a year earlier, while China's non-processing imports from Canada declined 10.9%. Furthermore, in 7 of the 21 industries, a contraction of processing imports from Canada actually went hand-in-hand with an expansion in non-processing imports from Canada.

Table 11: China's Processing Imports from Canada in Crisis, by Technology Level

	Non-processing Imports (US\$ million)			Processing Imports (US\$ million)		
	08Q1	09Q1	08Q1/ 09Q1	08Q1	09Q1	08Q1/ 09Q1
High technology	172	145	-15.7	158	105	-33.6
Aircraft	64	19	-70.3	5	3	-40.2
Pharmaceuticals	9	5	-44.4	0	0	-53.8
Office and computing machinery	11	16	45.5	1	1	-17.9
Radio, TV and comm, Equipment	39	50	28.2	147	97	-34.1
Medical, precision and optical instr.	45	54	20.0	6	5	-18.3
Medium-high technology	179	378	111.2	41	22	-47.1
Electrical machinery	26	31	19.2	15	8	-49.9
Motor vehicles	32	13	-59.4	3	1	-76.3
Chemicals	10	12	20.0	7	4	-33.4
Other transport equipment	4	1	-75.0	0	0	0.0
Machinery and equipment	111	324	191.9	16	9	-44.3
Medium-low technology	230	175	-23.9	130	35	-73.2
Shipbuilding and repairing	0	0	0.0	0	0	0.0
Rubber and plastic products	8	5	-37.5	4	3	-24.4
Petroleum products	7	6	-14.3	0	0	-63.4
Non-metallic mineral products	4	3	-25.0	1	0	-28.0
Metal products	212	162	-23.6	126	32	-74.9
Low technology	461	404	-12.4	139	66	-52.4
Manufacturing	6	2	-66.7	1	1	-26.1

	Non-processing Imports (US\$ million)		Non-processing Imports growth (%)	Processing Imports (US\$ million)		Processing Imports growth (%)
	08Q1	09Q1	08Q1/09Q1	08Q1	09Q1	08Q1/09Q1
Paper and paper products	405	345	-14.8	113	48	-57.3
Printing and publishing	1	1	0.0	0	0	-80.7
Food, beverages and tobacco	37	35	-5.4	12	10	-14.0
Textiles, apparel and leather	17	19	11.8	12	6	-46.8
Other	1,150	857	-25.5	141	90	-36.0
Total	2,200	1960	-10.9	610	320	-47.8

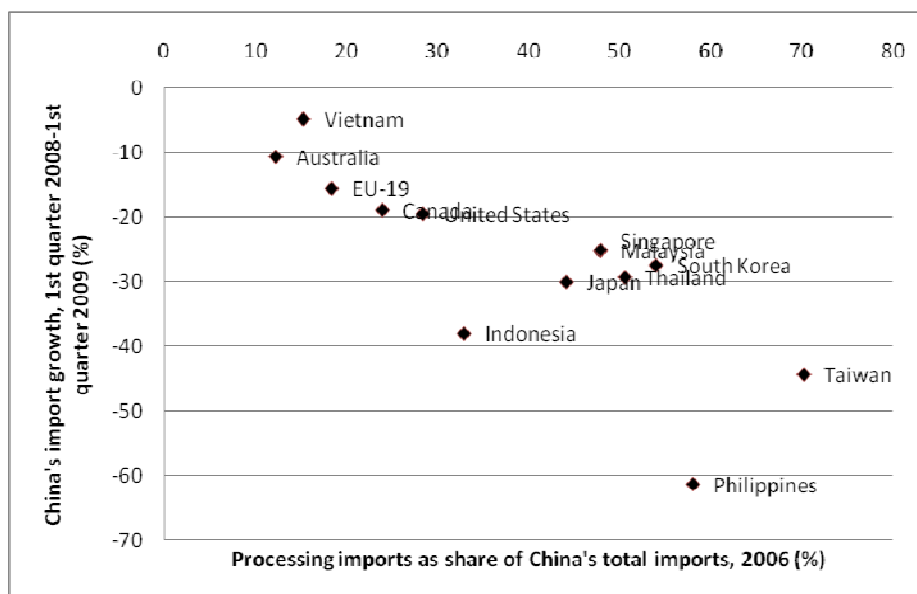
Third, the negative economic shock seems to have been amplified as it moved upstream from processing exports to processing imports. This is in line with the bullwhip effect that is often witnessed in global supply chains (Lee, Padmanabhan and Wang, 1997; Cachon, Randall and Schmidt, 2007). When a drop in final demand reduces downstream activities, a firm's first reaction is to run down its inventories. Thus a slowdown in downstream activities transforms itself into an amplified reduction in the demand for inputs that are located upstream. As it is shown in Table 8, in almost all industries, the decline in processing imports has been more pronounced than the drop in processing exports.

Fourth, the crisis has hit most severely China's imports from countries that more intensively supply China with its processing inputs, that is, its East Asian neighbors. As it is shown in Figure 9, with the exception of Vietnam and Indonesia, more than 40% of China's imports from its major East Asian trading partners were processing imports in 2006, which is a significantly higher share than for countries outside of East Asia. These East Asian countries have witnessed the largest import decline in the realm of the recent global economic crisis. Compared to the previous year, China's imports from its major East Asian trading partners have all declined between 25% and 61% in the first quarter of 2009. In contrast, China's imports from its major non-Asian trading partners have dropped less than 20%.

In sum, due to China's heavy integration into global production networks, its economy was less vulnerable to the recent economic crisis than it was generally feared. China effectively transferred a large portion of its negative export demand shocks to its input suppliers by reducing its demand for processing imports. This business-cycle pass-through effect implied that the large brunt of the burden of China's export decline fell upon its East Asian neighbors.

For policymakers, the empirical findings provide new evidence that business cycle shocks are rapidly transmitted internationally through global production networks (Burstein, Kurz and Tesar, 2008). This business cycle pass-through effect helps explain the large drop in world trade that was registered in the realm of the recent global economic crisis (Tanaka, 2009; Yi, 2009; Escaith, 2009).

Figure 10: Intensity of China's processing imports (2007) versus severity of China's imports contraction (08Q1-09Q1), by country of origin.



Source: Authors' calculations using China's Customs Statistics.

4. Concluding Remarks

Over the past few decades, many multinational firms have integrated China into their global production networks by moving labor-intensive processing plants to the country for export purposes. It is often neglected, however, that these processing plants heavily rely on imported inputs for their exports, while only a relatively small portion of the export value is produced in China. In the media and even in academic and policy circles, this has led to important misinterpretations of China's role in the world economy.

The goal of this paper has been two-fold. First, we have conducted an anatomy of China's processing trade to get a deeper understanding of China's role in global production networks. Second, we have used these insights to revise downward the speed of China's technological upgrading trajectory, and to explain the relatively limited impact that the sharp drop in exports had on China's economic performance during the recent global economic crisis.

More generally, our paper has illustrated that the growing role of global production networks in international trade presents researchers and policymakers with a new set of challenges. The assumption that a country's exports are entirely produced domestically has been inaccurate for some time. But, to date, little research has been conducted to comprehend the sometimes significant biases that this assumption may create. With our analysis, we hope to have convinced the reader that more granular, empirical research is needed to analyze the structure of global production networks, the role that Canada plays in these global production networks, and the implications that it has on policy formulation.

In recent years, Canadian government agencies and government-related think tanks have taken a number of initiatives to improve our understanding of global production

networks. In 2006-2007, Industry Canada organized two international conferences to understand the impact of “global value chains” on industries and the economy, as well as to clarify the role of governments in facilitating competitiveness in a world where global production networks are prevalent. Furthermore, in 2007, the Conference Board of Canada and the Department of Foreign Affairs and International Trade (DFAIT) published special policy pieces on Canada’s role in global value chains (Goldfarb and Beckman, 2007; Sabuhoro and Sydor, 2007). In the future, more research is needed in this direction.

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