CHINA'S EXPORT BOOM AND THE EFFECTS OF TRADE LIBERALISATION ON FIRM BEHAVIOUR: EVIDENCE FROM MICRO DATA

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Dedicated to my parents

for their great sacrifice and boundless love.

Abstract

This thesis contains three self-contained studies on firm bahaviour during a period of trade liberalisation and export boom in China.

In Chapter 1, we describe the general institutional background of the Chinese export boom from 2000 to 2007, look into the structure of this growth by examining the sources of the changes in export value, and give the outline of each core chapter.

In Chapter 2, we use a new linked firm-product data to measure the domestic value-added and technology intensity of Chinese exports over the period 2000-2007. We re-evaluate the extent of value-added in China's exports, using a modification of a method proposed by Hummels *et al*. (2001) which takes into account the prevalence of processing firms. In addition, we provide new estimates of the skill- and technology-intensity of China's exports. Our estimates of value-added suggest that, in 2006, the domestic content of China's exports was below 50%, much lower than previously estimated. We also show that Chinese exports have become increasingly skill- and technology-intensive, but this intensity is lower when the exports are evaluated by domestic value-added than by final value.

Chapter 3 looks into the effect of the elimination of the Multifibre Arrangement (MFA) quotas in 2005 on prices of products exported by Chinese firms to the U.S.. Using transaction-level customs data from China over the period 2000-2006, we find that the MFA quota removal reduced average export prices by about 30%,

which is compatible with other findings in the literature. A distinguishing feature of this study is that our data allows us to examine the sources of the price reductions. Evidence also shows that more than half of the price drop was due to firm entry and that the MFA had a smaller effect on the pricing behaviour of state-owned firms.

As an extension of Chapter 3, Chapter 4 presents evidence on how multi-product firms adjusted their product structure as triggered by the MFA quota elimination. We find that the removal of MFA quotas induced firms to abruptly expand their product scope by as much as one third, and meanwhile caused firms to reduce the share of their core product in export sales by nearly 10 percentage points as a result of a more diversified export product mix. While these effects are obvious for private and foreign-owned firms, they are very insignificant for state-owned firms, probably due to the fact that the latter were not constrained as much by the quotas because of their closer political connections to the quota allocation authorities. Our evidence also suggests that an increased weight was placed on the U.S. market relative to the Japanese market within exporting firms after the quotas were lifted, highlighting the trade barriers created by U.S. quotas.

Chapter 5 summarises the main findings of the thesis and discusses our future research directions.

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Contents

CHAPTER 1

Introduction

> "*[W]hile China acts as a manufacturing base for firms worldwide, its sheer size and rapid growth also creates challenges for many countries[. . .]On the export side, China is a formidable competitor in many markets, overlapping in its export composition with other countries such as India, Malaysia, Mexico, Pakistan, the Philippines and Thailand. These countries often attribute declines in their own export demand to competition from China. And on the import side, too, China's impact is felt worldwide. Its demand for raw materials, especially to fuel the investment boom of recent years (including the 2008 Olympics), creates market pressure and higher prices for building materials[. . .]So the challenges created by China's rapid growth and expanding trade are both domestic and international in scope.*"
>
> — Feenstra and Wei (2010, pp. 1-2)

The recent wave of globalisation has been dominated by the trade liberalisation of the People's Republic of China. A direct and observable result is the reshuffling of powers in the global trade community, largely due to the rise of China in the world economy. However, the growing importance of China has influences far beyond just changing the ranking of countries in the trade league table. On the one hand, China's rising role is the consequence of its own reform and "open-door" policy in the past three decades; on the other hand, it is also the cause of wide-ranging changes in other countries' economies. Such reasoning is grounded on the fact that China has grown to be the world's biggest supplier of manufactures while at the same time also exerting a huge demand for merchandise goods second to the U.S. (World Trade Organisation, 2011), a phenomenon that has attracted attentions globally from both politics and academia. The multi-dimensional impacts brought out by the rise of China have been made quite clear in a recent book edited by the National Bureau of Economic Research (Feenstra and Wei, 2010), with contributions from some of the most influential trade economists, as quoted in the beginning.

This chapter lays out the foundation and sketches the outline for the whole thesis. It proceeds as follows. Section 1.1 describes the general institutional background of the period under this thesis study, Section 1.2 reviews and depicts the patterns of the recent Chinese export boom, in Section 1.3 we analyse the sources of the export growth using decomposition methods, and in Section 1.4 we introduce the motivations and summarise the key findings of each core chapter.

1.1 General Institutional Background

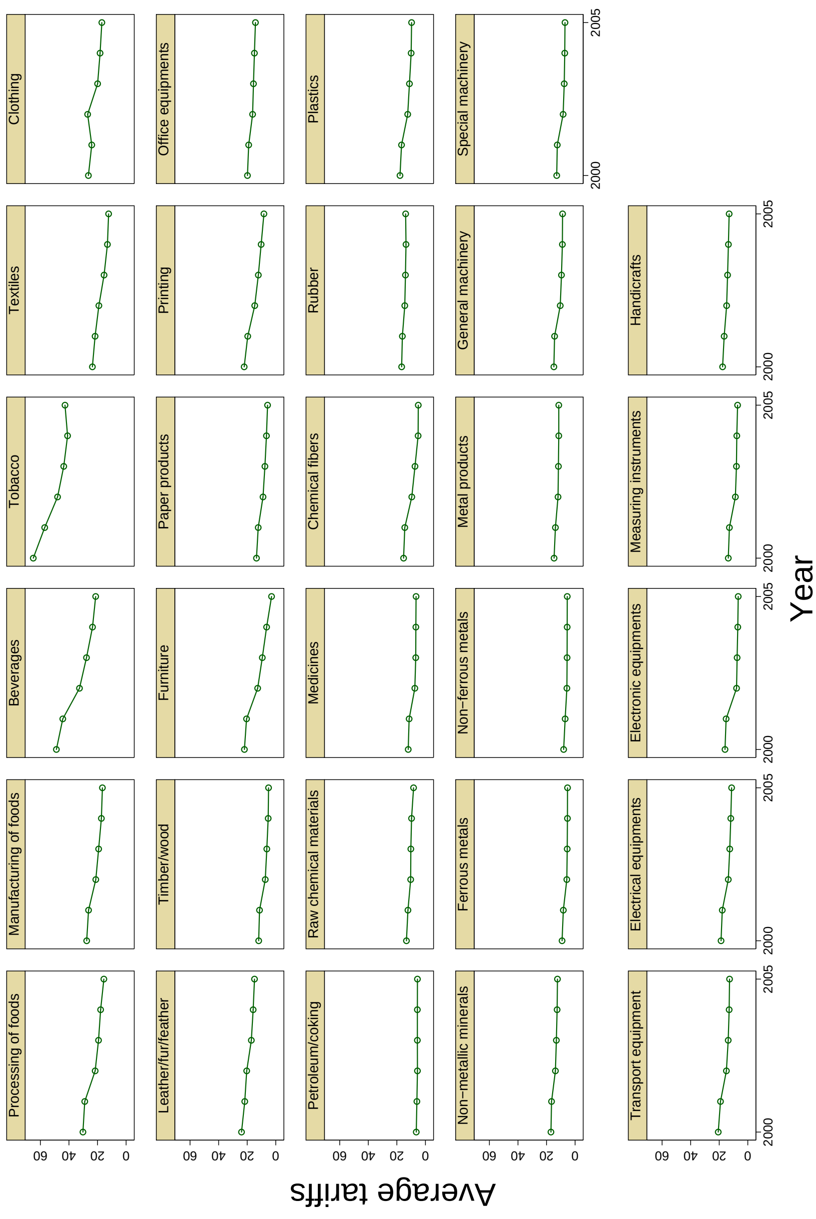
1.1.1 WTO accession

An important event that took place during this period is China's entry into the World Trade Organisation (WTO) at the end of 2001.[1] Roughly speaking, the WTO ac-

[1] The basic facts regarding China's WTO accession stated below are mainly from Rumbaugh and Blancher (2004).

cession has a two-folded effect on China. On the one hand, according to China's commitments to the WTO, trade barriers of various kinds would be removed gradually to create a fairer and freer environment for investment and trade. All import tariffs were eliminated or reduced mostly by 2004, and the import quotas of industrial goods were removed by 2005. As a result, the unweighted average tariff rate had decreased from 16.4% in 2000 to below 10% by 2007. Figure 1.1 shows that all broadly defined products (two-digit industries) had experienced reductions in tariffs after 2000, especially after 2001. Some labour-intensive goods, such as beverages, tobacco, textile, furniture and so on, had larger tariff cuts than others. At the same time, restrictions on trade rights and discriminations against foreign investment which were inconsistent with WTO rules were also eliminated. For example, within three years of the WTO entry, all firms would have the right to import and export directly except for some special goods (for example, energy and natural resources), and within five years, foreign firms would be allowed to distribute most of their products in China's domestic market.

On the other hand, having become a member country of the WTO, China also began to benefit from easier access to the overseas markets by enjoying the permanent status as a most-favoured-nation (MFN). By MFN treatment, Chinese exports would no longer meet discriminative tariffs and quotas relative to exports from other countries, although for some specific products (for example, textiles and apparels) safeguards provisions and surveillance strategies would continue to operate for certain periods. Altogether, these changes not only brought about a climate which was increasingly favourable for the influx of foreign capital and goods, but also encouraged indigenous firms to engage more in export activities targeted towards other countries.



Source: Customs Import and Export Tariff of the People's Republic of China (various years).

Fig 1.1. Average tariffs by two-digit industry

1.1.2 Changes in trade policies on textiles and apparel

For three decades after 1974, the dominant system regulating the global trade in textiles and apparel was the Multifibre arrangement (MFA). The MFA was in fact a series of bilateral agreements between major import and export countries of textiles and apparel and it worked via implementation of the agreed bilateral quotas. In 1995, however, the MFA was replaced by a new agreement named the Agreement on Textiles and Clothing (ATC) as a conclusion of the Uruguay Round negotiations. According to the major treaties of the ATC, all quota restrictions imposed by the WTO member countries on textile and clothing products were to be phased out through four stages (1 January of 1995, 1998, 2002, and 2005) and eventually the quotas would be completely eliminated on 1 January, 2005. At each stage of this period, quotas were progressively enlarged by agreed annual growth rates.

Although China was initially not a member of the WTO when the ATC came into effect, it was automatically integrated into the quota phaseout programme after it achieved its WTO membership in the end of 2001. For instance, in the fist half of 2002, the Unite States implemented the first three of the four stages of the ATC quota elimination programme for imports of textile and apparel from China (Harrigan and Barrows, 2009). Despite the gradual removal of quota restrictions, the ATC also established a new special safeguard mechanism to deal with new cases of damage or threat to domestic market arising from imports. As part of China's WTO accession negotiations, China also agreed to this special safeguard mechanism to be imposed on its exports of textiles and clothing.

As expected, textiles and apparel products from China surged in the U.S. market after the beginning of 2005 when quotas were abruptly eliminated overnight. In view of this, the United States was under extraordinary pressure from its domestic producers to restart negotiations with China and finally a bilateral memorandum was signed on 8 November, 2005. This memorandum reimposed quotas and annual growth rates on major categories of exports of textile and clothing products from China over the three-year period of 2006 to 2008 as a safeguard strategy in accordance with the ATC agreements.

At the same time, Chinese exports of textiles and clothing also swamped many of the European ports immediately after the quota restrictions by the MFA came to an end in January, 2005. The safeguard mechanism was launched by the European Union and negotiations were restarted which were finally concluded by a new E.U.-China bilateral agreement on 10 June, 2005, which reimposed quota restrictions on main product categories over the period from 2005 until the end of 2007. Because of the sudden imposition of the new import limits, a large inventory of textile and clothing products, most of which were ordered before the new restrictions came into effect, were piled up in E.U. ports, causing a potential shortage of related manufactured goods in the coming Christmas season in the European market. As a result, another E.U.-China agreement was signed on 5 September, 2005 to increase the import quantity limits on those products from China and consequently the inventory was finally released to the European market.[2]

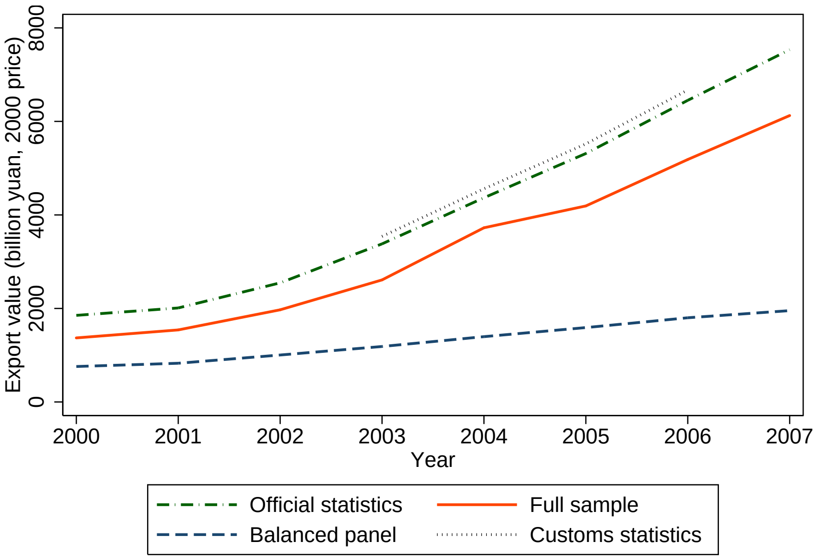
1.2 The Chinese Export Boom, 2000-2007: Overview

China's export boom in the 21st century is phenomenal. For exports of manufactures, the average annual growth rate between 2000 and 2007 is more than 30%, 10 percentage points higher than during the previous eight years (1993-2000). Meanwhile, China's share in world's trade in merchandise almost tripled, jumping from 4.7% in 2000 to 12% in 2007.

The export boom in this period is vividly shown in Figure 1.2. According to

[2]For more detailed account of Chinese exports of textiles and clothing in the U.S. and European market after the elimination of the MFA, please refer to Dayaratna-Banda and Whalley (2007).

China's official statistics,[3] China's total value of exports (measured in Chinese yuan (CNY) in 2000 price) almost quadrupled in the eight-year horizon. This extraordinarily high growth rate is also reflected in our full sample aggregate of individual export values.[4] It is worth noticing that the growth trajectory of our full sample export value resembles closely to that of the official data and constantly constitutes more than 70% of total exports (with the average being around 80%).



Source: China Statistical Yearbooks and authors' calculation.

Fig 1.2. Export values

While there is no doubt that the increase in Chinese exports is unusual, the value of exports itself tells us nothing about the mechanism of how it has come about. In the rest of this introduction, we provide some simple decompositions of how this export growth has been achieved, as well as considering the contribution of different industries, regions and firm types to the phenomenal growth in exports.

The first phenomenon is the uneven export growth across industries in terms of their share in total exports. The reshuffling of the export bundle towards relatively more sophisticated final products is reflected in Table 1.1, where the shares of ex-

[3] See *China Statistical Yearbooks* published annually by National Bureau of Statistics of China.

[4] The full sample refers to the population of firms existing in the firm data to be used in this chapter, while the balanced panel only contains those firms which exist in all years of the sample period. Section 2.2 of Chapter 2 gives a formal description of the data.

port value are calculated for each two-digit industry. In this table, we find that most of the reductions in export share took place in those sectors usually regarded as labour-intensive industries such as textile, clothing, and leather/fur/feather.[5] On the other hand, most of the increases in export share came from electronic, electrical, and transport equipments. An even more remarkable fact is that the overwhelming increase in electronics exports alone bypasses all other products and dominates the overall export growth with its share increased by 12 percentage points in total exports. Most of the industries that exhibit positive growth in export share are regarded as those requiring more capital and more advanced technology. Combined together, the evidence suggests that Chinese exports were experiencing a reallocation from those traditionally labour-intensive industries towards those new industries with high values in final products, which is highly consistent with the findings of the recent literature (e.g. Amiti and Freund, 2010).

Meanwhile, export activities along two other dimensions, ownership types and regions, are also distributed unevenly. Figure 1.3 plots the proportions of exporting firms by type of ownership and geographical location. First, foreign firms and Hong Kong/Macau/Taiwan (HMT) firms always had the highest ratios of exporters, far higher than those of non-state and state-owned domestic firms. Second, the coastal region had significantly higher proportions of exporting firms than inland region across all ownership types and in all years. A closer examination of the figure reveals that although the gaps in the fraction of exporters between regions were reduced over time in each of the four ownership categories, the largest inter-region gap is in HMT firms, followed by foreign, non-state domestic, and state-owned firms. This difference in regional gaps is not surprising if we consider the fact that in China foreign-invested firms are mainly located in the coastal provinces while the ratio of state-owned firms is higher in the inland areas. An explanation is that the trade cost is lower in the coastal region after economic openness and

[5] Despite the declining share, the absolute value of exports from these sectors grew enormously, as shown in Chapters 3 and 4.

Table 1.1. Reshuffling in the industrial structure of export value (%)

Industry	2000	2007	Change
Textiles	12.36	6.04	-6.32
Clothing	8.44	4.80	-3.64
Leather/fur/feather	5.71	3.17	-2.54
Office equipments	3.05	1.83	-1.22
Processing of foods	3.30	2.33	-0.97
Plastics	3.06	2.43	-0.63
Petroleum/coking	1.05	0.44	-0.61
Metal products	4.47	3.88	-0.59
Medicines	1.43	0.93	-0.50
Raw chemical material	3.95	3.63	-0.32
Manufacturing of foods	0.87	0.76	-0.11
Measuring instruments	2.72	2.63	-0.09
Beverages	0.37	0.29	-0.08
Non-ferrous metals	1.76	1.72	-0.04
Paper products	0.87	0.80	-0.07
Rubber	1.35	1.28	-0.07
General machinery	3.52	3.47	-0.05
Non-metallic minerals	2.21	2.13	-0.08
Printing	0.23	0.32	0.09
Chemical fibers	0.27	0.36	0.09
Timber/wood	0.64	0.88	0.24
Furniture	1.08	1.43	0.35
Special machinery	1.23	1.74	0.51
Ferrous metals	2.74	3.96	1.22
Transport equipments	3.90	5.15	1.25
Electrical equipments	6.38	8.19	1.81
Electronic equipments	23.06	35.42	12.36

Notes. The industries are arranged in ascending order of percentage change in export value share.

China historically had most of its state investments in the inland region for national security considerations.

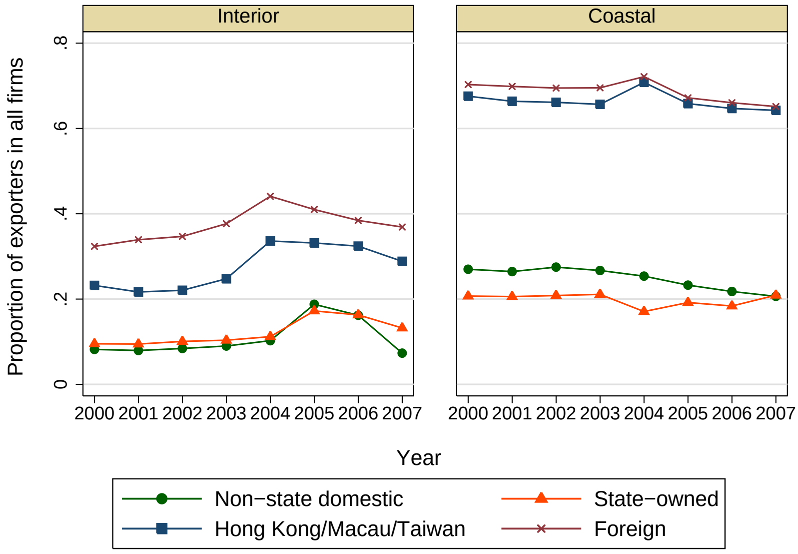


Fig 1.3. Proportions of exporting firms across ownership types and regions

The inequality of export participation across ownership types and regions is even clearer in Figure 1.4, where the vertical axis is now replaced by export values (deflated). Comparing the two panels in the figure reveals a sharp contrast. Over the eight years' period, there was little growth in export value in the interior provinces, but the export value from the coastal region surged after 2001 across firms of all ownership types except state-owned ones. Within the coastal region, the growth from foreign firms was even more explosive than that of other firms – the export value contributed by these firms increased sharply by more than seven times with the average annual growth being higher than 35%. The export expansion of these coastal firms further enlarged the gap between regions that had existed before and strengthened the role of the coastal area as the major exporter within China, which in 2007 accounted for as much as 93% of China's manufacturing exports.

There are mainly two reasons for the inferior export performance of state-owned firms across regions. The first is the government-directed reform which

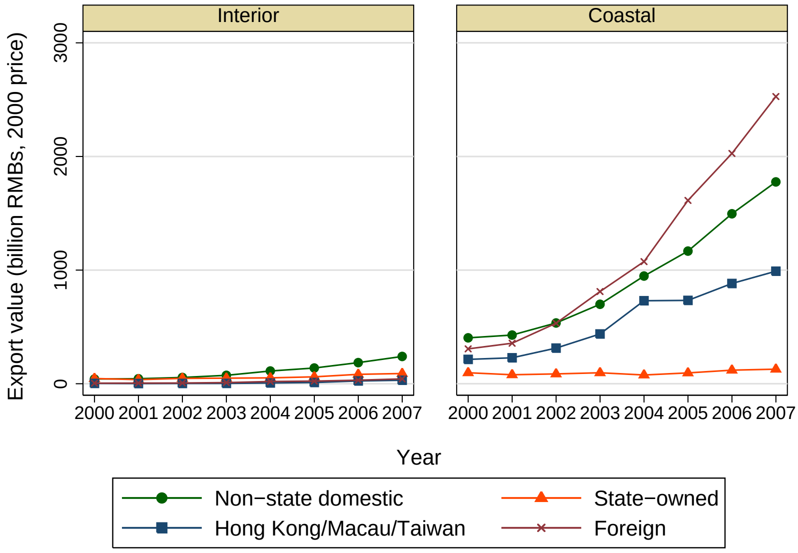


Fig 1.4. Export values across ownership types and regions

closed or restructured a large number of state-owned firms in order to enhance their overall efficiency and to give more market access to other participants. Second, the relatively low efficiency of the state-owned firms, as a legacy of the planned economy, significantly accelerated their process of dying out in an increasingly more competitive market. At the same time, the industrial policies introduced and implemented by the central government encouraged more foreign investment and domestic non-state firms to enter the market, making the invisible hand more effective by driving out less efficient firms. These factors collectively contribute to the result that the (export) market share of state-owned firms shrank rapidly.

Since this was also a period when the manufacturing output increased substantially, the export intensities (defined as the ratio of export value to output) across different groups were fairly constant over time despite the export value boom. This is illustrated in Figure 1.5. However, the gaps between regions and ownership types were still substantial. The coastal region had much higher fractions of output exported than the inland region and so did the foreign and HMT firms compared to the indigenous firms. Again, among all ownership types, the difference in the export intensity of foreign firms across regions is most prominent, followed by HMT firms, non-state domestic firms, and state-owned firms. These differences played an important role in shaping inter-regional gaps in exports.[6]

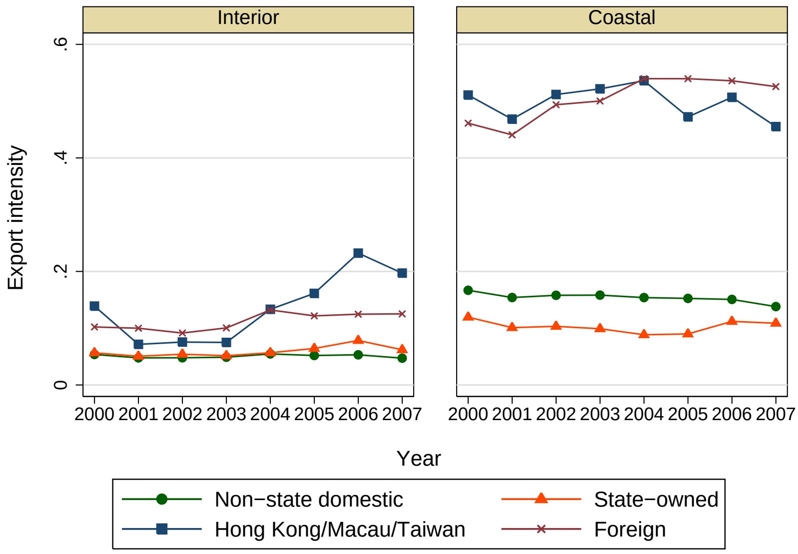


Fig 1.5. Export intensities across ownership types and regions

1.3 Decompositions of Export Growth

The driving forces behind the Chinese export boom described above are probably different from developed countries such as the U.S. as we suspect that new firms' entry could have played a much more important role here due to the significantly lowered exporting barriers. A starting point of looking at the sources of the export boom is by investigating the dynamics of firm turnover in the export market. Firm dynamics, including firm entry, firm exit, firm growth, and change in export intensity, can all contribute to the aggregate growth of exports. Some theoretical

[6]The superior export performance either in terms of participation rate or in terms of export intensity by foreign firms have been documented in some empirical studies, including Bernard and Jensen (2004b) on the U.S. firms sample and Kneller *et al.* (2008) on the U.K. firms sample. Zhang and Song (2001) and Zhang and Felmingham (2001) find that foreign firms in China are also more intensively engaged in export activities, but their conclusions are from trade data sources either at the national level or at the provincial level.

work has modelled the role of entry cost in explaining export market dynamics (e.g. Melitz, 2003; Melitz and Ottaviano, 2008; Bernard *et al.*, 2007). In these models, all firms face fixed costs upon starting to export, for example, costs of building initial business networks, advertising, learning about the new market, and so on. Because these costs will be sunk once the firms have started exporting, only those firms with higher productivity (or lower production cost per unit output) are able to cover these costs as they earn higher revenue in the export market. Further, when trade costs are reduced, the productivity cutoff that divides exporting and non-exporting firms also decreases, thus inducing more firms to enter into the export market.

Evidence from a large number of empirical work has confirmed the role of sunk costs predicted in the theoretical models (e.g. Roberts and Tybout, 1997; Aw *et al.*, 2000, 2001; Bernard and Jensen, 2004a,b), and has also documented the positive effect of trade liberalisation on aggregate industry productivity via reallocation of resources from less efficient firms to more efficient firms (e.g. Pavcnik, 2002; Eslava *et al.*, 2004; Amiti and Konings, 2007). However, their main focus is on productivity and few of them have explicitly examined the sources of export growth. The only exception is Bernard and Jensen (2004b) which decompose the U.S. export boom from 1987-1992 to firm entry, firm expansion, and export intensity. One of their key findings is that firm entry plays a relatively smaller role than export intensity and this lends support to the importance of sunk entry costs in the export market.

Compared to the U.S. case in Bernard and Jensen (2004a), there are at least two reasons which make Chinese exports during the period 2000-2007 a different setting for analysing the sources of export boom. First, in our sample period, China underwent a much deeper liberalisation in trade environment than the U.S. from 1987 to 1992, where the main external drive was dollar depreciation (Bernard and Jensen, 2004a). From the standpoint of China, because of the WTO accession, there were large cuts in import tariffs and in restrictions on foreign investment, and there were substantial decreases in trade barriers to other countries as well. More fundamentally, upon entry into the WTO, all trade began to be supervised and regulated under uniform and transparent WTO rules, including those regarding the resettlement of conflicts. For the first time in its history of opening up since the early 1980s, China was formally and institutionally integrated into the world trade.

Second, as a developing country with abundant labour, one needs to be careful in interpreting its rapidly growing export volume. The main reason is that many developing countries are engaging increasingly more in labour-intensive segments of the global production chain by taking advantage of their relatively cheap labour. For those exports of sophisticated products, probably only a small part of the final value is truly from these countries' value-added. For China in this case, more than half of its exports is from processing exports which are produced with extremely intensive use of imported inputs. It is therefore important to bear this fact in mind as the final value of goods could partly reflect the value created by other countries than the exporting countries.

The above facts highlight the importance of considering the vertical specialisation when analysing the firm dynamics. For this purpose, we use three data sources for the analysis in this section: (1) the firm-level data of the Chinese Annual Survey of Industrial Firms (CASIF) from the National Bureau of Statistics of China (NBSC), (2) the transaction-level data from the database of the Chinese Customs Trade Statistics (CCTS) which is compiled and maintained by the General Administration of Customs of China, and (3) a linked firm-transaction-level data between the CASIF and the CCTS. See Section 2.2 of Chapter 2 for a more detailed description of these data sources. In the analysis below, we try to provide answers to the questions of (1) what are the sources of the export boom in general? (2) did the export growth come more from processing firms or non-processing firms?

1.3.1 Methodology

To investigate the sources of the export boom both qualitatively and quantitatively, we use a simple decomposition framework here. This framework allows us to assess statistically the contributions of different factors to the growth by distinguishing intensive margins and extensive margins at different levels. As will be clear below, the decomposition is essentially taking total differentials in a discrete time context.

We start by defining E_t as the aggregate export value, $\bar{E}_t^E$ as the mean export value of exporting firms, and N_t^E as the total number of exporting firms at time t, respectively. Since

$$E_t = \bar{E}_t^E N_t^E, \tag{1.3.1}$$

it follows that

$$\begin{aligned}
\Delta E_t &= E_t - E_{t-1} \\
&= \bar{E}_t^E N_t^E - \bar{E}_{t-1}^E N_{t-1}^E \\
&= \bar{E}_t^E N_t^E - \bar{E}_{t-1}^E N_t^E + \bar{E}_{t-1}^E N_t^E - \bar{E}_{t-1}^E N_{t-1}^E \\
&= N_t^E \Delta \bar{E}_t^E + \bar{E}_{t-1}^E \Delta N_t^E .
\end{aligned} \tag{1.3.2}$$

Alternatively, we have

$$\begin{aligned}
\Delta E_t &= E_t - E_{t-1} \\
&= \bar{E}_t^E N_t^E - \bar{E}_{t-1}^E N_{t-1}^E \\
&= \bar{E}_t^E N_t^E - \bar{E}_t^E N_{t-1}^E + \bar{E}_t^E N_{t-1}^E - \bar{E}_{t-1}^E N_{t-1}^E \\
&= \bar{E}_t^E \Delta N_t^E + N_{t-1}^E \Delta \bar{E}_t^E .
\end{aligned} \tag{1.3.3}$$

Summing up (1.3.2) and (1.3.3) and dividing both sides of the equation by two yields

$$\Delta E_t = \underbrace{\frac{N_{t-1}^E + N_t^E}{2}\Delta \bar{E}_t^E}_{\text{intensive margin}} + \underbrace{\frac{\bar{E}_{t-1}^E + \bar{E}_t^E}{2}\Delta N_t^E}_{\text{extensive margin}}. \tag{1.3.4}$$

The first term of the right hand side of (1.3.4) is defined as the intensive margin of export growth, which measures the share of export growth arising from the growth in exports per exporting firm. The second term is defined as the extensive margin of export growth, which is the share of export growth due to the increase in the number of exporting firms.

Further, because firms can be decomposed into several groups (denoted by subscript j), for example, coastal group and inland group, the growth in E_t can be written as

$$\begin{aligned}
\Delta E_t &= \sum_j \Delta E_{jt} \\
&= \sum_j \Delta(\bar{E}_{jt}^E N_{jt}^E) \\
&= \sum_j \left(\frac{N_{jt-1}^E + N_{jt}^E}{2}\Delta \bar{E}_{jt}^E + \frac{\bar{E}_{jt-1}^E + \bar{E}_{jt}^E}{2}\Delta N_{jt}^E \right).
\end{aligned} \tag{1.3.5}$$

Therefore, the contribution of group j at the intensive margin (changes in the average export value) is

$$\frac{(N_{jt-1}^E + N_{jt}^E)\Delta \bar{E}_{jt}^E}{2\Delta E_t}, \tag{1.3.6}$$

while the contribution at the extensive margin (changes in the number of exporting firms) accounts for

$$\frac{(\bar{E}^E_{jt-1}+\bar{E}^E_{jt})\Delta N^E_{jt}}{2\Delta E_t}. \tag{1.3.7}$$

Because we have product-level data, we can then further decompose $\bar{E}^E_t$ and N^E_t into sub-components separately. First, $\bar{E}^E_t$ can be expressed as the product of two components for the sample of exporting firms: the mean export value of each product variety and the number of product varieties per firm. That is,

$$\bar{E}^E_t = \frac{\bar{e}_t \times n_t}{N^E_t} \equiv \bar{e}_t \times v_t, \tag{1.3.8}$$

where $\bar{e}_t$ is the mean export value of each product variety, n_t is the number of product varieties, N_t is the number of exporting firms, and v_t is the number of product varieties per exporting firm, defined as n_t/N_t. Then the contributions of the two parts to the growth in $\bar{E}^E_t$ are

$$\frac{(v_{t-1}+v_t)\Delta\bar{e}_t}{2\Delta\bar{E}^E_t}, \tag{1.3.9}$$

$$\frac{(\bar{e}_{t-1}+\bar{e}_t)\Delta v_t}{2\Delta\bar{E}^E_t}. \tag{1.3.10}$$

Lastly, we also decompose the number of exporting firms into two parts: the change in the proportion of exporters and the change in the total number of firms. If we use N_t to denote the total number of firms and P^E_t to denote the proportion of exporting firms, the identity is now

$$N^E_t = P^E_t N_t. \tag{1.3.11}$$

Then the contributions from the two components of ΔN_t^E in sector j are

$$\frac{(N_{jt-1}+N_{jt})\Delta P_{jt}^E}{2\Delta N_t^E}, \tag{1.3.12}$$

$$\frac{(P_{jt-1}^E+P_{jt}^E)\Delta N_{jt}}{2\Delta N_t^E}. \tag{1.3.13}$$

1.3.2 A discussion on the identification of "new" exporters

The identification of "new" firms, especially "new" exporters, is crucial to our assessment of export growth in terms of intensive and extensive margins. If our firm sample represented the whole population of manufacturing firms, then the identification would be quite straightforward – the "new" firms would be simply those which appeared the first time in the sample after the initial year (2000), and similarly the "new" exporters would be those which started exporting after the initial year.

However, the above criteria is problematic when the sample is not the population, as in our case. Since "below-scale" firms (with annual sales roughly below 5 million yuan) are not included in our sample by the nature of the survey, identification by the above method could probably overestimate the firm entry rate. The reason is that a firm that appears the first time in the sample might not necessarily be newly established firm but could be from the "below-scale" cohort which is not included in the sample. As a result, a firm identified as a "new" exporter can be (1) a non-exporting firm that existed in the "above-scale" sample before, (2) a newly established "above-scale" firm, (3) a previously "below-scale" non-exporting firm, or (4) a previously "below-scale" exporting firm. The concern raised before comes from the possibility of (4). If many "new" exporters fell in this last category, the above identification would lead to biased result.

One way to address this issue of potential misidentification is to look at the firm ages, constructed by subtracting firms' business starting years from the years they operate in. By the firm age information, we can at least identify genuinely new firms whose ages should be zero. To best utilise the age information, we first classify "new" firms and "new" exporting firms by the above method. The latter is further broken down into two subgroups: "new" firms and "existing" firms. Then we look into the age distribution by each group, where age distribution is simplified as three distributional sections – "age=0", "1≤age≤5", and "age>5". The result is shown in Table 1.2.

We have several observations from the age distribution. First, in column I, genuinely new firms only account for 8.4% of all "new" firms, which in other words means that 91.6% of the "new" firms are misclassified. There are probably two sources for the misclassification of "new" firms: firms from the "below-scale" cohort or firms which had existed before but which somehow disappeared from the sample for some time.[7] Second, from column II.I, we see that 6.1% of "new" exporting firms are actually genuinely new firms which started exporting right away after their establishment. In contrast, 66.1% ($44.17\% + 21.89\% = 66.1\%$) of them are misclassified as "new" firms, some of which could be previously "below-scale" firms. However, unfortunately, we cannot tell how many of them are really from the "below-scale" cohort and whether they used to be "below-scale" non-exporters or "below-scale" exporters. Third, the transition rate from non-exporters to exporters in the "above-scale" sample is 27.8% ($14.45\% + 13.34\% = 27.8\%$), calculated from column II.II.[8] This transition rate is moderate and comparable with the current studies such as Bernard and Jensen (2004b) (30% over eight years).

In the above analysis, we only pinned down part of the genuinely new exporting

[7]For example, some firms in some years could be dropped by the data cleaning.

[8]The 0.1% of firms in column II.II probably misreported their business starting years, because they existed in the previous years in the sample but have ages of zero. However, their extremely small amount makes them negligible.

Table 1.2. Distribution of the ages of the "new" firms and the "new" exporting firms: aggregated over all years

I. "New" firms[a]			II. "New" exporting firms[b]					
			II.I "New" firms[c]			II.II "Existing" firms[d]		
age=0	1≤age≤5	age>5	age=0	1≤age≤5	age>5	age=0	1≤age≤5	age>5
8.39%	61.26%	30.36%	6.05%	44.17%	21.89%	0.10%	14.45%	13.34%

Notes.

[a] Firms that appeared for the first time in the CASIF data after 2000.

[b] Firms that appeared for the first time as an exporting firm in the CASIF data after 2000.

[c] Firms that appeared for the first time in the CASIF data and became an exporting firm in the same year after 2000.

[d] Firms that appeared for the first time as an exporting firm but existed in the previous years in the CASIF data after 2000.

firms; they amount to 33.9% ($6.1\% + 27.8\% = 33.9\%$) of all "new" exporting firms identified before. For the remaining 66.1% of the firms, nothing is known about their previous activities as they could have anyhow disappeared from the sample, could have been dropped by data cleaning, or could have been in the unobservable "below-scale" cohort excluded from the firm survey. Ideally, a data with all firms included would be helpful for clarifying this puzzling riddle. For this purpose, we resort to an external data, the database of the First National Economic Census of China from the NBSC. This census was conducted in the end of 2004 and was the most comprehensive economic census ever in China. It is a cross-sectional data set which covers all firms and other legal organisations registered in local authorities. We extract the whole population of manufacturing firms from the database and then compare them with the sample of firms of 2005 from the CASIF data.

It is now possible to trace precisely the statuses of the "above-scale" exporting firms in 2005 back in 2004. The result is reported in Table 1.3. It is now clear that only 1.7% of "new" exporting firms are misclassified as they did export in the "below-scale" cohort in the previous year. According to the 2004 Census database, 37.4% of manufacturing exporters are "below-scale" manufacturing firms, but they only account for 2.3% of total manufacturing exports. Therefore, only a very small part of "below-scale" exporters switched to "above-scale" exporters in the next year. On the contrary, about 93.3% (1.11%+92.15%=93.26%) of currently "new" exporting firms are from non-exporting firms in the previous year, of which the vast majority used to be non-exporting firms in the "above-scale" sample. All together, the evidence from the comparison between our sample and the Census data demonstrates that our identification of new exporting firms is 98.3% correct on a year-to-year basis, or 88.7% ($(98.3\%)^7=88.7\%$) correct on an eight-year basis. We are therefore largely justified in using the CASIF data to identify new exporters.

Table 1.3. Compositions of "new" exporting firms: comparing year 2005 with year 2004

	Existing firms[b]		
Genuinely new firms[a]	Below-scale exporters at (t-1)[c]	Below-scale non-exporters at (t-1)[d]	Above-scale non-exporters at (t-1)[e]
5.04%	1.69%	1.11%	92.15%

Notes.

[a]Exporting firms in 2005 that did not exist in the 2004 Census.

[b]Exporting firms in 2005 that existed in the 2004 Census.

[c]Exporting firms in 2005 that existed as "below-scale" exporting firms in the 2004 Census.

[d]Exporting firms in 2005 that existed as "below-scale" non-exporting firms in the 2004 Census.

[e]Exporting firms in 2005 that existed as "above-scale" exporting firms in the 2004 Census.

1.3.3 Decomposition results

Table 1.4 presents the decomposition result of total export value growth obtained by applying Eq. (1.3.4). We see that the intensive margin and the extensive margin are equally important in fuelling export growth. Half of the export growth was from exporting firms increasing their exports, and half was from the net effect of firms entering and exiting the export market.[9] The contribution from the extensive margin here is much higher than what is found for other countries. For example, in a study of the U.S. export growth from 1987 to 1992, Bernard and Jensen (2004a) find that only 13% of the growth is attributed to the net entry of firms. Bernard and Jensen (2004a) take this finding as evidence of the importance of sunk costs in firms' decisions to export. In a setting where trade costs are reduced dramatically, the role of the extensive margin should be larger as it is easier for firms to export. Our result here, when compared with Bernard and Jensen (2004a), provides a dynamic version of evidence which lends support to the effect of reduced trade costs predicted by heterogeneous firm models.

[9]As clarified in Section 1.3.2, about 11.3% of the identified "new" exporting firms may be mislabeled genuinely new exporters in our sample. Therefore, we believe ignoring this problem is unlikely to change our results qualitatively.

The above result is obtained with the full CASIF sample. However, as explained in Section 1.3.2, relying on the full sample will overstate the role of firm entry as some existing firms will be mistakenly classified as "genuine" new firms. Although our evidence shows this type of misclassification is statistically unimportant, a feasible way to eliminate the influence of such misclassification is to rely on the balanced panel where all firms existed for all years. Because the balanced panel only keeps firms which were active in each year of the sample period, the extensive margin now only contains those firms which were always in the sample and which transited from non-exporting status to exporting status after 2001. It is shown that when it comes to the balanced CASIF panel, the extensive margin is reduced dramatically, and this pattern persists from Table 1.4 to Table 1.9. What is lost in the extensive margin, compared to the full sample, is those firms who started their business and began to export after 2001. The huge gap in the extensive margin between the two samples now reveals that most of the extensive margin is actually from those new firms[10] rather than from the pre-existing non-exporting firms entering into the export market. This could happen if the sunk costs associated with exporting were reduced to a considerably low level which allowed newly established firms to export right away. As described before, this is probably the case when most of the firms were entitled to export and import independently and enjoy more favourable tariffs and quotas in other countries after China became a WTO member.

The large growth of exports at the extensive margin raises the question of the composition of new exporting firms. We are particularly interested in the proportion of processing firms in the export growth, because processing firms rely heavily on imported materials but contribute a high share in the final value of exports. The firm-level CASIF data provides no infirmation for identifing whether an exporting firm is a processing firm or not. We therefore turn to the firm-product-level

[10]"New firms" here, of course, include genuine new entrants and firms which moved above the size threshold, though the latter only account for a small proportion as indicated in Section 1.3.2.

Table 1.4. Sources of export value growth

	Full CASIF	Balanced CASIF
Export value (2000)	1118.5	239.8
Export value (2007)	5825.8	837.0
Change (2000/2007)	4707.3	597.2
Intensive margin	0.500 (50.0%)	0.956 (95.6%)
Extensive margin	0.500 (50.0%)	0.044 (4.4%)

Notes. Export values and their change are measured in billion CNY in 2000 price. Numbers in parentheses are shares of intensive margin or extensive margin within each group.

matched CASIF-CCTS sample. While there are four broadly categorised customs regimes, we define an exporting firm pertaining to a specific type if its exports of that customs regime contribute more than 50% of its total exports. Then we apply the above decomposition method to the exporting firms in this sample and the result is seen in Table 1.5.

As expected, processing firms dominate the export growth, especially in terms of the extensive margin ($7\% + 64.7\% = 72\%$ of export growth), which implies that the entry of new processing firms is the principal reason for the growth. However, what looks a bit odd is that almost all export growth from processing firms is from processing firms which *import* materials rather than "processing and assembling" firms. The former's share in export growth is as high as 84%. To understand this, it is important to note the difference between the two processing regimes. When processing-and-assembling firms import materials from foreign suppliers, the property rights of the materials still pertain to the foreign suppliers, and all the assembled products go back to these suppliers; in other words, these firms are like workshops of those foreign companies. By contrast, when processing-with-imported-materials firms import materials, they gain the complete property rights over these materials, and after the materials are processed into final or semi-final goods, these firms can decide which foreign companies to export to; in other words, these firms are sellers in the international market instead of merely workshops for foreign firms. This said, the difference in the contributions between the two types of processing firms probably means that Chinese processing firms are choosing to play a more influential role in the export market.

Table 1.5. Sources of export value growth
(matched CASIF-CCTS sample, by customs regime)

	Ordinary-trade firms	Processing-and-assembling firms	Processing-with-impt.-matls. firms	Other firms
Export value (2003)	49.9	161.5	1042.0	4.2
Export value (2006)	94.0	363.1	2429.4	10.7
Change (2003/2006)	44.1	201.6	1387.4	6.5
Int. margin	0.011 (40.7%)	0.053 (43.1%)	0.199 (23.5%)	0.003 (75.0%)
Ext. margin	0.016 (59.3%)	0.070 (56.9%)	0.647 (76.5%)	0.001 (25.0%)

Notes. Export values and their change are measured in billion CNY in 2000 price. Numbers in parentheses are shares of intensive margin or extensive margin within each group.

Table 1.6 gives the results of decomposition by region. We have two basic findings here. First, it shows that almost all of the export value growth came from exporting firms located in the coastal region, whether in the full sample or in the balanced panel. Second, the coastal region had a higher proportion of export growth from the extensive margin, compared to the inland provinces. These findings are not surprising if we consider the substantial regional gaps in export activities in China.

Table 1.6. Sources of export value growth (by region)

	Full CASIF		Balanced CASIF	
	Coast	Inland	Coast	Inland
Export value (2000)	1022.4	96.1	222.0	17.8
Export value (2007)	5422.2	403.7	768.6	68.4
Change (2000/2007)	4399.8	307.6	546.6	50.6
Intensive margin	0.452 (48.3%)	0.041 (63.1%)	0.887 (96.9%)	0.072 (84.7%)
Extensive margin	0.483 (51.7%)	0.024 (36.9%)	0.028 (3.1%)	0.013 (15.3%)

Notes. Export values and their change are measured in billion CNY in 2000 price. Numbers in parentheses are shares of intensive margin or extensive margin within each group.

The decomposition result for ownership type is in Table 1.7. Although foreign firms were dominant in the export growth, the results of the breakdown of export growth are similar across the firm types except for state-owned firms. The fact that more export growth is contributed by the extensive margin than by the intensive margin applies to all firm types except state-owned firms. This again implies that the net entry of firms into the export market is a more important factor than the growth in exports per firm for the export boom. The large, negative role of the extensive margin for state-owned firms has its institutional reasons. Primarily due to the state-initiated reshuffling, merging, ownership transformation, and closing-up of state-owned enterprises, the state-owned sector contracted dramatically, reflected in the decreasing number of firms.

Table 1.7. Sources of export value growth (by ownership)

	Full CASIF			
	Non-state	State	HMT	Foreign
Export value (2000)	445.9	143.0	217.6	312.0
Export value (2007)	2016.6	218.0	1021.1	2570.1
Change (2000/2007)	1057.7	75.0	803.5	2258.1
Intensive margin	0.143 (42.8%)	0.088 (550.0%)	0.067 (39.2%)	0.211 (44.0%)
Extensive margin	0.191 (57.2%)	-0.072 (-450%)	0.104 (60.8%)	0.269 (56.0%)
	Balanced CASIF			
	Non-state	State	HMT	Foreign
Export value (2000)	96.2	17.2	37.8	88.5
Export value (2007)	380.9	71.9	77.8	306.4
Change (2000/2007)	284.7	54.7	40	217.9
Intensive margin	0.453 (95.0%)	0.098 (107.7%)	0.067 (100%)	0.339 (92.9%)
Extensive margin	0.024 (5.0%)	-0.007 (-7.7%)	-0.000 (0.0%)	0.026 (7.1%)

Notes. Export values and their change are measured in billion CNY in 2000 price. Numbers in parentheses are shares of intensive margin or extensive margin within each group.

To see how the two margins differ across industries, we present the decomposition results for each two-digit industry in Tables 1.8 and 1.9. Industries are ordered in ascending order of the share of intensive margin. As has been found before, the electronics industry is the largest source of export growth and its contribution is even more pronounced in Table 1.9 where the extensive margin is significantly reduced due to the reason explained before. In the top part of Table 1.8, the industries have higher extensive margins than intensive margins, while in the bottom part the relationship is reversed. A closer look at the industries reveals that the industries in the top part are those typically labour-intensive industries while those in the bottom part are mainly capital/technology-intensive ones. We interpret this as evidence of the labour-intensive industries having a higher degree of net entry of new firms in the export market than capital-intensive industries. An explanation is that since the labour-intensive industries have lower entry costs, firms in these industries are more responsive to changes in trade barriers, and more reductions in trade barriers related to these products took place in overseas markets. For example, the termination of the quota restrictions imposed by the MFA in 2005 boosted an extraordinary increase of Chinese textile exports to developed countries. In fact, it was indeed one of China's main motivations to join the WTO – to create a favourable environment for its labour-intensive firms to export more easily to the world.

Another issue we are interested in is how the technology related to the exports changed over time. Particularly, we want to know whether Chinese exports had become more technology-intensive over time. A problem with the CASIF data set is that it contains detailed technology information related to, for example, workers' educations, skills, R&D investment, and so on, but they are not available for each year of the sample period. Because of this reason, we restrict our sample to a balanced panel where each firm reported information on any of the technology measures for at least one year. We are then able to track the technology level of each firm by exploiting this information. We label two groups of firms within each industry – higher technology group and lower technology group for each of these technology measures. To extend firms' technology information to other years where the information is missing, we assume that firms in one technology group do not transit to the other group over the sample period. For example, in respect of education, we define the higher technology group as being those firms with their education index rankings in the top 25% percentiles and the lower technology group

Table 1.8. Sources of export value growth (full CASIF, by industry)

Industry	Exp. val. (2000)	Exp. val. (2007)	Change (2000/2007)	Int. margin	Ext. margin	% Int. margin	% Ext. margin
Leather/fur/feather	63.8	168.4	104.5	0.0038	0.0184	17.3%	82.7%
Non-metallic minerals	24.7	67.5	42.7	0.0018	0.0073	19.6%	80.4%
Plastics	34.2	120.2	86.0	0.0037	0.0146	20.3%	79.7%
Metal products	50.0	166.0	116.0	0.0053	0.0193	21.7%	78.3%
Textiles	138.2	333.1	194.9	0.0117	0.0297	28.3%	71.7%
Furniture	12.1	79.9	67.8	0.0042	0.0102	29.2%	70.8%
Clothing	94.5	270.5	176.0	0.0131	0.0243	35.1%	64.9%
Office equipments	34.1	107.7	73.6	0.0055	0.0101	35.4%	64.6%
Non-ferrous metals	19.7	54.6	34.9	0.0029	0.0045	38.8%	61.2%
Timber/wood	7.2	46.7	39.5	0.0033	0.0051	39.4%	60.6%
Electrical equipments	71.3	470.0	398.6	0.0358	0.0488	42.3%	57.7%
Printing	2.6	19.5	16.9	0.0016	0.0020	43.5%	56.5%
Processing of foods	36.9	107.4	70.5	0.0065	0.0085	43.6%	56.4%
Rubber	15.1	60.5	45.4	0.0042	0.0054	43.9%	56.1%
General machinery	39.4	218.1	178.8	0.0172	0.0208	45.2%	54.8%
Transport equipments	43.6	330.2	286.5	0.0296	0.0312	48.7%	51.3%
Special machinery	13.7	108.4	94.7	0.0099	0.0102	49.2%	50.8%
Electronic equipments	257.9	2402.2	2144.3	0.2360	0.2195	51.8%	48.2%
Measuring instruments	30.4	171.0	140.6	0.0160	0.0139	53.6%	46.4%
Raw chemical materials	44.2	178.0	133.8	0.0156	0.0128	55.1%	44.9%
Chemical fibers	3.0	17.7	14.7	0.0018	0.0013	58.2%	41.8%
Manufacturing of foods	9.7	38.3	28.6	0.0035	0.0025	58.3%	41.7%
Paper products	9.8	45.3	35.5	0.0046	0.0029	61.4%	38.6%
Medicines	16.0	47.1	31.1	0.0043	0.0023	64.8%	35.2%
Ferrous metals	30.6	169.7	139.1	0.0192	0.0104	64.9%	35.1%
Beverages	4.1	14.8	10.7	0.0016	0.0006	71.7%	28.3%
Petroleum/coking	11.7	13.3	1.5	0.0003	0.0000	100.0%	0.0%

Notes. Export values and their change are measured in billion CNY in 2000 price. The industries are arranged in ascending order of the share of intensive margin.

Table 1.9. Sources of export value growth (balanced CASIF, by industry)

Industry	Exp. val. (2000)	Exp. val. (2007)	Change (2000/2007)	Int. margin	Ext. margin	% Int. margin	% Ext. margin
Chemical fibers	0.3	1.9	1.6	0.0017	0.0009	63.9%	36.1%
Printing	1.0	4.0	3.1	0.0036	0.0015	70.2%	29.8%
Non-metallic minerals	6.2	10.5	4.3	0.0054	0.0018	74.6%	25.4%
Non-ferrous metals	3.2	7.6	4.3	0.0056	0.0017	76.6%	23.4%
Rubber	3.6	11.5	7.8	0.0103	0.0028	78.9%	21.1%
Ferrous metals	10.2	60.7	50.5	0.0685	0.0161	81.0%	19.0%
Timber/wood	2.1	8.3	6.2	0.0084	0.0020	81.0%	19.0%
Transport equipments	9.0	52.7	43.7	0.0622	0.0109	85.1%	14.9%
Plastics	6.1	11.9	5.8	0.0088	0.0009	91.1%	8.9%
Electrical equipments	18.2	72.9	54.6	0.0837	0.0078	91.5%	8.5%
Manufact. of foods	2.3	5.0	2.7	0.0041	0.0004	92.1%	7.9%
Medicines	3.4	7.5	4.1	0.0063	0.0005	92.5%	7.5%
Special machinery	4.1	16.0	11.9	0.0184	0.0015	92.6%	7.4%
Metal products	6.7	18.2	11.6	0.0179	0.0014	92.7%	7.3%
General machinery	7.2	25.3	18.1	0.0282	0.0021	93.1%	6.9%
Leather/fur/feather	10.3	20.5	10.2	0.0161	0.0010	94.2%	5.8%
Clothing	16.4	31.8	15.4	0.0246	0.0011	95.6%	4.4%
Electronic equipments	62.3	321.3	259.0	0.4154	0.0183	95.8%	4.2%
Beverages	0.7	1.2	0.5	0.0008	0.0000	96.1%	3.9%
Furniture	1.9	5.4	3.5	0.0058	0.0001	98.4%	1.6%
Measur. instruments	7.1	21.7	14.6	0.0242	0.0002	99.0%	1.0%
Raw chemical matls.	10.0	29.2	19.2	0.0320	0.0001	99.7%	0.3%
Textiles	27.8	51.6	23.8	0.0414	-0.0015	103.8%	-3.8%
Office equipments	7.6	12.9	5.3	0.0104	-0.0014	116.0%	-16.0%
Paper products	3.5	12.9	9.4	0.0188	-0.0031	119.9%	-19.9%
Processing of foods	7.1	13.2	6.1	0.0122	-0.0021	120.1%	-20.1%
Petroleum/coking	1.3	1.4	0.1	0.0006	-0.0005	475.6%	-375.6%

Notes. Export values and their change are measured in billion CNY in 2000 price. The industries are arranged in the ascending order of the share of intensive margin.

as in the bottom 25% percentiles. Education index is defined as the proportion of workers with higher-education degrees. It should be unlikely that firms with this proportion in the bottom 25% could climb up to the top 25% in the industry, or *vice versa*, in no more than eight years.

After these definitions, the shares of export value by these groups are calculated and the changes in share are decomposed in the same way as above. The results are given in Table 1.10. From this table, it is quite clear that all higher technology groups had their share of export value increased over time while lower technology groups exhibited the opposite trends. This is due to the disproportionately higher growth of exports in the more technologically sophisticated groups. We see this as evidence of increasing technology content of exports. Interestingly, the extensive margin for the lower technology groups is either near zero or negative, indicating that there was net exit among those firms. Although the decomposition by the balanced panel does not capture the full picture of the contributions from the two margins, the contrast between the relative sizes of the two margins offers further evidence that the technology level of Chinese exports had been rising significantly.

1.3.4 Further decompositions of the intensive and extensive margins

With similar methodology, we also decompose $\bar{E}$ and N^E into two components, as described in Equations (1.3.8) to (1.3.13). The decomposition results of $\bar{E}$ are in Table 1.11. The intensive margin ($\bar{e}$) here represents the export value per product and the extensive margin (v) represents the number of products exported per exporting firm. We apply the decomposition both to the full CCTS sample and the matched CASIF-CCTS sample. The results are similar. The intensive margin is positive and the magnitude is large, while the extensive margin is negative and its magnitude is also large. The fact that the two margins work in opposing ways

Table 1.10. Sources of export value growth (balanced CASIF, by technology group)

	Share of exp. val. (2000)	Share of exp. val. (2007)	Contribution to exp. val. growth	Intensive margin	Extensive margin
Education $\geq$ 75% pctl.	31.2%	47.6%	54.1%	49.4%	4.7%
Education $\leq$ 25% pctl.	14.2%	9.9%	8.2%	8.4%	-0.2%
Skill $\geq$ 75% pctl.	21.8%	34.7%	39.9%	38.3%	1.6%
Skill $\leq$ 25% pctl.	34.3%	25.7%	22.2%	22.0%	0.2%
R&D intensity $\geq$ 50% pctl.	16.1%	30.2%	35.9%	30.7%	5.2%
No R&D expenditure	49.2%	34.4%	28.5%	29.1%	-0.6%
Worker-training $\geq$ 50% pctl.	38.9%	55.6%	62.3%	57.8%	4.5%
No worker-training	18.8%	11.8%	9.0%	9.1%	-0.1%
New product intensity $\geq$ 50% pctl.	16.9%	22.1%	24.4%	20.0%	4.4%
No new products	53.7%	33.6%	25.5%	26.0%	-0.5%

Notes. The second and the third columns are the shares of different technology groups in the total export value of each year. The fourth column is the share of export value growth of different technology groups in total export value growth. The last two columns break down the fourth column into the intensive margin and the extensive margin.

has its implication. The number of firms entering into the export market was far more than the increased number of product categories. This consequently leads to an increasing export volume per product and a decreasing number of products per exporting firm. New firms starting to export, among other factors, seems to have been the key driving force of the Chinese export growth.

The decomposition results of N^E are in Tables 1.13 to 1.15. Now the intensive margin is the proportion of exporters in all firms, and the extensive margin is the number of all firms. Since by construction the balanced panel excludes those firms which entered or exited during the period, we focus on full sample results. These tables give results by sector in various aspects. But all of them point to the same finding. That is, the extensive margin dominates the intensive margin. It has large, positive magnitudes as opposed to the intensive margin which is negative and low in magnitude throughout the tables. This means that there were disproportionately more new firms than new exporting firms during the period. All the sectors (different regions, ownership types, and industries) grew faster than the exporting firms within each sector in terms of the number of firms, and this highlights the importance of sectoral expansion in the export boom.

Table 1.11. Sources of growth in the mean export value $\bar{E}$

	Full CCTS	Matched CASIF-CCTS
$\bar{E}_{2003}$	4,575,147.4	6,200,965.5
$\bar{E}_{2006}$	5,661,913.7	7,637,733.1
$\Delta\bar{E} = \bar{E}_{2006} - \bar{E}_{2003}$	1,086,766.3	1,436,767.6
Intensive margin ($\bar{e}$)	3.840 (384.0%)	3.961 (396.1%)
Extensive margin (v)	-2.840 (-284.0%)	-2.961 (-296.1%)

Notes. $\bar{E}_t^E = \frac{\bar{e}_t \times n_t}{N_t^E} \equiv \bar{e}_t \times v_t$. Export values are measured in thousand USD.

Table 1.12. Sources of growth in the number of exporters N^E

	Full CASIF	Balanced CASIF
Number of exporters (2000)	27,864	4,980
Number of exporters (2007)	63,648	5,230
Change (2000/2007)	35,802	250
Intensive margin	-.059 (-5.9%)	1.000 (100.0%)
Extensive margin	1.059 (105.9%)	0.000 (0.0%)

Notes. $N_t^E = P_t^E N_t$.

Table 1.13. Sources of growth in the number of exporters N^E (full CASIF, by region)

	Coast	Inland
Number of exporters (2000)	24,267	3,597
Number of exporters (2007)	57,620	6,029
Change (2000/2007)	33,353	2,432
Intensive margin	-0.158 (-16.9%)	-.008 (-11.8%)
Extensive margin	1.091 (116.9%)	.076 (111.8%)

Notes. Numbers in parentheses are shares of intensive margin or extensive margin within each group.

Table 1.14. Sources of growth in the number of exporters N^E (full CASIF, by ownership)

	Non-state	State	HMT	Foreign
Number of exporters (2000)	15,960	3,571	4,596	3,737
Number of exporters (2007)	38,257	9,84	11,937	12,471
Change (2000/2007)	22,297	-2,587	7,341	8,734
Int. margin	-0.175 (-28.1%)	0.011 (-15.3%)	-0.011 (-5.4%)	-0.014 (-5.7%)
Ext. margin	0.798 (128.1%)	-0.083 (115.3%)	0.216 (105.4%)	0.258 (105.7%)

Notes. Numbers in parentheses are shares of intensive margin or extensive margin within each group.

1.4 Outline of the Thesis

This thesis aims to address some important issues related to the behaviour of Chinese manufacturing firms in international trade, some more policy relevant and some others carrying more theoretical implications. Studying the production and trade patterns of Chinese firms in a period of tremendous export growth is of special interests for two main reasons.

First, given the increasing share of China in world trade, it is worth looking into firms who contribute to China's imports and exports to see how these production and trade units has shaped the aggregate growth story. Particularly, revealing how Chinese firms engage in production and trade will greatly help us better understand the nature and extent of the potential impacts of China's unique economic development path is having on the world economy.

Second, in the recent decade, China has taken a series of big steps towards trade liberalisation, including, most notably, its entry into the World Trade Organisation (WTO). China's accession into the WTO (and its economic reforms in preparation for the WTO entry) brought China much closer to the outside world: on the domestic market side, it gradually dismantled protectionist policies towards foreign investors and private firms, and on the trade side, it significantly reduced tariff bar-

Table 1.15. Sources of growth in the number of exporters N^E (full CASIF, by industry)

Industry	N^E_{2000}	N^E_{2007}	ΔN^E	Int. margin	Ext. margin	% Int. margin	% Ext. margin
Non-ferrous metals	328	616	288	-0.01	0.01	-81.9%	181.9%
Ferrous metals	254	450	196	0.00	0.01	-61.9%	161.9%
Textiles	3,797	7,172	3,375	-0.06	0.15	-59.9%	159.9%
Medicines	597	867	270	0.00	0.01	-52.7%	152.7%
Chemical fibres	87	180	93	0.00	0.00	-38.7%	138.7%
Clothing	3,435	6,844	3,409	-0.03	0.13	-36.1%	136.1%
Raw chemical materials	1,818	3,381	1,563	-0.01	0.06	-33.7%	133.7%
General machinery	1,721	4,441	2,720	-0.02	0.09	-25.0%	125.0%
Office equipments	1,061	2,249	1,188	-0.01	0.04	-24.1%	124.1%
Leather/fur/feather	1,473	3,306	1,833	-0.01	0.06	-22.9%	122.9%
Paper products	439	781	342	0.00	0.01	-17.8%	117.8%
Measuring instruments	565	1,250	685	0.00	0.02	-15.7%	115.7%
Beverages	260	368	108	0.00	0.00	-15.5%	115.5%
Metal products	1,584	4,107	2,523	-0.01	0.08	-14.1%	114.1%
Timber/wood	417	1,337	920	0.00	0.03	-11.1%	111.1%
Processing of foods	1,264	2,318	1,054	0.00	0.03	-8.4%	108.4%
Rubber	371	814	443	0.00	0.01	-7.9%	107.9%
Plastics	1,230	3,399	2,169	0.00	0.06	-4.3%	104.3%
Electronic equipments	1,502	4,363	2,861	0.00	0.08	-2.1%	102.1%
Manufacturing of foods	572	1,005	433	0.00	0.01	3.9%	96.1%
Electrical equipments	1,546	4,686	3,140	0.01	0.08	9.7%	90.3%
Special machinery	808	2,317	1,509	0.01	0.04	12.0%	88.0%
Transport equipments	881	2,502	1,621	0.01	0.04	19.8%	80.2%
Furniture	369	1,471	1,102	0.01	0.02	21.2%	78.8%
Non-metallic minerals	1,279	2,889	1,610	0.01	0.03	28.3%	71.7%
Printing	150	480	330	0.01	0.00	65.3%	34.7%
Petroleum/coking	56	56	0	0.00	0.00	n.a.	n.a.

Notes. Export values and their change are measured in billion CNY in 2000 price. Numbers in parentheses are shares of intensive margin or extensive margin within each group.

riers for foreign goods. Such large scale and massive changes in policy, as China's key commitment to the WTO member states, result in a large reduction in trade costs for firms doing business in and with China. Moreover, being part of the WTO also means China automatically began to enjoy the "Most favoured Nation" (MFN) status in other countries and thus becomes eligible for equal trade treatments.

Having this process of trade liberalisation as the general background, studies presented in this thesis either look into some aspects of the globalisation explicitly, or treat changes in external trade environment as a policy shock to investigate the relationships between changing trade barriers and firm behaviour. This thesis contains three core chapters, each addressing a specific topic. These chapters are basically self contained, but exhibit a certain degree of inter-connections under the big theme of trade liberalisation and behaviour of firms in Chinese manufacturing sector.

Chapter 2, entitled "Weighing China's Export Basket: An Account of the Chinese Export Boom", deals with one of the hottest contemporary topics regarding the extent of China's value-added in the global production chain. Given China's enormous volume of goods exported to the world, many scholars have their concerns. A widely-accepted observation is that the product composition is becoming more and more similar to that of high-income countries. If this is true, then China's exports are not only competing with those of developing countries in the world market, but have also been moving to replacing products produced by developed economies. In other words, according to this argument, there has been a significant upgrade of export structure from China and that could be crowding out high-income countries' exports. These perceptions have been further influenced by some recent studies showing that, given its low level of GDP per capita, the value distribution of China's export products is more similar to that of developed countries than would be expected.

However, one important fact that has been ignored by these evaluations is that more than half of China's exports is contributed by processing trade. Processing trade is different from ordinary trade in that it heavily uses *imported* materials to export; by some processing exports, all inputs, only except labour, are from other countries. Thus, ignoring the prevalence of processing trade in China's trade is likely to largely overstate China's *real* contribution to the export product value. In this chapter, we explicitly consider the speciality with processing trade, and re-assess two important questions: (a) how has the *domestic value-added* of Chinese exports changed? (b) how has the *technology intensity* of Chinese exports changed? Applying a modified version of the method of Hummels *et al*. (2001) which estimates domestic value-added of exports, we give a "corrected" valuation of China's value-added in its exports. Our answer in a nutshell is: previous results have indeed been largely overestimated. By our estimates, less than half of China's export value was from its own value-added. Furthermore, we use a range of technology measures to estimate the technology intensity of Chinese exports. Our finding is that China's technology intensity of exports is still very low as most of the technological improvement observed in final export value is from imported materials, a result that seems to contrast some most popular views (e.g. Rodrik, 2006; Schott, 2008).

The integration of China with the world not only exerts immense impact on other countries, but also brings about a changing environment for firms in China. As said, China's WTO entry is a double-edged sword. In one respect, while the door of China is open wider to foreign investors, Chinese firms have easier access to foreign markets too. One example is the textile industry. For a long time, developed countries protected their domestic producers from imports of textiles and apparel from developing countries, under the framework of the Multifibre Arrangement (MFA) which allows major importers (such as the U.S. and the E.U.) to impose quotas on textile and apparel imports from labour-abundant exporters (such as China, India, and Bangladesh). However, since China gained its membership to the free trade club of the WTO at the end of 2011, it automatically enjoyed the textile quota liberalisation scheme laid out by the Agreement on Textiles and Clothing (ATC), a succeeding agreement that replaced the MFA in 1995. According to the ATC, all quantity restrictions on textiles and clothing should terminate on 1 January, 2005, in accordance with the spirit of the WTO. Understandably, most importers retained their quotas against developing countries right until the midnight of 31 December, 2004.

From a research point of view, the abrupt removal of quotas offers a unique and fantastic opportunity to study the behaviour of firms in response to changes in trade policy. On the one hand, it has been clear both in theory and from evidence that quota does lead to quality upgrading via a shift in demand towards products of higher costs/prices (e.g. Falvey, 1979; Feenstra, 2003). Yet, empirically nothing is known about the quota effect on the supply side. Specifically, while we already have convincing evidence on how quotas affect product quality at the product-level in the market, we still lack information on how firms actually respond to quotas. When a firm faces changes in the restrictiveness of quotas, it could respond by entering/exiting the export market or by changing their product composition and product shares. On the other hand, while recent emerging multi-product firm models could explain why and how firms respond to changing market environment, it has been challenging to empirically test or evaluate these theories because in reality trade policies are usually complicated and cannot be exclusively related to specific firms or products.

However, the removal of MFA quotas created a policy shock that was massive in scale, discrete in timing, and exogenous to firms and consumers in the textile industry, and importantly, it could be linked to individual firms and products as we are able to tell in data which products a firm exported and which products were subject to quotas.

Chapter 3, entitled "Quota Restrictions and Price Adjustments of Chinese Textile Exports to the U.S.", studies the effect of the MFA quota termination in 2005 on the prices of Chinese textile and clothing products exported to the U.S. by Chinese firms. While Harrigan and Barrows (2009) have looked at the effect of the MFA termination on product prices in the U.S. import market, ours focuses on the side of the Chinese exports, thus supplementing their work by providing a mirror image of the story. In addition, our data is at the firm-product-level, more disaggregated than their product-level data, allowing further analysis regarding firm response. Since the time of the MFA termination can be exactly identified and the quota removal did not affect all textile products, we use a "difference-in-difference" approach to estimate the causal effects of the lift of quotas. We document clear evidence that firms lower their product prices by 30% on average in face of a sudden removal of quotas, and also find this effect varies across products and firms: half of the fall in price is due to firm entry in the export market, and state-firms were least affected by the quota removal.

The removal of quotas could also trigger intra-firm reallocations, apart from firm entry and exit. In this regard, Chapter 4, entitled "Quota Restrictions and Intra-firm Reallocations: The Effect of the MFA Elimination", extends the study of Chapter 3 by looking into resource reallocations within exporting firms. We focus on two aspects of intra-firm adjustments: (a) *product scope*, that is, the number of products exported by firms, and (b) *product concentration*, that is, the value share of best-sales product in total exports. Theories, with different assumptions on market structure and looking from different angles, have ambiguous and sometimes competing predictions on the effect on trade liberalisation on intra-firm reallocation in the above two aspects (see, among others, Bernard *et al.* (2011), Eckel and Neary (2010), and Mayer *et al.* (2011)). It is not entirely clear how changes in trade costs would induce firms to change their product mix and product focus.

Instead of taking a general view, the objective of Chapter 4 is specific and clear:

it only looks at existing exporting firms, and examines how an exporting firm would alter the number of products it exports and how the distribution of its export sales would be changed when all quota restrictions were dismantled. Our key findings are that the liberalisation of MFA quotas induced firms to dramatically expand their product scope by as much as one third, and meanwhile caused firms to reduce the weight of their core product by nearly 10 percentage points in their total export sales as a result of a more diversified product mix. Also interestingly, the analysis reveals that firms tended to put more weight on the U.S. market compared to the Japanese market after 2005, suggesting a within-firm cross-destination channel of resource reallocation induced by quotas.

Another common feature of Chapters 3 and 4 is their explicit considerations of the quota allocation system in China. Given the fact that the largest fraction of quotas were allocated through administrative procedures, rather than by the market (such as open bidding), there may be room for rent-seeking. One conjecture is that quotas may not be allocated based purely on firms' efficiency, rather, preferences could be given to firms that have closer relationships with quota allocation authorities. The most obvious example is state-owned firms. According to anecdotal evidence, it is widely believed that state-owned firms are the most favoured in the allocation and thus are least likely to be restrained by the quota system. If it is the case, state-owned would be the least affected when quotas terminated. Results in both chapters support this conjecture.

We conclude the main findings and implications, as well as point out future directions of research in Chapter 5. The Appendices contain extra materials which are relevant to but are not presented in the main texts.

CHAPTER 2

Weighing China's Export Basket: An Account of the Chinese Export Boom

2.1 Introduction

How much domestic value-added is there in China's exports to the world? How technologically sophisticated are these exports? These are the basic questions that we try to answer in this study. Among all the current issues regarding the impact of China's trade on the rest of the world, these are two fundamental questions which have arisen in policy discussions, academic studies and anecdotal evidence (see, among others, Amiti and Freund, 2010, 2007; Rodrik, 2006; Schott, 2008). They are of particular importance in terms of the deep influence that China's growing trade has been exerting and could exert on other countries in the near future.

By and large, the above concerns stem from the increasing impacts felt from the extraordinarily rapid growth of China's trade value compared to any other country in the world. From a historical point of view, China's trade boom has been one of the major engines and results of its miraculously rapid economic growth since 1978 when the reform and opening-up policy was launched. Its rapid expansion in trade is particularly prominent in recent years. According to the statistics by the WTO, China's share in the world's merchandise exports grew dramatically from 3.3% in 1997 to 8.7% in 2007, which makes it now the largest exporter only behind Germany. In the meantime, its share in world trade in manufactures jumped from 4.7% in 2000 to 12% in 2007, bypassing all other countries and as a result becoming a real "world factory". However, a profound question that follows naturally is how much value-added has been created in this factory. In other words, has this factory been an innovation studio that adds much value to the final products or is it still just an assembly workshop that imports materials and exports high-end products but contributes little to their final value?

Answers to these questions are crucial to the rigorous assessment of China's role and impact on the world trade and a number of other related economic issues. More specifically, having a correct perception of China's domestic content in its exports is important in at least two mutually related aspects. First, the composition of the basket of China's exports brings about different competitive pressures to countries of different income levels. If China exports more higher-end products, developed countries are expected to lose more market share of these products, and the same effect holds for less developed countries if China's exports remain highly labour-intensive.[1] Second, the above effect can also translate to the factor market. As China's share in the world trade is large, according to Samuelson-Stolper theorem, competition from China's exports could affect the wages of other countries' labour force with different skill levels. This latter concern has been particularly strong and prevailing among some researchers and policy makers.[2]

In this chapter, we use new, detailed and comprehensive linked firm-transac-

[1]For the latter impact, see, among others, the papers by Lall and Albaladejo (2004) and the collection of studies in Lederman *et al*. (2009) for their analysis of China's substantial export growth on other developing countries.

[2]See, for example, Krugman (1995), Freeman (1995), and Sachs and Shatz (1996). However, there are also authors such as Wood (1995) who hold the opposite view that imports from major developing countries like China and India do not hurt both skilled and unskilled workers in developed countries, mainly because these imported products are no longer produced in developed countries.

tion-level data to look into the export boom by examining China's domestic content and technological sophistication. The data we use comprise an annual census of all large- and medium-sized manufacturing firms in China over the period 2000-2007, and a monthly transaction-level database of all merchandise passing through Chinese customs from January 2003 to December 2006. We are then able to link the two data sets together to get a linked firm-transaction-level data set, which is the first of its kind among all existing micro-level data sets on Chinese manufacturing sector. The rich information enables us to document a series of new facts about the Chinese export boom. By doing this, our study contributes both to the growing literature which describes the Chinese export boom, and to the literature on measuring value-added creation in the global value chain.

More specifically, this chapter focuses on the following two main questions:

1. How has the *domestic value-added* of Chinese exports changed? Does the fact that processing and assembly are such an important fraction of exports mean that the domestic content of exports is particularly small?

2. How has the *technology intensity* of Chinese exports changed? Have Chinese exporting firms become more skill and capital intensive, or does the reliance on processing and assembly mean that Chinese exporters are in fact still quite labour intensive?

An overview of this study is given as below. First, because we observe imports and exports by firms, we are able to provide a new measure of the value-added in Chinese exports by examining the extent to which the export value is from imported intermediates and from domestic value-added. We show that the foreign content of Chinese exports is much higher than previously estimated, and therefore the domestic content lower. On average, the foreign content in Chinese exports was about 70%, meaning that China's own value-added only accounted for 30% in its huge volume of exports.

Second, our unique data set allows us to examine the characteristics of firms which contributed to the growth in exports, because we have measures of firms' technological and human capital inputs. Particularly, we have information on the skill composition of the workforce, R&D expenditure and the development of new products. The results show that lower-technology industries tended to export higher proportions of their products than higher-technology industries, which suggests that China's comparative advantages had not actually changed much. Moreover, it is also revealed that a higher proportion of domestic value-added in exports was produced by relatively low technology firms than was final value of exports. This finding is novel and implies that the technological improvement during the export boom had not changed the overall technology intensity of Chinese export value-added as much as implied from only looking at the export final value, a result that contrasts with some popular views.

The remainder of the paper is structured as follows. In Section 2.2 we describe the sources and characteristics of the data to be used in this study in more detail. Section 2.3 proposes a new measurement method of vertical specialisation that takes into account the speciality of the Chinese exports. We then assess the technological intensity of Chinese exports evaluated both at the final export value and domestic value-added in exports, and discuss the implications in Section 2.4. Section 2.5 summarises and concludes.

2.2 Data

There are two main sources of micro data, firm-level and transaction-level. The firm-level data comes from the Chinese Annual Survey of Industrial Firms (CASIF) from the National Bureau of Statistics of China (NBSC). The transaction-level data comes from the database of the Chinese Customs Trade Statistics (CCTS) which is compiled and maintained by the General Administration of Customs of China.

2.2.1 Firm data

The CASIF survey data that we use covers the period 2000 to 2007. Two groups of firms are included in the survey. The first is all state-owned firms, and the second is firms of other ownership types with annual sales above 5 million Chinese yuan (CNY), equivalent to around 700 thousand U.S. Dollars (USD) during that period. On average, more than 200 thousand firms are included each year, and according to the description of the survey, they account for around 95% of total Chinese industrial output and 98% of industrial exports, covering nearly 40 two-digit industries, of which 30 belong to manufacturing industries, and spreading across all 31 mainland provinces and municipalities.

The NBSC required firms to report details on their production activities, financial measures and other basic characteristics such as ownership structure, location and industry. In addition, each firm reports their export value of shipments (if any), including those exported by the production firms themselves and/or through trading agents.[3] The data cleaning process is described in detail in Appendices A.1 and A.2.

2.2.2 Trade data

The second data source is the database of the Chinese Customs Trade Statistics (CCTS) which is compiled and maintained by the General Administration of Cus-

[3]Firms are given assurances that information from this survey will not be released to the public or be used against them by other governmental agencies, such as tax authorities (see Cai and Liu (2009)). For these reasons, firms have less incentive to misreport the information and the data is less likely to be manipulated by local governments.

toms of China.[4] It records, monthly, all merchandise transactions passing through Chinese customs from 1 January 2003 to 31 December 2006, containing firm identification (name, address, ownership), product code, value of imports and exports, quantity of goods, customs regimes, means of transportation, customs code, origin and destination country. We exclude service trade from the original data as it is not relevant to our study.[5] We also collapse the data to yearly frequency for consistency with the firm-level data.[6]

The product codes of traded goods are eight-digit Harmonised Commodity Description and Coding System (HS) codes. The export and import values are reported as free on board (FOB) values in USD. The corresponding quantities are reported in various units depending on the nature of the goods.[7] Each transaction is also classified under one of 18 customs regimes.[8] We collapse these original trade regimes into four broad categories: *ordinary*, *processing and assembling*, *processing with imported materials* and *others*. In this chapter, the term "processing" is equivalent to "inward processing" under which certain goods can be brought into Chinese customs territory for manufacturing or processing with exportation. The regime of "outward processing" refers to trade under which goods in free circulation within Chinese Customs territory may be temporarily exported for manufacturing, processing abroad, and then re-imported. However, this latter regime only accounts for 0.004% of China's total trade value in 2005. Table 2.1 shows that processing trade alone, including both *processing and assembling* and *processing with imported materials*, accounts for around 40% of all imports and 50% of all exports. These shares have remained quite stable over the limited period of the customs data.

[4]This relatively new data has been recently explored by, among others, Manova and Zhang (2009, 2012), Fernandes and Tang (2011).

[5]See Appendix A.3 for more details.

[6]Both the firm survey and the customs data record information from the 1 January to 31 December of each year.

[7]For example, kilograms, sets, pairs, metres, square metres.

[8]See Table A3 in Appendix A.3 for a complete list.

Table 2.1. Shares of imports and exports by major customs regime

	Imports (%)			
Year	Ordinary	Processing and assembling	Processing with imported materials	Others
2003	45.58	9.30	30.05	15.06
2004	44.25	9.42	30.01	16.32
2005	42.41	10.01	31.42	16.17
2006	42.12	9.20	31.33	17.35
	Exports (%)			
Year	Ordinary	Processing and assembling	Processing with imported materials	Others
2003	41.47	12.39	42.83	3.31
2004	40.98	11.56	43.80	3.66
2005	41.25	11.03	43.74	3.99
2006	42.90	9.76	42.96	4.38

2.2.3 Matched firm-transaction data

Merging the two datasets described above allows us to link firm production with firm trade. We can then examine, for example, the contribution of imported intermediates to total exports and the skill intensity of exports. The firm- and trade-data do not use consistent firm identification numbers, so we use firm name as the matching criteria. Firm name is a reliable match variable because it is ruled that no firms can have the same name in the same administrative region, and given that virtually all firms contain their local region name as part of their firm name. About 50% of the exporting firms in the cleaned CASIF data can be matched to the customs trade records and they account for 60% of exports recorded in the cleaned CASIF data.[9] The remaining 50% of the exporting firms are not matched. The most likely explanation for this is that these firms export via trading agents and therefore do not appear in the customs records. The sample of matched firms is summarised in Table 2.2.

[9] See Appendix A.4 for details regarding the matching procedures.

Table 2.2. Summary of the matched CASIF-CCTS sample

Year	Number of firms[a]	Number of customs-registered firms[b]	Number of exporters[a]	Output (bn CNY)[a]		Exports (bn CNY)[a]		Imports (bn)[b]		Exports (bn)[b]	
				Nominal	Real	Nominal	Real	USD	CNY	USD	CNY
2003	22,787	22,781	16,972	3,839.1	4,026.9	1,188.2	1,260.1	103.4	855.4	123.6	1023.5
2004	34,410	34,397	27,748	5,315.5	5,347.3	1,724.4	1,787.8	145.6	1207.4	174.9	1447.3
2005	37,787	37,766	27,979	6,762.1	6,640.2	2,125.1	2,182.1	173.4	1417.9	235.9	1930.8
2006	42,492	42,470	31,281	8,289.4	8,129.6	2,805.5	2,898.0	203.9	1620.7	293.4	2236.4

Notes.

[a]Information originally from the CASIF sample.

[b]Information originally from the CCTS sample and converted to the currency unit of yuan when necessary.

Three points are worth noting. First, there are gaps between the number of firms and the number of exporters in Table 2.2. For example in 2003, there are 22,787 firms in the CASIF data appearing in the matched sample, but only 16,972 of them are exporters. The reason is that some firms are importers and do not export anything in some years. These importers account for about one-fourth of all matched firms.

Second, normally each firm in the matched sample should have a unique firm code and a unique customs registration code. But Table 2.2 shows the number of customs-registered firms is slightly less than that of firms identified by firm codes in the CASIF data, implying that some customs registration codes correspond to multiple firm codes. This could happen if some firms changed their firm codes in the CASIF data (for example because of ownership changes or simply typos) but did not change their registration code in the the customs data. However, such cases are very rare and are unlikely to have a significant effect on our analysis.

Third, we have two different measures of exports from the two data sets, in different currency units. After we convert USD into CNY using yearly average exchange rate, we find that exports from the CASIF data are consistently 10%-25% higher than exports from the CCTS data. Apart from the inaccuracy of using yearly average exchange rates instead of actual exchange rates for each transaction, the most likely explanation for this discrepancy is that some of the matched firms export products themselves, and at the same time export through trading agents. While the goods exported through trading agents are counted as part of the production firms' exports in the CASIF data, they are recorded under the name of the trading agents in the CCTS data.

2.3 The Domestic Value-added of Exports

In this section, we propose a new method of measuring domestic value-added of exports by taking into account the speciality of processing trade, and apply it to our unique micro data in order to reveal how much China's domestic value-added is contained in its exports.

2.3.1 Review of related studies

An important part of the growth in world trade in recent decades is the results of *vertical specialisation*. Vertical specialisation refers to the phenomenon of fragmentation of global production across countries. In the global production network, each country only engages in certain stages of the whole production process where it has comparative advantages. With the development of global production, cross-border transfer of materials and goods with this purpose has been playing an increasingly dominant role in the world trade (Hummels *et al.*, 2001; Yi, 2003; Dean *et al.*, 2008).

Hummels *et al.* (2001) (HIY hereafter) first propose a rigorous measure of vertical specialisation, before which there have been many case studies and anecdotes spread widely in the economic and business study literature but none of them has a clear and tractable conceptual framework. The measure in HIY is defined as the value share of imported intermediates in exports and is thus interpreted as the "imported input content of exports". Specifically, it is constructed by scaling the value of exports by the proportion of imported intermediates in total output:

$$VS_{\text{HIY}} = \left(\frac{M}{Y}\right) \cdot X, \tag{2.3.1}$$

where M is imported intermediates, X is exports, and Y is total output.

By applying this measure to ten OECD countries using input/output tables (I/O tables), HIY show that 21% of these countries' exports can be accounted for by vertical specialisation. Koopman *et al*. (2010) modifies the standard I/O models by adjusting for the flow of intermediates across multiple countries, and find that overall 36% of China's exports are value-added from foreign countries. Dean *et al*. (2007) apply this method to China by making use of the Chinese I/O tables and customs trade data. They show that about 35% of China's exports could be attributed to imported intermediates in 2002, and there had been a 6.5 percentage-point increase between 1997 and 2002.

Nevertheless, a problem with the HIY approach, as seen in Eq. 2.3.1, is that it assumes that imported inputs are used evenly in production for domestic sales and in production for exports. If imported inputs are used more intensively in production for exports, this approach will underestimate the degree of vertical specialisation. In the example of China, processing exports are prevailing and even dominant in some industries, and this may result in a more intensive use of imported materials in processing exports than in production for normal exports or domestic sales. We have already known from Table 2.1 that processing trade plays a dominant role in Chinese exports. Apart from that, foreign firms and processing firms have contributed a large fraction of the growth in Chinese exports. This suggests an important role for vertical specialisation: Chinese exporters are possibly a relatively low value-added segment of an international production chain. The prevalence of processing trade in China, where firms import materials to produce final or semi-final products to export to original foreign suppliers, highlights the importance of considering vertical specialisation in China's trade.

In view of this problem, Chen *et al*. (2004) and Koopman *et al*. (2008) modify the method of Hummels *et al*. (2001) by splitting the standard I/O tales into separate tables for processing trade and other types of productions (productions for ordinary trade and domestic sales). Combining these new I/O tables with trade data, their calculations produce a higher degree of vertical specialisation. For example, by Koopman *et al.*'s (2008) estimation for the year 2002, China's share of vertical specialisation is around 50% in general and as high as 80% for some industries.[10] These numbers, as opposed to those in Dean *et al.* (2007), reflect in turn the significance of processing exports in China.[11]

2.3.2 The measuring method

Domestic value-added is the value of exports when the content of vertical specialisation is subtracted. We modify the HIY method of measuring the extent of vertical specialisation by taking into account the prevalence of processing trade in China. Because processing firms typically import a large fraction of their final output, ignoring this will lead to underestimates of the domestic content of Chinese exports. Different from the conventional approaches which rely on trade statistics and I/O tables to calculate the vertical specialisation or domestic content, we will go down directly to the firm level to see how much a typical firm imports its intermediates from abroad and how much it exports. To do this, we will base our analysis on the unique firm-transaction level data set which has never been used before. By focusing on pure exporting firms which sell all their products abroad, we are able to obtain the first micro-level evidence of how much foreign content is contained in Chinese exports.

We note that all the above work on China, i.e. Chen *et al.* (2004) and Koopman

[10] Chen *et al.*'s (2004) study gets a similar result, however it only focuses on the trade between China and the United States for 1995.

[11] In a later study, Dean *et al.* (2008) extend their previous work by comparing the method using standard I/O tables and that using separate I/O tables as in Koopman *et al.* (2008). The latter method is found to generate a systematically larger degree of vertical specialisation than the former, and more interestingly, the gap between the two estimates is positively correlated with the share of processing exports in total exports at the sector level.

et al. (2008), are basically cross-sectional and their time periods do not cover more recent years after 2002. For China, however, the period under our study, 2000 to 2007, is a time when China was increasingly more integrated to the world trade and the trade barriers were also significantly reduced in order to be in accordance with the WTO rules. Over time, it had been easier not only for foreign goods to be imported into China but also for Chinese products to be sold in other countries. Therefore a natural result of this change in trade environment is that China could import more and export more simultaneously over time, which could have affected the domestic content. Our micro data allows for exploration of this over-time change.

As a first step, we identify two groups of imported intermediates in the trade data: imported intermediates for processing trade and imported intermediates for ordinary trade. Figure 2.1 illustrates the different modes of vertical specialisation for ordinary exports and processing exports, modified from Hummels (2001, Figure 1). For ordinary trade (see subfigure (a)), the imported intermediates can be partly used in production for domestic sales and partly used in production for ordinary exports. We identify imported intermediates in all ordinary imports (for example imports to be used as capital and consumption goods) by the classification of the Broad Economic Categories (BEC) and its HS concordance (see Appendix A.6 for the details). However, for the ordinary imported intermediates, because we cannot tell by the data how much proportion of it is actually used in production for domestic sales and how much is used in production for exports, we still rely on the HIY method to impute the proportion of ordinary imported intermediates in exports.[12]

For processing trade (see subfigure (b)), firms import materials or parts through customs, and then export through customs after these materials are processed or

[12]Since there are no obvious clues on the final directions of ordinary imported materials in general, the errors due to our reliance on the HIY method in this part of calculation are idiosyncratic.

assembled. According to the rule regulating trade in China, all processing imports, classified either under the regime of *processing and assembling* or under the regime of *processing with imported materials*, should only be used for the purpose of processing exports. Therefore all processing imports are used as intermediate inputs and all of them are finally embedded in processing exports.

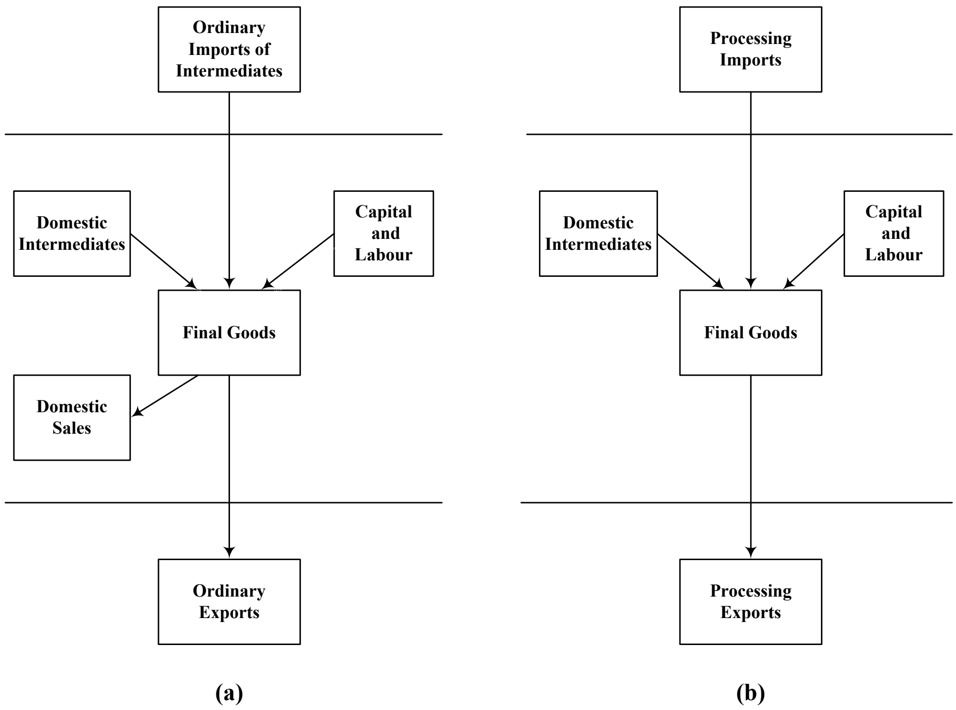


Fig 2.1. Modes of vertical specialisation for ordinary exports and processing exports

Based on the above reasoning, a revised formula for the measure of vertical specialisation is:

$$VS_{\text{NEW}} = M^p + \frac{M^o}{Y - X^p} \cdot X^o. \tag{2.3.2}$$

Here the superscripts p and o denote processing trade and ordinary trade respectively. $Y - X^p$ is the value of domestic sales plus ordinary exports, and the whole fraction, $M^o/(Y - X^p)$, gives us the proportion of ordinary imports of intermediates used in ordinary exports. If M^p and X^p were zero, this would be equivalent to VS_{HIY}.

To see how it has improved the HIY measurement, we can look at the difference between Eq. (2.3.1) and Eq. (2.3.2):

$$
\begin{aligned}
VS_{\text{HIY}} - VS_{\text{NEW}} = &\left(\frac{X^o + X^p}{Y} - 1\right) \cdot M^p \\
&+ \left(\frac{Y - X^o - X^p}{Y - X^p}\right) \cdot \left(\frac{X^p}{Y}\right) \cdot M^o.
\end{aligned} \tag{2.3.3}
$$

For exporting firms who sell their products both in the domestic market and in the foreign market, the first term is negative as output value always exceeds or is equal to export value, and the second term is also non-negative by the same reason. However, if processing trade is dominant in trade and the value of ordinary trade is close to zero (both X^o and M^o are close to zero), then the whole equation could well be negative because the second term is now close to zero. This is how the downward biased estimation of VS (or upward biased estimation of DV) caused by the HIY method takes place.

To make further refinements on these results, a possible correction is to restrict our sample to pure exporting firms which export all their goods abroad. The reason is straightforward: when these firms have no products sold in the domestic market, all their imported intermediates are used in production for exports. In this case, Eq. (2.3.1) and Eq. (2.3.2) collapse to the same equation:

$$
VS_{\text{HIY}} = VS_{\text{NEW}} = M^o + M^p. \tag{2.3.4}
$$

Once the measure of vertical specialisation VS_{NEW} is obtained, it is easy to calculate domestic value-added (domestic content) in exports:

$$DV_{\text{NEW}} = X - VS_{\text{NEW}}. \tag{2.3.5}$$

And the domestic value-added share in exports is:

$$DVS_{\text{NEW}} = \frac{DV}{X} = 1 - \frac{VS_{\text{NEW}}}{X}. \tag{2.3.6}$$

However, it needs to be born in mind that the estimate is a lower bound estimate of foreign content or upper bound estimate of domestic content of exports because it is not possible to trace back how much foreign intermediates are contained in the firm's domestic inputs.[13] Albeit the impossibility to get precise estimate of domestic content of exports, the micro-level evidence is a valuable supplement to the highly aggregated sector-level estimates and more importantly, enables us to explore within-firm variations such as changes over time and origin/destination variation.

2.3.3 Estimated results

We apply the above methods to the matched CASIF-CCTS sample.[14] The industry-level estimates are presented in Table 2.3, and are also illustrated in Figures 2.2 and

[13]It would be helpful to illustrate this by an example. Suppose a pure exporting firm has 30 thousand dollars of intermediates imported from abroad and another 20 thousand dollars of intermediates bought from the domestic market, and it combines these materials with capital and labour inputs to produce 100 thousand dollars of products which are later all sold to other countries. Our upper bound estimate of domestic content in the firm's exports is 70% ($(1-\frac{30}{100})\times 100\% = 70\%$). However, if the domestic intermediates were also produced with some foreign materials and have half of the value is foreign content (10 thousand dollars), then the precise estimate of domestic content should now be 60% ($(1-\frac{30+10}{100})\times 100\% = 60\%$).

[14]Due to the large volatility in imports of raw materials across years, the industries of ferrous-metals and non-ferrous metals are excluded for the estimation. They account for 4%-6% of the export value of manufactured goods.

2.3 for clearer visualisation.

We have three findings here. First, it is found that paper products and electronics have the lowest share of domestic value-added in their exports. The electronics industry made up a large proportion of Chinese exports but also imported large amounts of materials from other countries. Therefore overall vertical specialisation could have been driven up by the electronics exports alone. Second, the HIY estimates of domestic value-added are generally higher than our estimates, which confirms that the HIY method tends to underestimate the real degree of vertical specialisation or overestimate the real share of domestic value-added. Third, in contrast to Dean *et al*. (2007) (who study the period 1997–2002), we find that in almost every industry domestic value-added increases between 2003 and 2006. However, the increase is small, from 45% to 50% of total export value. Even in electronics, which is by far the most important exporting industry, there has been a small increase in domestic value-added. In theory, it is still possible that overall domestic value-added fell if exports shifted towards industries with low values of DVS_{NEW}, but Figure 2.3 also shows that the average, weighted by export value, has also increased slightly over this period.

In Table 2.4, we redo the estimations by restricting the sample to the pure exporters of the matched sample, which are defined as firms with more than 95% of their output exported. The result is also visualised in Figure 2.4. For many industries which have large export values, such as electronic/electrical/transport equipments and textiles, the estimated domestic value-added share in exports are lower than the estimates with the matched sample in Table 2.3. This fact implies that pure exporters have higher share of their intermediates imported than other exporting firms.

Table 2.3. Estimated domestic value-added shares in exports (by industry)

		Our method, all firms				HIY method, all firms			
Code	Industry	03/04	04/05	05/06	**03/06**	03/04	04/05	05/06	**03/06**
22	Paper products	-0.025	0.099	0.211	**0.134**	0.300	0.447	0.490	**0.421**
40	Electronic equipments	0.250	0.265	0.295	**0.281**	0.346	0.436	0.438	**0.405**
30	Plastics	0.305	0.366	0.447	**0.418**	0.432	0.491	0.569	**0.537**
41	Measuring instruments	0.488	0.515	0.521	**0.517**	0.520	0.556	0.572	**0.561**
23	Printing	0.457	0.533	0.589	**0.522**	0.560	0.631	0.650	**0.595**
28	Chemical fibres	0.592	0.503	0.479	**0.535**	0.766	0.705	0.692	**0.714**
19	Leather/fur/feather	0.504	0.539	0.561	**0.563**	0.585	0.604	0.620	**0.630**
29	Rubber	0.552	0.593	0.595	**0.583**	0.786	0.780	0.754	**0.767**
37	Transport equipments	0.625	0.632	0.646	**0.645**	0.705	0.698	0.707	**0.711**
26	Raw chemical materials	0.654	0.638	0.624	**0.647**	0.751	0.750	0.744	**0.759**
18	Clothing	0.583	0.637	0.694	**0.650**	0.635	0.686	0.742	**0.699**
39	Electrical equipments	0.649	0.681	0.719	**0.693**	0.705	0.737	0.773	**0.747**
20	Timber/wood	0.687	0.749	0.716	**0.717**	0.700	0.779	0.753	**0.745**
32	Ferrous metals	0.707	0.715	0.720	**0.719**	0.781	0.785	0.782	**0.783**
34	Metal products	0.665	0.710	0.757	**0.724**	0.700	0.752	0.814	**0.772**
13	Processing of foods	0.693	0.722	0.733	**0.728**	0.772	0.808	0.824	**0.805**
36	Special machinery	0.677	0.729	0.760	**0.737**	0.749	0.791	0.818	**0.798**
17	Textiles	0.710	0.742	0.758	**0.748**	0.769	0.798	0.816	**0.803**
24	Office equipments	0.732	0.742	0.767	**0.760**	0.756	0.769	0.785	**0.781**
35	General machinery	0.839	0.798	0.812	**0.798**	0.811	0.850	0.871	**0.854**
27	Medicines	0.819	0.801	0.779	**0.810**	0.901	0.899	0.893	**0.904**
21	Furniture	0.811	0.846	0.869	**0.850**	0.836	0.863	0.889	**0.870**
14	Manufacturing of foods	0.832	0.895	0.878	**0.855**	0.889	0.921	0.921	**0.902**
31	Non-metallic minerals	0.856	0.853	0.855	**0.863**	0.882	0.873	0.868	**0.880**
15	Beverages	0.898	0.920	0.930	**0.927**	0.937	0.947	0.964	**0.959**

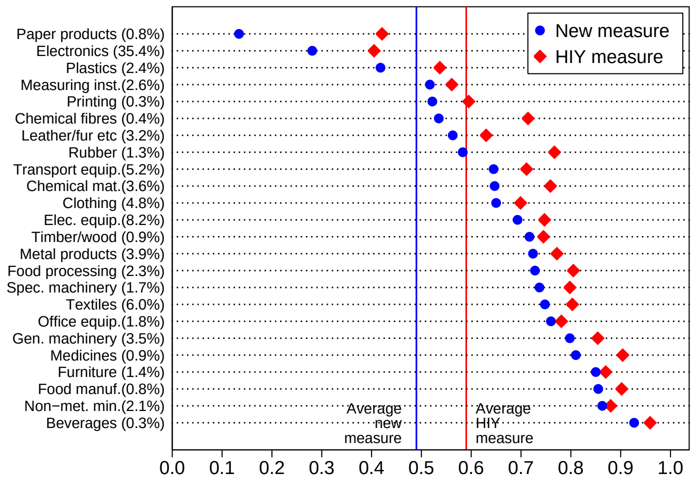


Fig 2.2. Comparison of domestic value-added shares by industry, 2003–2006, calculated from firm- and transaction-level data. Industries are ordered by DVS_{NEW}. Each industry's share of total export value is reported next to that industry's name. Average value-added shares are weighted by export value.

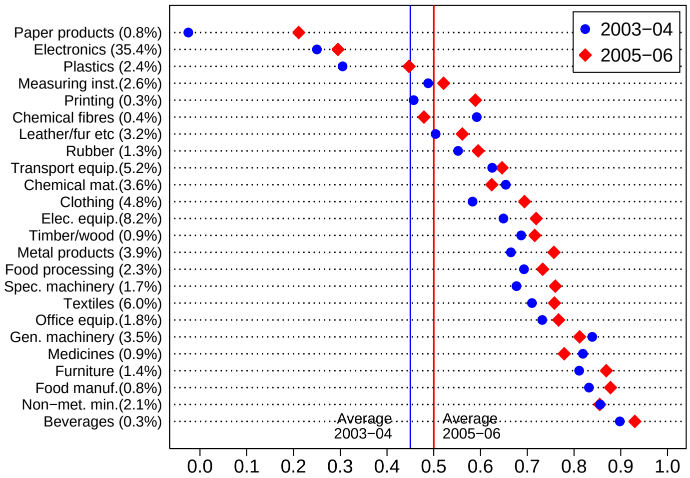


Fig 2.3. Domestic value-added shares by industry by year, 2003–2006. Industries are ordered by DVS_{NEW} for the whole period. Average value-added shares are weighted by export value.

Table 2.4. Estimated domestic value-added shares in exports by the sample of pure exporters (by industry)

	Our method/HIY method, pure exporters			
Industry	03/04	04/05	05/06	**03/06**
Electronic equipments	0.156	0.158	0.140	**0.166**
Raw chemical materials	0.591	0.606	0.396	**0.356**
Plastics	0.254	0.338	0.415	**0.376**
Paper products	0.502	0.579	0.730	**0.426**
Printing	0.475	0.520	0.566	**0.504**
Transport equipments	0.479	0.533	0.514	**0.505**
Measuring instruments	0.512	0.552	0.521	**0.566**
Rubber	0.529	0.601	0.590	**0.584**
Leather/fur/feather	0.521	0.506	0.585	**0.596**
Timber/wood	0.662	0.690	0.632	**0.627**
Clothing	0.560	0.626	0.682	**0.631**
Textiles	0.578	0.658	0.691	**0.634**
Special machinery	0.646	0.694	0.685	**0.659**
Electrical equipments	0.635	0.654	0.676	**0.665**
Processing of foods	0.686	0.699	0.719	**0.706**
Metal products	0.672	0.738	0.778	**0.722**
Office equipments	0.725	0.716	0.743	**0.739**
Beverages	0.876	0.843	0.881	**0.797**
Furniture	0.814	0.835	0.862	**0.842**
General machinery	0.832	0.864	0.865	**0.853**
Manufacturing of foods	0.848	0.855	0.819	**0.855**
Non-metallic minerals	0.882	0.882	0.825	**0.859**
Medicines	0.961	0.908	0.792	**0.910**
Chemical fibres	0.638	0.868	0.964	**0.965**

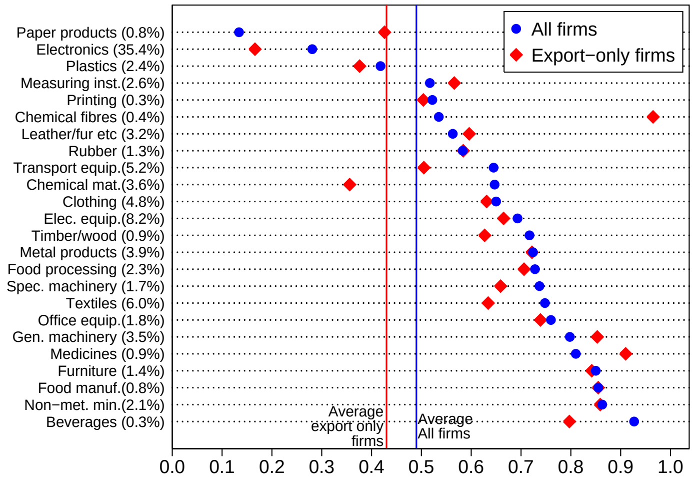


Fig 2.4. Domestic value-added shares by industry 2003–2006, comparison of all matched firms with sample of firms which export at least 95% of their output. Industries are ordered by DVS_{NEW} for the larger sample of firms. Average value-added shares are weighted by export value.

2.3.4 Differences across firm types

A great advantage of our firm-level data is that we are able to examine how domestic value-added varies across different types of firm, as well as across industries. This is shown in Table 2.5. First, note that the vast majority of Chinese exports are produced in the coastal provinces, and firms in these locations have much lower domestic value-added. Second, domestic value-added is much lower in foreign-owned firms.[15] This is a clear indication that foreign-owned firms in China are vertically integrated with their parent companies. They engage in production of relatively sophisticated products with materials or key parts imported from abroad. In contrast, non-state domestic firms are much less likely to be vertically integrated with international companies and thus have fewer chances to import technology-intensive parts.

Interestingly, the share of domestic value-added in exports for foreign-owned firms grew proportionately faster than for other types of firm . Given the relatively

[15] Ownership types are defined using 50% equity share of the relative party as the threshold. For example, foreign-owned firms are defined as firms with foreign share in equity above 50%.

short period of time, this growth is worth noting. One explanation is that more foreign suppliers of intermediates are moving their factories to or setting local plants in China (e.g., the establishment of some major Korean LED production plants in China in 2005), thus the intermediate goods they supply to manufacturing firms in China are no longer *foreign* intermediates. It is more so for foreign-owned firms than for other firms since they have closer relationship with foreign suppliers of intermediates. Another possible reason is that domestic Chinese firms have been more capable of producing intermediates and favoured by these foreign-owned manufacturers as qualified suppliers. Both forces could be working hand-in-hand, implying a higher degree of integration of foreign-invested firms with the Chinese local economy.

Finally, entrants to the export market had higher share of domestic value-added than existing exporters and those firms which exited the export market, again suggesting that these new exporters are less likely to be vertically integrated into a global production chain. This is unsurprising given that these new entrant firms usually lack experience of exporting, are smaller in size, and as a result may face additional costs in entering overseas markets and finding reliable suppliers.

2.4 Evaluating the Technology Intensity of Exports

We now turn to the technology intensity of exports which is to be evaluated both at export value and at domestic value-added.

2.4.1 Review of related studies

The issue of the technology intensity of Chinese exports is closely related to the recent discussion on China's export sophistication level. Rodrik (2006) and Schott

Table 2.5. Variation in domestic value-added across different types of firm

	2003–2004	2005–2006
DV share (*DVS*) overall	0.45	0.50
Coastal provinces	0.44	0.49
Interior provinces	0.72	0.75
Non-state domestic	0.64	0.72
State-owned	0.70	0.76
Foreign-owned	0.35	0.43
Entrants to the export market	0.55	
Existing exporters	0.47	
Exiters from the export market	0.46	

(2008) consider the similarity of China's export bundle with high-income countries in order to reveal how sophisticated China's exports are. Their evidence suggests that the structure of the Chinese export bundle is increasingly similar to that of high-income countries (Rodrik, 2006; Schott, 2008). However, a fundamental assumption underlying these export structure assessments is that the more similar a country's export bundle is to high-income countries, the more sophisticated its exports are. This approach could be misleading in that it does not take into account the fact that the production process of even the same exported product that actually takes place can be very different across countries.

It should also be noted that although Schott (2008), Xu (2007), and Xu and Lu (2009) have, to some extent, treat product quality as a possible factor for explaining the within-product price variations, they do not focus on the production side behind the product itself. Even if two countries exported exactly the same products of the same quality, what had happened with production of these products within each country could be completely different. Countries exporting the same products could have very different contributions in value-added to the products exported, given the increasingly complicated international divisions in production of commodities. In this case, even if quality was perfectly measured, it would still be far from a full description of the sophistication story.

Take the computer industry as an example. Both China and the U.S. export laptops, but the U.S. designs and produces many of the key parts such as CPUs itself, while China usually imports the most sophisticated components from abroad, assemble them with relatively low-skill labour, and then export the computers as a whole. More generally, this is exactly what firms normally do in production for processing exports. In this case, even if China's export structure is found to be over-sophisticated given its income level as in Rodrik (2006) and Schott (2008), this can well have been overestimated because the actual production activities involved in the production of many sophisticated products in China are in fact not as intensive in skill or technology as in developed countries. Actually, according to the calculation by Koopman *et al*. (2008), China's own value-added in its exports is only 50% on average, and is even as low as 20% for seemingly sophisticated products such as electronic devices.

Since the prevalence of processing trade, or more generally, the presence of international division of production, can lead to biases with the measurement of sophistication on the product side, the production process should be taken into account when it is used to assess a country's export sophistication. Unfortunately, almost none of the currently available firm-level data contains matched information on imports and exports associated with export production due to consideration of commercial secrets and/or other reasons. One normally cannot tell how sophisticated a firm's contribution exactly is throughout its production process of exporting products. Thus, given current data limitations, it is difficult to explicitly incorporate the production process of exported goods into rigorous econometric analysis and thus hard to measure the sophistication of export production process directly. However, despite the data restrictions, there may still exist some ways by which one can look into the sophistication of export production process *indirectly*. A possible approach is turn to examine the production technology associated with the exports.

Amiti and Freund (2010) recently provide the first evidence of China's export sophistication on the technology side by measuring its skill content indirectly. Their work is mainly based on Chinese product-level customs data. They plot the cumulative export share of Chinese industries which are ranked in ascending order of industry skill intensity along the horizontal axis. Since the cumulative distribution curve is shown to have been shifting rightward between 1992 and 2005, this is interpreted as evidence of increasing sophistication of Chinese exports, as exports are now concentrated more within industries with high skill intensity. However, when processing exports are excluded from the sample, hardly any shift is found in the cumulative distribution curve of industry export share. This difference implies that although the increasing share of exports from skill intensive industries has been observed, this may well have been due to the increase in processing exports which rely heavily on imported materials or parts. Furthermore, when they go on to examine the cumulative distribution curve of imported inputs share separately for processing imports and non-processing imports, a much larger increase in the skill content of imported inputs in found for processing imports than for non-processing imports. All together, these findings suggest that China's exports and imports have both been coming increasingly more from processing trades with high industry skill intensity, although the skill content change in net exports is still unclear.

However, this approach is problematic and the result can be misleading if the distribution of domestic value-added across industries (products) is largely different from that of final export value. To see this, suppose China exports only two goods, Christmas dolls and laptops. The total value of dolls is 15 million USDs with domestic value-added 10 million USDs, and the total value of laptops is 85 million USDs with domestic value-added also 10 million USDs, because all the high-value parts are from the United States. Further, the skill intensity of dolls is 0.2 while that of laptops is 0.6. Now if we calculate the overall skill intensity of the exports in terms of final value, the results is 0.54 ($\frac{15}{15+85} \times 0.2 + \frac{85}{15+85} \times 0.6 = 0.54$). However, the result will be only 0.4 ($\frac{10}{10+10} \times 0.2 + \frac{10}{10+10} \times 0.6 = 0.4$) if we use domestic value-added instead. This simple example illustrates that final value and domestic value-added could attach very different weights to a product's skill intensity and could therefore lead to essentially different conclusions on the overall skill intensity of the export bundle.

In addition, the measurement of industry technology intensity in Amiti and Freund (2010) is also far from satisfactory. They measure the skill intensities of Chinese industries in 1992 and 2005 by using Indonesian data in 1992 due to lack of Chinese data. This could generate bias if the relative skill intensities of Chinese industries in 2005 is significantly different from those in Indonesia in 1992. This gap could be even larger if Chinese industries achieved more rapid technical improvements than Indonesia did during the period of over ten years, whether through indigenous innovations or through foreign technology transfers.

2.4.2 Approach of measuring technology intensity

Measuring the technology intensity of domestic value-added in exports is new to the current literature and can help uncover the real technology content in Chinese exports. In addition, we will also compare the results obtained with the two measures to have a look at the discrepancy between them and thus to see how the previous method could bias the result.

The measure of skill intensity will also be improved. In this part, we construct both firm and sector level skill intensity measures directly based on China's own data within the period of export boom, as opposed to resorting to other country's data as in Amiti and Freund (2010). The way skill intensity is measured in Amiti and Freund (2010) is also questionable in that it is simply represented by the ratio of nonproduction workers to total employment. When skill improvement takes place in other ways than simply an increase in nonproduction workers, or when there is much (product-related) skill heterogeneity among nonproduction workers (for example, marketing staff versus lab researchers), this simple measure obviously cannot capture all the skill variation cross sections and over time. Fortunately, however, our data allows us to base our measurements on much richer firm skill information which includes worker education, worker skill qualification, firm investment on research and development, and firm expenditure on worker training. This rich skill information makes it possible to provide the first evidence from the production perspective on how skill intensive Chinese exports are and how it changed over time in the export boom after 2000.

By exploring the technology intensity of exports, our study is also related to the the factor content of Chinese exports. In the Heckscher-Ohlin-Vanek (HOV) model, factor endowment as well as factors embedded in net exports (exports minus imports) are key elements for predicting the trade pattern of a country. On the empirical side, however, little is known about the real factor content especially technology-related factors associated with Chinese exports. Our study uses micro-level data and is able to provide the first-hand evidence on the intensity of the use of technology inputs in exporting firms, and therefore can hopefully improve our understanding of the technology content of Chinese exports.

2.4.3 Industry technology levels and export intensities

Here we use six indices to measure the technology levels for all two-digit industries. The measures are constructed at the firm level and industry-averages computed. The definitions of these measures are as follows.

Our three measures of skill intensity are:

- *Education intensity*. We define the education intensity of an industry as the proportion of workers with higher-education degrees in 2004. One practical reason why education intensity is measured this way is that China has a compulsory education law which rules that normally each citizen must receive at least nine years' school education (equivalent to junior middle school). As a result, almost all workers have achieved the legally required compulsory education and therefore the variation in schooling only exists in education beyond the junior middle school level. Senior middle school education (including some vocational training education) is also very common and have almost become a prerequisite in any formal job market. However, many labour-intensive positions still do not necessarily require workers to have had higher-education degrees. Because of this, there is sufficient variation in the proportion of workers with higher-education degrees, which makes this measure effective as an proxy for education intensity.

- *Skill intensity*. The data set provides information on the number of workers with technical qualifications at the firm level in 2004. They are usually those people whose jobs are related to research, product design, maintenance and repair of sophisticated machines, or other special skills. By dividing the number of these workers by total employment, we get the measure of skill intensity which captures the relative endowment of skilled workers.

- *Worker-training intensity*. We calculate the firm expenditure on worker-training per worker as a proxy for the on-the-job human capital investment. Although this is a flow measure, it captures the cross-industry differences in human capital if industries with high human capital intensity train their workers more than other industries.

Our three measures of technology intensity are:

- *Computer intensity*. This variable is constructed as the number of computers used per worker. We assume that the value of variable is positively correlated with the overall skill level of an industry. As much of the sophisticated innovation activities are carried out on computers, this measure is intended to capture differences in the use of these equipments at the extensive margin. However, given the number of computers used, the differences in both the quantities and qualities of innovation conducted on these machines are not reflected in this measure.
- *R&D intensity*. We use this index to capture the intensity of R&D expenditure in the final value of output. Specifically, it is the ratio of industrial R&D expenditure on industrial output. This value of this index means how much R&D is invested in order to produce one yuan's worth of output in an industry. The higher the value, the more R&D intensive the industry is.
- *New product intensity*. This measure is measured as the ratio of new product value over total output. In the CASIF data, new product value is defined as value of output of those products made by new technology, or with new product designs, structural improvements, new materials, and so on. To some extent, this reflects how creative firms are in product innovations.

These measures are only available for each firm in certain years.[16] Therefore we assume that skill- and technology-intensity are fixed for each firm over the sample period and we cannot capture within-firm changes in skill or technology intensity. Nevertheless, over the relatively short time period, we believe this is a reasonable approximation.

[16] Education, skill and computer intensity are asked in 2004 only. Training intensity is asked in each year from 2004 to 2007. R&D intensity is asked in each year of 2001, 2002, and 2005 to 2007. New product intensity is asked in 2000 to 2003, 2006 and 2007.

In Figure 2.5 we plot the three skill intensity measures for two-digit industries. The two measures of academic and professional qualifications are very highly correlated, which suggests it will make little difference whichever measure is used. The relationship between qualification and training is still positive, but less strong. Of the five most export-intensive industries, it is clear that electronics and measuring instruments are relatively skill-intensive in terms of qualification, while clothing, leather goods and office equipment (e.g., stationery) are far less skill-intensive. In terms of training the ranking is quite different, with measuring instruments being a relatively high training industry and electronics being a relatively low training industry.

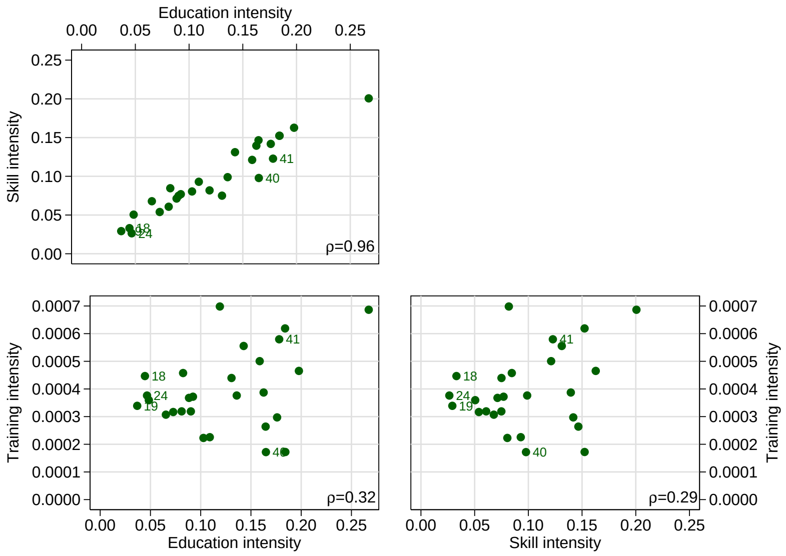


Fig 2.5. Three measures of industry skill-intensity. Source: CASIF. The five most export-intensive industries are labelled: 18=Clothing, 19=Leather and fur, 24=Office equipment, 40=Electronics, 41=Measuring instruments. The correlation coefficient between each measure is reported. Industry codes are listed in Table 2.3.

In Figure 2.6 we plot the three technology-intensity measures. Unsurprisingly, R&D intensity and new product intensity are very closely related, but the use of computers has a weaker relationship with these other two measures. In particular, plastics and metal products have very high computer use, but relatively low measures of new products and R&D. Once again, for all three measures, it is clear that of the five most export-intensive industries, electronics and measuring instruments are technology-intensive, while clothing, leather and office equipment are much less technology intensive.

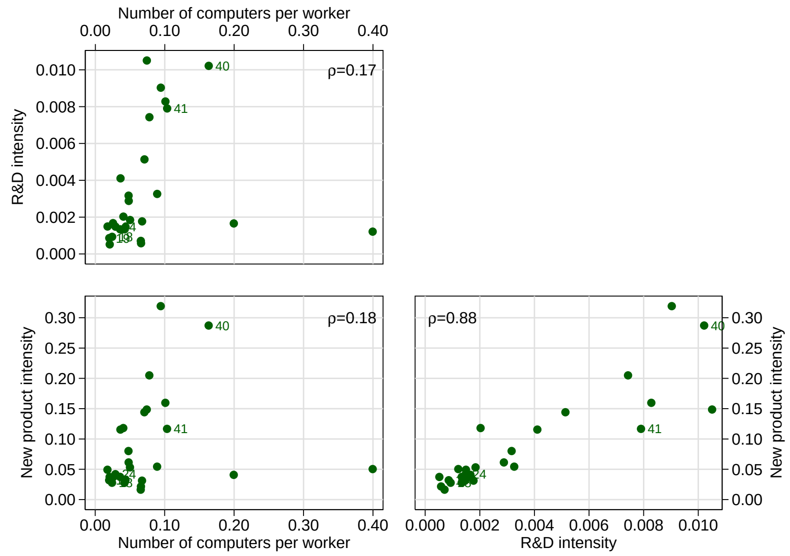


Fig 2.6. Three measures of industry technology-intensity. Source: CASIF. The five most export-intensive industries are labelled: 18=Clothing, 19=Leather and fur, 24=Office equipment, 40=Electronics, 41=Measuring instruments. The correlation coefficient between each measure is reported. Industry codes are listed in Table 2.3.

The relationship between export intensity and our six measures of skill- and technology-intensity is shown in Figure 2.7. A clear negative relationship is apparent for all six measures, although more so for the three skill intensity measures. Thus, at the industry level, industries which are less skill- and technology-intensive tend to have higher export intensities. This is consistent with the finding of Amiti and Freund (2010, Figure 4), which shows a concentration of exports in less skill-intensive industries, reflecting China's comparative advantages in trade with the world. It is also notable that industry 41, electronics (which accounts for over one-third of all exports), tends to be an outlier in that it is relatively skill intensive.

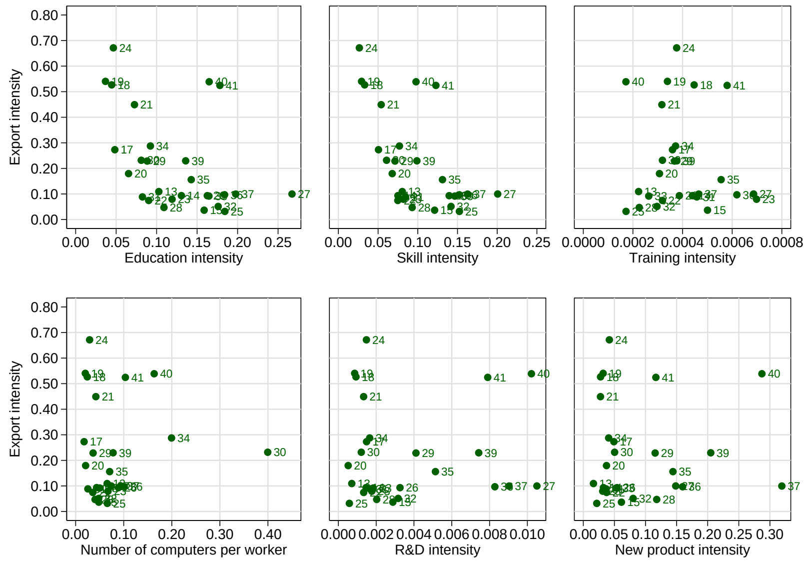


Fig 2.7. Export intensity and industry skill- and technology-intensity. Source: CASIF. Industry codes are listed in Table 2.3.

2.4.4 Within-industry technological changes in exports

Since the above analysis reveals substantial differences in technology levels across industries, we plan to take a look at how firms of different technology levels contributed to exports *within* their corresponding industries in order to control for these cross-industry technology differences. Within-industry examination could uncover useful information regarding technological change with industry-specific characteristics excluded. However, since the data set has information on different technology measures only for some specific years, we restrict our sample to the balanced panel of the CASIF firm data so that every firm in the data has non-missing values of these technology measures for at least one year.[17] We then categorise the firms into two groups: higher-technology group and lower-technology group by their technology rankings in each corresponding industry averaged over the years where the technology information is available. We then assign values of these group labels for each firm to other years where the technology information is missing, assuming

[17]By doing this we are not allowing entry and exit to affect the tech intensity of an industry.

that firms did not transit between these groups during the sample period.

By displaying the shares of export value by each technology group and by year, Figure 2.8 depicts a general picture of the evolution of skill content in exports. Firms with higher levels of technology saw their share of export value in the balanced panel significantly increased over time, while firms with lower levels of technology had their share decreased. It is suggestive of an rising technology content in Chinese exports regardless of how the technology is measured, consistent with the widely-existed conjectures and basic messages conveyed in some of the current studies (e.g. Rodrik, 2006; Schott, 2008).

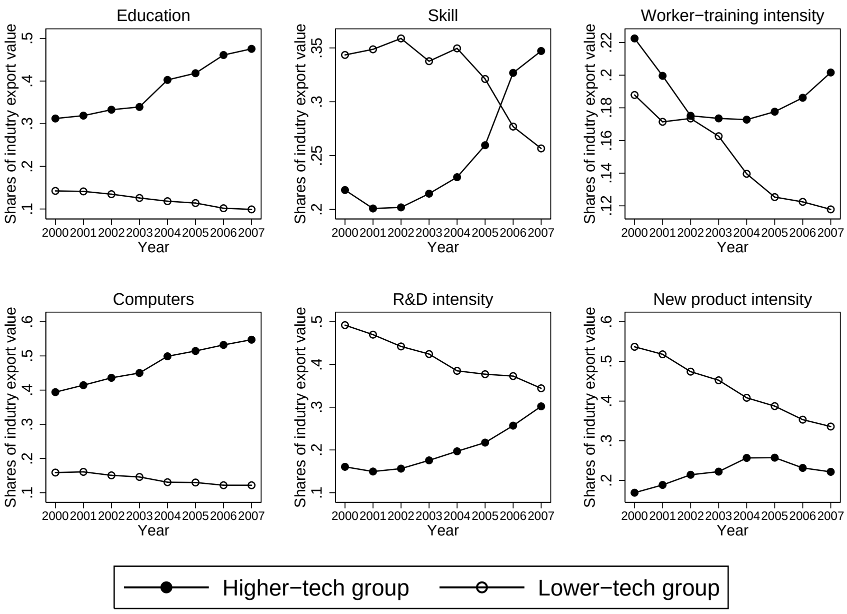


Fig 2.8. Shares of export value by technology group

A more rigorous way to examine this effect requires controlling for more influential effects. We do this by regressing the firm-level growth rate of export value over the eight-year horizon on firms' technology measures and dummies of years, industries, and ownership types. These dummies are included to capture the differences in export growth along the dimensions uncovered earlier in this chapter. The results are reported in Table 2.6. The control group here comprise firms with medium levels of technology. The coefficients of the indicators of higher-technology groups are universally positive at high significance levels, while the coefficients of the indicators of lower-technology groups are significantly negative. This further confirms the above conclusion that the technology content of exports increased as firms with higher technology levels appeared to play increasingly larger parts in exports, offering new evidence to the literature on the technology level of Chinese exports cited above in terms of firm composition. More generally, the evidence here emphasises the role of firms in shaping the technology level of exports, and thus directs the ongoing discussions at the aggregate level down to more fundamental economic activity, namely firm behaviour.

Table 2.6. Variations of export value growth across different technology groups (balanced panel)

	Education	Skill	Computer	R&D	Worker-training	New product intensity
Higher-tech group	0.353	0.294	0.314	0.116	0.361	0.272
	(0.056)	(0.059)	(0.054)	(0.079)	(0.053)	(0.091)
Lower-tech group	-0.152	-0.074	-0.099	-0.490	-0.092	-0.283
	(0.057)	(0.055)	(0.062)	(0.062)	(0.059)	(0.056)

Notes. Dummies for years, industries, regions, and ownership types are included in the regressions as well.

2.4.5 Technology intensity of export value

To see whether the skill intensity of Chinese exports has increased between 2000 and 2007,[18] we replicate the analysis of Amiti and Freund (2010), but using our Chinese firm-level measures of skill- and technology intensity. We aggregate the firm-level measures to the three-digit industry level by each year and order industries by increasing skill intensity. Figure 2.9 plots the cumulative distribution of export value in each industry against industry skill- and technology-intensity and repeats this analysis for 2000 and 2007.

[18]Note that we are able to analyse skill intensity in 2007 because we use export information from the CASIF firm-level data, not the transaction level data.

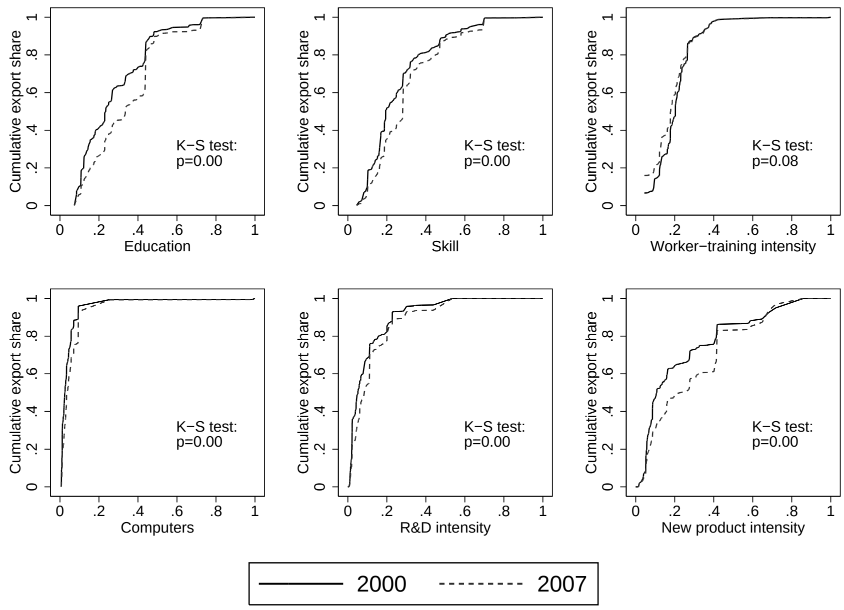


Fig 2.9. Cumulative share of exports by industry-level skill and technology measures, 2000 and 2007. Skill and technology intensity is measured at the firm-level using the CASIF data and aggregated to the three-digit industry level. *p*-values from a two-sample Kolmogorov-Smirnov test are also reported.

Figure 2.9 confirms that Chinese exports are still heavily weighted towards industries with less human capital and technology. In 2000, for example, 60% of Chinese exports were accounted for by industries in the bottom 30% of the education distribution. A similar pattern is observed for the other measures, with a particularly strong concentration of exports amongst industries with low computer use.

Figure 2.9 also shows that there has been an increase in the skill- and technology-intensity of Chinese exports when measured at the industry level aggregated from firm-level information. For five out of the six measures, the cumulative distributions shift significantly to the right.[19] This result confirms the finding of Amiti and Freund (2010), but is more reliable than the latter because here it is based on the measured distribution of skill- and technology-intensity in Chinese firms them-

[19]To have a statistical ground for the difference in the distributions, *p*-values from a two-sample Kolmogorov-Smirnov test are reported in Figure 2.9.

selves, rather than relying on the skill-distribution of another country.

Amiti and Freund also show that the increase in skill intensity disappears if one excludes processing exports. This implies that the increase in skill intensity was larger in industries with more processing trade. Note, however, that our measures of skill- and technology-intensity already take into account any effect from trade processing. For example, suppose that the increase in Chinese exports was accounted for by processing firms which required only very low levels of skill and technology, because these firms were simply assembling sophisticated inputs from abroad. If this was the case, the distribution of exports would have shifted to the left. Thus, Figure 2.9 provides evidence that *despite* the importance of processing trade in Chinese exports, the skill intensity of exports has increased.

2.4.6 Technology intensity of domestic value-added in exports

However, it still remains possible that the shift in the skill distribution of Chinese exports is a result of industries with low value-added (but high skill intensity) increasing their export share. As we have seen in Section 2.3.3, the electronics industry is the single most important contributor to Chinese exports, has very low value-added, but also employs a higher than average share of skilled workers. To examine this issue, we use the measures of domestic value-added defined in Eq. (2.3.6).[20] In Figure 2.10 we compare the skill and technology distribution of Chinese exports in 2006 based on final export value and on domestic value-added.[21] In five of the six measures the distribution of domestic value-added is to the left of the distribution of export value, indicating that this re-weighting reduces the measured "sophistication" of Chinese exports.

[20]Because this relies on the transaction-level data, measures of domestic value added are only available up to 2006.

[21]Results for other years are very similar, and are available on request from the authors.

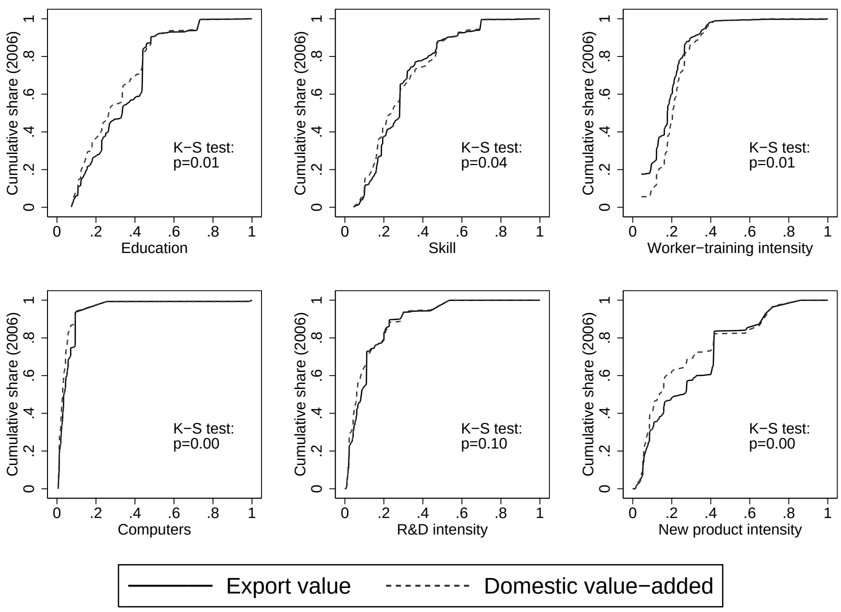


Fig 2.10. Cumulative shares of gross exports vs. domestic value-added in exports with respect to technology and skill measures (2006). Gross exports are from the CASIF data, while domestic value-added are computed as the product of gross exports and domestic value-added share at the three-digit industry level estimated from the CCTS data.

Finally, we wish to examine whether the increase over time in skill- and technology-intensity is affected by the use of domestic value-added rather than final export values. Figure 2.11 shows that there has still been an increase in skill and technology-intensity, but rather less than in Figure 2.9.

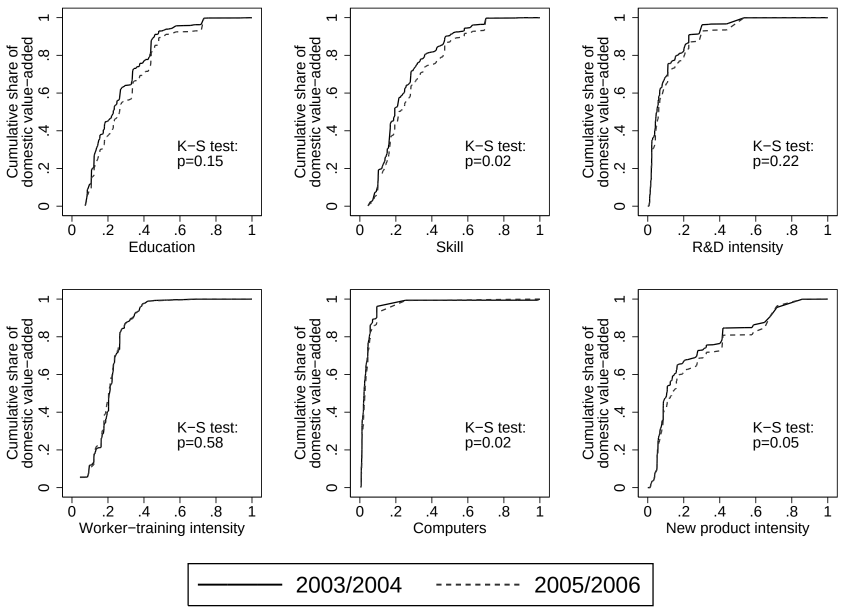


Fig 2.11. Cumulative shares of domestic value-added in exports with respect to technology and skill measures (2003–2006). Domestic value-added are computed as the product of gross exports and domestic value-added share at the three-digit industry level estimated from the CCTS data.

2.5 Conclusions

This chapter attempts to provide an assessment of the Chinese export boom from 2000 to 2007, which made China rise from a top five exporter to a top two exporter. Specifically, our main purpose is to evaluate the domestic contribution and foreign contribution to China's manufacturing exports and the technology intensity of the exports.

Distinct from the existing studies which all use sector-level data, our study relies on two micro data sets, the firm survey data and the customs trade records, and also a unique, comprehensive firm-product-level data constructed from them. We first develop an accounting method to measure the domestic value-added in Chinese exports, which fits the Chinese case. The method is improved based on Hummels *et al.*'s (2001) (HIY) measuring framework of vertical specialisation by taking into account the difference between processing trade and ordinary trade. The share of China's value-added in exports is shown to be only 30%, lower than what would be obtained by the HIY method. The foreign content increased moderately over time, which was primarily driven by coastal and foreign firms. We also find that entering exporting firms were the main source of decreasing domestic content, while existing exporting firms drove up the foreign content predominantly. Considering the previous finding that exporters are more likely to be processing firms, the implication here is that engaging in processing trade in China could greatly probably reduce not only entry costs of exporting but also variable costs of exporting.

Besides, we also examine the technology intensity of Chinese exports. Different from previous studies, we use a wider range of technology measures based on China's own data to capture the picture more precisely. As expected, we find general technological improvement in Chinese exports, although the lower-technology industries are still found to have tended to export higher proportions of their products than higher-technology industries. More interestingly, the technology intensity of Chinese value-added in exports was lower than that of exports measured in export value. The export value was distributed more towards higher-technology industries but the domestic content showed less prominent trend. This finding is novel and it seems that the "surprisingly" big numbers might be to some extent misleading and might have covered some important facts: technological improvement during the export boom had not changed the product composition of China's own domestic content in exports as much as its final export value implied to many researchers.

CHAPTER 3

Quota Restrictions and Price Adjustments of Chinese Textile Exports to the U.S.

3.1 Introduction

In the last chapter, we looked at the contribution and structure of Chinese exports in general. This chapter takes a more micro perspective and narrows down the focus to firms which export textile[1] and clothing products. Specifically, we investigate empirically how these firms respond to changes in a specific type of trade policy – product quotas. Quotas, as one of the major instruments of protectionist trade policies, have long been used by many countries to limit the volume of imports for various purposes. Amongst other things, a major reason for it being favoured to be a policy tool is that the quantity cap set by a import quota is believed as a convenient and effective way to protect domestic producers from foreign competition. Such protectionist policy, however, can lead to additional effects both in the importing and exporting country.

The reasons behind it are related to a widely accepted notion that quotas work

[1]For simplicity of expression, the broad term "textile(s)" is frequently used in this chapter to represent both "textiles" and "clothing" hereafter.

differently from tariffs as there is no simple "tariff-equivalence" for quotas. One reason is to do with the market structure: imperfect competition allows firms to exercise their market power by charging higher prices and selling fewer products than under tariffs (Bhagwati, 1965; Feenstra, 2003). A second reason is that the imposition of quotas induces quality upgrading by exporters. As first rigourously analysed by Falvey (1979), a quota is equivalent to a *specific price increase*, that is, the same price increase for each physical unit of goods, therefore as a result the quota will cause the relative price of expensive goods to decrease and shift the demand toward these high-price goods. Since the share of high-price goods increases, the average price goes up. In this sense, this effect of quota is very similar to the quality upgrading due to the per unit transport cost which was first observed by Alchian and Allen (1964) and empirically supported by Hummels and Skiba (2004). Given that our purpose is not comparing quotas with tariffs – instead, we simply focus on the effect of quotas –, the quality upgrading hypothesis is more relevant to our study.

Some empirical studies have lent direct support to the quality upgrading hypothesis for the effects of quotas. Feenstra (1988) studied the effect of U.S. quotas against Japanese automobiles and found evidence of quality upgrading of car models via two channels: improvement in characteristics for each model and an increase in the share of high-cost models. The descriptive analysis of Moore (2002, Ch. 4) documented rising unit value of the U.S. imports of Chinese textiles and apparel after China became a signatory to the Multifibre Arrangement (MFA) in 1983. More recently, Harrigan and Barrows (2009) tested the hypothesis by looking at the effect of the removal of the U.S. textile quotas on imports of Chinese textiles and apparel according to the quota phase-out requirement of the MFA. Their study finds clear evidence of quality downgrading due to the quota removal and thus confirms the hypothesis.

Without much doubt, it has been clear that a quota does lead to quality upgrading via changes in the shares of products of different costs/prices. However, our current knowledge of the quota effect is only limited to the demand side and nothing is known about the supply side. Specifically, while we already have convincing evidence on how quotas affect product quality at the product-level in the export market, we still lack information on how firms actually respond to quotas. When a firm faces changes in the restrictiveness of quotas, it could respond by entering/exiting the export market or by changing their mix and relative shares of export products. Investigation into firm response is not just out of theoretical curiosity; it also has implications for policy designers. Recognition of the possibility that quotas lead to reallocation of resources both among and within firms in the exporting country could refine our understanding of the economic effects of quotas, as a trade policy, in terms of impacts on industry dynamics and firm behaviour.

In this regard, our study is also closely related to the recently emerging theories on multi-product firms. Motivated by the growing evidence that international trade is dominated by multi-product firms and that a significant part of the margins of trade growth is driven by changes in product mix within firms, the multi-product firm models extend the single-product firm models by building the product-mix decisions of firms into the heterogeneous firm model of Melitz (2003). Theoretical work in this direction includes, but not limited to, Arkolakis and Muendler (2010), Bernard *et al*. (2011), Eckel and Neary (2010), and Nocke and Yeaple (2008). A key feature of this line of theories is the product-level heterogeneity aside from the firm-level heterogeneity. In the setup of these models, firms differ from each other in their productivity and also are able to produce or export products of different qualities. Consequently, firms not only select to export but also select to export some specific products. When there are changes in trade costs, firms have two extensive margins of adjustments: between-firm extensive margin and within-firm extensive margin. The former refers to firms' entering/exiting the export market, the sole extensive margin in the Melitz (2003) model, while the latter represents firms' adding/dropping product lines, a new margin of adjustment.

Models such as this could explain why and how firms respond to the changing market environment by making entry/exit decisions and/or by optimising product structures. But it has been a challenge to empirically test or evaluate these theories because, in reality, trade policies mostly come as part of complex policy packages and thus cannot be linked to specific firms or products. For example, in the study of product switching patterns of Indian firms, Goldberg *et al*. (2010) use the tariff rate of a firm's main industry as the trade policy measure, but this could be problematic for studying multi-product firms as it may be that a firm's products are not always protected by the industry tariff uniformly; a firm could in fact produce products across different industries, and even for the products in the same industry, they could be subject to different tariff schemes. As an improvement, Bernard *et al*. (2011) use four-digit SIC tariffs of Canada on U.S. imports as a proxy for the degree of trade liberalisation when studying the behaviour of U.S. firms, but the four-digit tariffs are still too aggregated to identify how differently products are restrained by tariffs within a single firm.

Firmly connected to the two literatures, this chapter provides empirical evidence on how quotas affect exporting firms. Specifically, we examine how firms make adjustments to their export behaviour when there are changes in import quotas in a foreign market. We choose the case of Chinese textile exports to the U.S. for this study. This is an ideal case for studying firm behaviour involving changes in quota policies for several reasons. First, our data is originally from the trade transactions recorded by Chinese customs and, after aggregation, provides a unique and comprehensive firm-product-level data set which greatly facilitates analysis of both firms and products. Second, the time period of the data covers the event of the global removal of textile quotas, which is widely known as the MFA/ATC quota elimination. This event is large-scale, discrete in timing, and exogenous to firms and consumers. Third, the information on the levels of U.S. textile quotas can be mapped to Chinese textile products, thus making it possible to distinguish products of different quota restrictiveness within firms. Finally, the above features of the data perfectly allow for research designs of treatment-control comparisons with different controls, enabling us to reveal causal effects of quotas at different levels.

This study contributes to the literature in the following ways. On the one hand, by exploring firm behaviour, our study opens up a new angle of looking at the economic effects of quotas, and adds to the micro-level and supply-side evidence on the effect of quotas. Importantly, our results complement those of Harrigan and Barrows (2009), which are all about the effects on products in the importing market, from the other side of the mirror.

In addition, our study enriches the broad literature of firms' response to trade policies. We produce clear evidence on how changes in quota restriction induce firms to adjust their export prices, and how the effect of quota liberalisation varies across different types of firms and products. Since within-firm adjustment in the multi-product firm models is a new element to the heterogeneous firm models, the new predictions regarding within-firm adjustments need to be evaluated with data. However, in the existing theoretical models, trade policies are mostly oversimplified as policies leading to changes in trade costs. For this reason, contexts of concrete policy environments are required such that related issues could be addressed and discussed in a clear way. However, as already mentioned, trade policies in the existing empirical work concerning multi-product firms are too aggregated to be related to individual firms and products. By contrast, quotas in this study can be linked to individual products at a very disaggregated level. Apart from this, other nice features of the MFA/ATC quota elimination provide a unique and clear-cut policy shock for studying firm responses.

In a recent paper by Khandelwal *et al*. (2011), they also explore the MFA quota elimination, using the same data as ours, and find evidence for firm exit and product price drop. By comparing firms of different ownership types, they attribute the price drop to the exit of state-owned firms and entry of non-state firms which charged lower prices. This finding is consistent with their theory of inefficient allocation of quota licenses, which, based on the anecdotal evidence that state-owned firms were more likely to get licenses, predicts that the removal of MFA quotas would force inefficient state-owned firms to leave and more productive firs to enter the export market. A main difference between our study and theirs is that we explore the sources of the drop price and the heterogeneity of the quota elimination effect both across firms and across products.

A brief overview of our findings is given as below. First, using an entirely independent source of data, we provide consistent results to Harrigan and Barrows (2009) – the MFA quota removal reduced average export prices by about 30%. Second, a further analysis reveals that the most important contribution to this price fall is caused by the entry of "low price" firms, which implies that quotas impose higher trade barriers on market entry than on exporting new products. Third, it is also shown that less than one-third of the price reduction is due to firms lowering prices on products which they sold before and after the quota removal, indicating a degree of price drop even within product categories. Finally, we find evidence about how the quota removal effect varies across firms of different ownership types, and this sheds light on the inefficiency of the quota allocation system in China.

The rest of the chapter is organised as follows. Section 3.2 gives the institutional background of the MFA/ATC quota system. Section 3.3 describes the data used in this study. In Section 3.4, we propose our research design and explain the empirical methodology involved. Empirical results are presented in Section 3.5 and we check their robustness in Section 3.6. Section 3.7 concludes with remarks on future research directions.

3.2 Institutional Background

For trade in textile and clothing products, the Multifibre Arrangement (MFA) had been the dominant international agreement that protected markets in developed countries from developing countries via quota limitations on imports between pairs of importing and exporting countries since 1970s. Central to the MFA were a series of bilateral agreements between large developed-country importers, such as the U.S. and E.U. countries, and developing-country exporters, such as Bangladesh, China, and India.

In 1995, the MFA was succeeded by a new agreement, the Agreement on Textiles and Clothing (ATC), as an achievement of the Uruguay Round talks. Under the ATC framework, countries reached bilateral agreements on the details of how quotas were imposed and how they would be removed gradually. By the rules of the ATC, textile and clothing products were integrated into GATT/WTO rules in four phases (1995, 1998, 2002, and 2005), and each phase involved quota phase-outs on more products and an acceleration of growth rates in quotas. Particularly, in the final phase the quotas were to be totally eliminated on 1 January, 2005.

The U.S. is the second largest overseas market for Chinese textile exports, after Japan.[2] As China was not a member of WTO before 2001, it was initially not eligible for the ATC quota phaseouts. However, after China entered into the WTO in the end of 2001, it immediately enjoyed the first three stages of quota integration in the U.S. market in 2002 (Harrigan and Barrows, 2009). The U.S. quotas on imports of Chinese textiles were removed on 1 January 2005. But according to China's WTO accord, special safeguard mechanisms against Chinese textile exports would remain in effect until December 31, 2008 in case these products disrupted the destination market. This implies quotas could still be reimposed temporarily after 2005

[2]If we see Hong Kong as an overseas market for Chinese exports, then Hong Kong ranks second among all destination. But we do not consider reexports of Chinese textiles from Hong Kong to other countries, which will unnecessarily complicate our analysis.

if Chinese textile exports were believed to have harmed the market of the importing country (Yeung and Mok, 2004; Harrigan and Barrows, 2009). Indeed, as the imports of Chinese textiles did grow extraordinarily fast, some temporary quantity caps on imports were set by the U.S. against the large influx of some Chinese textile products after the middle of 2005. According to a new memorandum reached by both countries in November 2005, some new quotas would remain in force for a three-year period from 2006 to 2008.

While there were dramatic changes in the U.S. quotas on imports of textile products from China, it is worthwhile to note that the U.S. Most-Favoured-Nations (MFN) tariffs for these products which also naturally applied to China after its WTO entry remained fairly stable. Particularly, from 2004 to 2005, all U.S. MFN tariffs on textiles remained unchanged, thus making the lift of MFA/ATC quotas by far the only major policy shock during this short period.[3]

3.3 Data

3.3.1 Data source

Our sample consists of products covered by the MFA/ATC which were exported by Chinese firms to the U.S. market from 2000 to 2006. The data is from the transaction-level database of the Chinese Customs Trade Statistics (CCTS) which records monthly the firm identifications, free-on-board values, physical quantities, destination/source countries, and other information on all goods passing through Chinese customs. All goods are labeled by eight-digit Chinese HS codes. Since virtually all the MFA/ATC products fall in the Harmonised System (HS) chapters

[3] The information on U.S. tariffs can be found in the Tariff Database on the website of the United States International Trade Commission (USITC) at `http://dataweb.usitc.gov/`.

of textile and clothing products, i.e., chapters 50 to 63,[4] we first drop all products outside these chapters. Further, since MFA/ATC products account for more than 90% of the export value of these textile products, we exclude the small proportion of products which are not covered by the MFA/ATC.[5] The raw data contains a number of trading agents (intermediary firms) which mediate trade for other firms without directly engaging in production themselves. Inclusion of these firms could cause problems as their behaviour is probably very different from that of *production firms* which are the objects of this study. Therefore we exclude these trading firms which are identified by certain keywords in their names.[6] The data is further collapsed to the firm-product level for each year to facilitate our analyses. Thus, an observation in the data is identified by a firm code (i), a six-digit product code (j), and the year (t).

3.3.2 Identification of MFA/ATC products

MFA/ATC products account for more than 92% of Chinese textile products exported to the U.S. (HS chapters 50 to 63) and are identified according to the Appendix of the ATC.[7] HS codes are common across countries for the first six digits and each

[4]We notice that the HS codes were upgraded in 2002 to a new version, but for six-digit-level textile and clothing products, the codes remained almost the same. Besides, for the key parts of this study, we only compare products which existed both in 2004 and 2005, which excludes product categories that were given codes new to the previous HS. Thus, the switch of HS codes are very unlikely to affect our analyses.

[5]In the related studies on imports of Chinese textiles in the U.S., Harrigan and Barrows (2009) and Brambilla *et al*. (2010) also restricted their samples to MFA/ATC products.

[6]Manova and Zhang (2009, 2012) identified such firms for the period of 2000 to 2005, but they did not mention what these keywords were. Ahn *et al*. (2011) used the Chinese characters meaning "importer", "exporter", and "trading" to identify the "intermediary firms". By contrast, we use our own, but more comprehensive list of keywords which are exclusively used by various kinds of trading agents in China. See Wang and Yu (2010) for a complete list of the keywords and the comparisons of our identification results with those by Manova and Zhang (2009, 2012) and Ahn *et al*. (2011).

[7]See Table B1 of Appendix A for the proportion of the MFA/ATC products in Chinese textile products exported to the U.S. in 2004. The full text of the ATC, including its Appendix, is available at the WTO webpage at `http://www.wto.org/english/docs_e/legal_e/16-tex_e.htm`.

country can add more digits according to its own needs. The Appendix of the ATC details the products at the six-digit HS level, enabling us to identify these products precisely in our customs data.

3.3.3 Identification of quota products

The U.S. implemented quotas on Chinese textile products through the U.S. Office of Textile and Apparel (OTEXA), which listed by year detailed quota information. In practice, these quotas were implemented through three-digit OTEXA quota categories and each category contains multiple ten-digit HS codes, the most detailed HS level.[8]

One difficulty that prevents us from precisely identifying quota products at the most detailed eight-digit Chinese HS level in our data is the fact that the Chinese and the U.S. HS systems are consistent only up to the first six digits. This means although the U.S. quotas can be linked to the ten-digit U.S. HS codes, they cannot be linked to the Chinese HS codes at levels more detailed than 6 digits. For this reason, we collapse our data on product from the eight-digit level to the six-digit level so that we are able to map data on U.S. quotas to our customs data (at the six-digit level).

3.3.4 Calculation of fill rates

The fill rate (or utilisation rate) is a widely used measure which indicates how restrictive a quota is during a given time period (normally a year). It is defined as the ratio of the actual quantity imported to the quantity set by the quota. It ranges from 0 to 1, with a bigger number representing a higher proportion of a quota

[8]We obtained the concordance between OTEXA quota categories and ten-digit HS codes from OTEXA.

actually used. A higher fill rate indicates a higher degree of restriction a quota imposes on a product. An effective quota is a quota which is sufficiently restrictive to impose real restraint on trade in a product. If the fill rate falls below a certain level, the quota is then seen as being not restraint on trade. Therefore, the quota fill rate is a crucial measure to differentiate effective (binding) quotas from ineffective (unbinding) quotas.

The calculation of fill rates for this study, however, has been largely complicated by both the fact that we can only restrict our main analyses at the six-digit level and the fact that the U.S. administered textile quotas through three-digit OTEXA categories. In principle, the calculation of the fill rate for each six-digit product j at year t in the U.S. market should be as straightforward as

$$\text{FILLRATE}_{jt} \equiv \frac{\text{QUANTITY}_{jt}}{\text{QUOTA}_{jt}}, \tag{3.3.1}$$

where QUANTITY is the actual quantity exported and QUOTA is the quantity limit imposed. Obviously, to get FILLRATE_{jt}, one must know QUANTITY_{jt} and QUOTA_{jt}. But the reality is that we have no direct data on both QUANTITY_{jt} and QUOTA_{jt}.

However, using an external data on the U.S. import quantity of each ten-digit product from China by year,[9] we are able to get QUANTITY_{jt} simply by aggregation over all subsidiary ten-digit products k under j, i.e.,

$$\text{QUANTITY}_{jt} = \sum_{k \in j} \text{QUANTITY}_{kt}. \tag{3.3.2}$$

[9] We obtained this information from the underlying data of Schott (2008), which is downloadable at Peter Shott's personal webpage at `http://www.som.yale.edu/faculty/pks4/sub_international.htm`

Now the difficulty is in how to get QUOTA_{jt}. Quotas are quantity limits, and therefore as above, QUOTA_{jt} can be seen as an aggregation from ten-digit products:

$$\text{QUOTA}_{jt} = \sum_{k \in j} \text{QUOTA}_{kt}. \tag{3.3.3}$$

Unfortunately, since U.S. textile quotas were mostly implemented at the much more aggregated three-digit OTEXA category level, we do not have exact information on the quota level for each ten-digit product, QUOTA_{kt}, which is essential for the calculation. However, if fill rates for all ten-digit products within each quota category are assumed to be the same as the category-level fill rate, FILLRATE_{kt} will be known from OTEXA and can be attributed to all HS products within corresponding U.S. quota categories.[10] The quota level QUOTA_{kt} can now be computed as

$$\text{QUOTA}_{kt} = \frac{\text{QUANTITY}_{kt}}{\text{FILLRATE}_{kt}}. \tag{3.3.4}$$

Inserting Eq. (3.3.2), (3.3.3), and (3.3.4) into Eq. (3.3.1), we eventually obtain the six-digit-level fill rate which is aimed for:

$$\begin{aligned} \text{FILLRATE}_{jt} &= \frac{\sum_{k \in j} \text{QUANTITY}_{kt}}{\sum_{k \in j} \text{QUOTA}_{kt}} \\ &= \frac{\sum_{k \in j} \text{QUANTITY}_{kt}}{\sum_{k \in j} (\text{QUANTITY}_{kt} / \text{FILLRATE}_{kt})}, \end{aligned} \tag{3.3.5}$$

Finally, following Brambilla *et al*. (2010), Harrigan and Barrows (2009), and Khandelwal *et al*. (2011), a quota is defined to be binding if and only if $\text{FILLRATE}_{jt} \geq$

[10] In fact this is exactly how Brambilla *et al*. (2010) attached quota information to HS products.

0.9, but we will check the sensitivity of our results to a range of other cutoffs for binding fill rates later on .[11]

3.4 Research Design

The purpose of this empirical work is to reveal the effect of the MFA/ATC quota removal on the exporting behaviour of firms, in particular in terms of the export price and entry into and exit from the export market. From the point of a research design, we already have the event of policy change clearly defined on the time line – the MFA/ATC quota removal on 1 January 2005, and our data covers periods both before and after that event. But to complete this task of identifying the causal effect, we still need clearly defined treatment and control groups which exist in both the pre-event and post-event periods. Treatment-control comparisons in such a fashion naturally call for a "difference-in-differences" (DD) design. However, the construction of treatment-control groups depends on the specific content of research target.

As the first step, we start with a product-level comparison, abstracting away the role of firms. The data are collapsed down to the product level, so each product price is actually the quantity-weighted average price across all firms. This is to be in line with Harrigan and Barrows (2009) and allows us to see how the quota removal affects products in general. The crucial data underlying our DD comparisons are

[11] In some cases there existed two layers of quotas for some Chinese textile products. The first layer was simply category-specific quotas which were implemented through three-digit OTEXA quota categories. All products within a category were subject to a common quantity limit. The second layer was category-group quotas which were imposed on multiple OTEXA quota categories within the category group. Some products were subject to quotas of both layers (See Brambilla *et al.* (2010) for more details). For example, in 2001, products in OTEXA category 218 were subject to a category-specific limit of 12,565,591 square metres, 91.0% of which was filled by the end of the year; but at the same time, they were also constrained by a category-group (GROUP-I which consisted of categories 210, 218, 219, etc.) limit of 1,506,349,283 square metres, 85.1% of which was filled by the end of the year. In such cases, we take the maximum of the two fill rates (91.0% in the above example) as the actual fill rate of these products in that year.

the data of the years 2004 and 2005. The treatment group here is those products bound by quotas in 2004 but no longer subject to quotas after 2004, while the control group is those products unbound by quotas (including those without quotas) in 2004 and no longer subject to quotas after 2004. A product's status of belonging to either the treatment group or the control group is fixed over time, that is, it does not switch its status over time. By this setup, we exclude products which were reimposed quotas after 2005, and thus simply focus on the effect of the quota removal. Apart from this, if a product lacks data in 2004 and 2005, it will not be classified as being in either of the groups. For this reason, the products which do not exist in our data in either of these two years are excluded from our analytical sample.[12] The DD regression takes the form of:

$$\mathrm{Y}_{jt} = \alpha + \sum_{t\in\mathbf{T}} \delta_t \mathrm{YR}_t + \rho \mathrm{TREAT}_j + \sum_{t\in\mathbf{T}} \lambda_t (\mathrm{YR}_t \times \mathrm{TREAT}_j) + \mathbf{FE} + \varepsilon_{jt}, \quad (3.4.1)$$

where subscripts j and t index product and year, $\mathbf{T}$ represents the whole set of years, i.e., $\mathbf{T} = \{2000, 2001, 2002, 2003, 2005\}$, Y_{jt} is the outcome variable, which could be value, quantity, or unit value,[13] YR_t is the year-fixed effect, TREAT_j indicates whether a product is in the treatment group or the control group as follows:

$$\mathrm{TREAT}_j = \begin{cases} 1, & \text{bound by quota in 2004 and no quota in 2005;} \\ 0, & \text{unbound by quota in 2004 and no quota in 2005.} \end{cases}$$

The term **FE** represents some sorts of fixed effects to be included where necessary. The constant term α captures the average of Y_{jt} for the control group in 2004. The

[12] These products account for about 0.5% of the value of all export products.

[13] Unit value is the calculated as total value divided by total quantity.

error term ε_{jt} is assumed to be of *i.i.d.* distribution. In the spirit of DD design, δ_t captures the change in Y_{jt} over time for all products, and ρ picks up the difference between the treatment and the control group in the base year, that is, 2004. Further, the coefficient λ_t gives a second difference: it estimates the differences in the outcome variable between the treatment and the control groups after removing cross-year differences controlled by δ_t. The year 2004 is chosen to be the omitted year as this is the year right before the MFA/ATC quota elimination. Importantly, of λ_t of various years, λ_{2005} is the key one as it is the DD coefficient that captures how the quota removal in 2005 affected previously quota-bound products and previously quota-unbound products differently. Particularly, if λ_{2005} turns out to be negative and significant in the price regression, it then indicates that the removal of quotas lowered product prices, or reversely, the imposition quota of would raise product prices.

The data also allow us to explore variations in the outcome variables at more disaggregated firm-product levels, that is, we can replace Y_{jt} with Y_{ijt}, where i indexes firms. Further, since it is possible that some time-invariant characteristics could to some extent drive our results, we again add **FE**, which represents various forms of fixed effects, to control for these unobserved but potentially influential time-invariant factors. Specially, **FE** can be firm fixed effects, product fixed effects, or firm fixed effects plus product fixed effects in some circumstances. The addition of these fixed effects restricts the above-mentioned treatment-control comparisons to be within-firms, within-products, or within firm-product combinations. Note that a DD setup is a version of fixed effects estimation itself, which is seen in our time and treatment dummies. But since the flexibility of the content of **FE** allows refined exploration of treatment-control comparisons at different levels, the differences in these results should give meaningful implications on the sources of variations in the outcome variables. Thus, the complete specification for the log unit value comes as the following:

$$\begin{aligned}\ln \mathrm{Y}_{ijt} = \alpha + \sum_{\substack{t \in \mathbf{T} \\ t \neq 2004}} \delta_t \mathrm{YR}_t + \rho \mathrm{TREAT}_j + \sum_{\substack{t \in \mathbf{T} \\ t \neq 2004}} \lambda_t (\mathrm{YR}_t \times \mathrm{TREAT}_j) \\ + \omega \mathrm{MSHARE}_{ijt} + \mathbf{FE} + \varepsilon_{ijt}.\end{aligned} \tag{3.4.2}$$

While the above DD regression is designed for evaluating treatment effects, it is not able to further distinguish the effects between groups of observations. Specifically, the DD regression is expected to give the *average* quota effect of the sample, but it is not able to offer any answers to how that effect differs between, for example, new exporters and existing exporters. As will be clearer later on, further splitting the sample into different groups of observations of different characteristics enables us to inspect the heterogeneity in the quota effect, especially that regarding how the quota effect worked on different types of firms differently.

To overcome this problem, we extend the DD regression simply by one additional dimension, which is often termed as "difference-in-differences-in-differences" (DDD) design[14] in analogy with DD design. In practice, DDD estimates could be obtained from differences between multiple DD regressions. Suppose these DD regressions take the same form as above:

$$\begin{aligned}\ln \mathrm{Y}^d_{ijt} = \alpha^d + \sum_{\substack{t \in \mathbf{T} \\ t \neq 2004}} \delta^d_t \mathrm{YR}_t + \rho^d \mathrm{TREAT}_j + \sum_{\substack{t \in \mathbf{T} \\ t \neq 2004}} \lambda^d_t (\mathrm{YR}_t \times \mathrm{TREAT}_j) \\ + \omega^d \mathrm{MSHARE}_{ijt} + \mathbf{FE} + \varepsilon_{ijt},\end{aligned} \tag{3.4.3}$$

where the only difference with Eq. (3.4.2) is the superscript d which is an indicator of the regression based on a subsample of the previous DD regression sample. At some point in the analyses that follow, we divide products into *differentiated*

[14] This method is sometimes also called "triple differences" design.

products and *homogeneous products* by their price variabilities for the purpose of relating variations in price drop to quality differentiation. In that case,

$$d = \begin{cases} \text{dif}, & \text{differentiated products;} \\ \text{hom}, & \text{homogeneous products.} \end{cases}$$

In the case where we try to identify the differences in the treatment effect for firms of different ownership types and sizes, the specifications of the subsamples are

$$d = \begin{cases} \text{state}, & \text{state-owned firms;} \\ \text{foreign}, & \text{foreign firms;} \\ \text{dom}, & \text{other domestic firms.} \end{cases}$$

and

$$d = \begin{cases} \text{large}, & \text{large exporters;} \\ \text{small}, & \text{small exporters.} \end{cases}$$

Finally, we also intend to look at the differences between entrants and incumbents in the export market, in which case

$$d = \begin{cases} \text{new}, & \text{new exporters;} \\ \text{cont}, & \text{continuing exporters.} \end{cases}$$

The DDD estimates of interest for the above two cases are $\lambda_{2005}^{\text{dif}} - \lambda_{2005}^{\text{hom}}$, $\lambda_{2005}^{\text{state}} - \lambda_{2005}^{\text{dom}}$, and $\lambda_{2005}^{\text{foreign}} - \lambda_{2005}^{\text{dom}}$, $\lambda_{2005}^{\text{large}} - \lambda_{2005}^{\text{small}}$, $\lambda_{2005}^{\text{new}} - \lambda_{2005}^{\text{cont}}$.

3.5 Empirical Results

3.5.1 Descriptive results

To have a sense of the scope of the changes in the quota coverage, Table 3.1 shows the numbers of products (six-digit HS level) covered by quotas and products bound by quotas for each year. The changes in these numbers over time are highly consistent with the timeline of quota removal and reimposition. Before 2004, the numbers of products not subject to U.S. quotas increased only very slightly from 33 to 46.[15] In 2004 quotas on about 90 ($134 - 46 = 88$) more products were removed, but the number of products *not* subject to quotas increased abruptly by 420 ($554 - 134 = 420$) in 2005 when all the MFA quotas were scheduled to be eliminated completely. However, because of the U.S. special safeguard mechanism, quotas were reimposed on some products in the middle and end of 2005, and a new U.S.-China memorandum was reached which specified which and how new quotas were to be imposed from 1 January 2006 to 31 December 2008. This explains the reason why in the table the number of quota products was still positive in and after 2005 when it should have been zero if the U.S. had not taken any safeguard measures. The number of quota-bound products exhibited similar trends, but an exception is that new quotas in force in 2006 were not binding. In other words, none of the 179 products subject to U.S. quotas in 2006 had a fill rate above 0.9.

Note that the figures given above of how many products were bound and unbound by quotas each year are not exact indications of the treatment and the control group. As explained in Section 3.4, the definitions of the two comparison groups require data on two crucial years: 2004 and 2005. If a product does not exist in our

[15] In fact, there could be some products which exited quota coverage before 2004 if a product is defined at more detailed HS levels than 6 digits. But in such case, we would not be able to link these products with quota information from the U.S. source. As a result, if a six-digit HS product exited quota coverage in a year, it should be interpreted as a case that all products in this HS category exited quota coverage entirely.

Table 3.1. Numbers of the MFA/ATC products exported from China to the U.S.

	Subject to U.S. quotas or not		Bound by U.S. quotas or not		
Year	No	Yes	No	Yes	Total
2000	33	471	236	268	504
2001	35	480	380	135	515
2002	40	501	471	70	541
2003	46	529	460	115	575
2004	134	446	443	137	580
2005	554	107	565	96	661
2006	477	179	656	0	656

Notes. Products are six-digit HS products. Quota products are those textile and clothing products subject to U.S. quotas. Quota-bound products are those textile and clothing products subject to U.S. quotas with fill rates larger than 90%. Fill rate of a product is the ratio of actual quantity imported by the end of calendar year to quota level of that year. An exception is the year 2005, in which quotas were reimposed on some products after the middle of the year and the fill rates are calculated based on periods shorter than 7 months in stead of a whole calendar year.

data in 2004 or 2005, it is excluded from our analytical sample. For this reason, the numbers of products in the treatment and control groups should be smaller than those of the quota-bound and the quota-unbound products, respectively. Indeed, such discrepancy is seen if one compares Table 3.1 with Table 3.2 which gives a brief summary of the two comparison groups.

The export values from the two comparison groups in Table 3.2 are more intuitively displayed in Figure 3.1 which makes a comparison of the export value growth rates between these two groups of products. The difference between these two groups graphically captures the effect of the quota removal in 2005 on export value growth. Indeed, it shows that the difference in growth from 2004 to 2005 is prominent. Underlying data suggest that after quotas were removed, the previously quota-bound products experienced 155% growth ($(1735/681-1)\times 100\% = 155\%$) in exports, while those not bound by quotas in 2004 only grew by 61% ($(4540/2830-1)\times 100\% = 60\%$). This big contrast reflects the significant effect of the MFA quota elimination and is also generally consistent with what Harrigan

Table 3.2. Summary of the treatment and control groups in the analytical sample

	Number of products			Value of products (million USD)		
Year	Treatment	Control	Total	Treatment	Control	Total
2000	75	295	370	400	813	1,213
2001	82	300	382	472	873	1,345
2002	87	322	409	424	1,169	1,593
2003	93	344	437	557	2,003	2,560
2004	98	374	472	681	2,830	3,510
2005	98	374	472	1,735	4,540	6,275
2006	96	366	462	2,382	5,531	7,912
Average	90	339	429	950	2,537	3,487

Notes. Products are six-digit HS products. Treatment group: products bound by quotas in 2004 and not subject to quotas in 2005. Control group: products unbound by quotas in 2004 and not subject to quotas in 2005.

and Barrows (2009) found for the U.S. imports of Chinese apparel and textiles in the same period.[16]

The fact that export quantities increased far faster in the group of products which had binding quotas removed is entirely unsurprising. More pertinently, in Figure 3.2, we plot by year the unit values for the treatment and control groups separately. To make the unit values comparable across products with different physical measurement units (e.g., kilograms and square metres), all unit values are demeaned within each group of products with the same physical measurement u-

[16]By the estimates of Harrigan and Barrows (2009), the value of imports of Chinese apparel and textiles grew by 45%. There are several possible reasons for the discrepancy between their estimate and ours. First, Harrigan and Barrows's (2009) sample includes all MFA/ATC products imported from China, while ours excludes trading firms, keeping only pure production firms. Production firms may have incentive to increase their exports more by themselves than by trading agents after the MFA/ATC quotas expired in order to save costs on intermediary fees paid to trading firms. Second, their definition of goods is at the ten-digit HS level, more detailed than ours. Export value of quota-bound six-digit products in 2004 may be lower than that of quota-bound ten-digit products because our measure of fill rates of six-digit products may have been driven down by quota-unbound ten-digit products within each six-digit category. This leads to fewer products classified as quota-bound products in 2004 than by ten-digit definition. Third, their estimates of growth are weighted averages of quota groups, where the weights are the groups' shares of exports averaged over 2004 to 2005. As the share of quota-unbound products were much higher in 2004 than in 2005, their measure probably gives more weights to the export growth of quota-unbound products than if simply calculates the aggregate value growth.

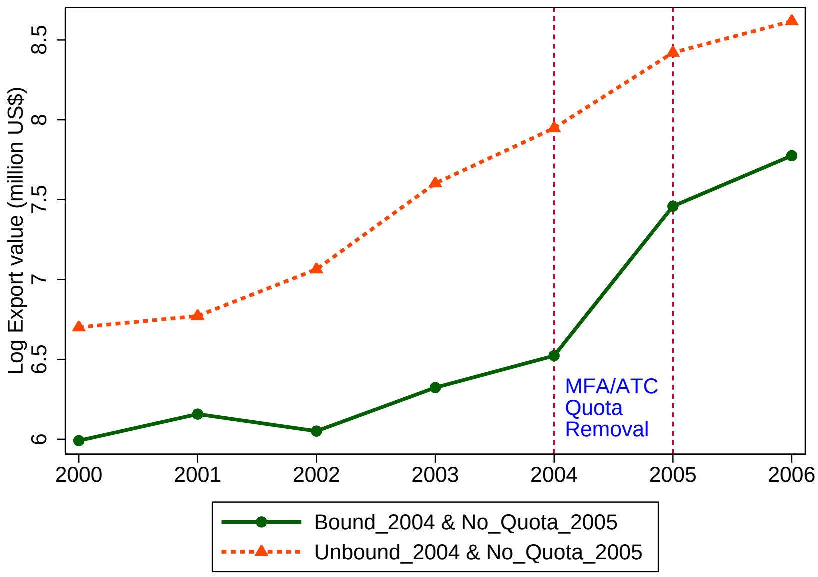


Fig 3.1. Export value of products

nit. On top of others, a compelling message from the figure is that with a common declining trend, the unit value plummet in 2005 was much steeper for the treatment group than for the control group: the average decrease of demeaned price is more than 3 USDs for the treatment products, while it is only more than 1 USD for the control products. This finding serves as strong evidence of price decline caused by the quota removal. Overall, the graphical illustration here implies a sizable negative effect of the quota removal on product price, and also justifies the use of formal estimation strategies involving treatment-control comparisons.

3.5.2 Product-level analysis

The baseline estimates come from the product-level regressions of Eq. (3.4.1). The results are reported in Table 3.3, with the outcome variable being log value ($\ln V_{jt}$), log quantity ($\ln Q_{jt}$), or log unit value ($\ln P_{jt}$). First, let us look at the plain OLS specification ("No FE") without including any fixed effects. The parameter δ_{2005} shows that the total export value of an average textile product nearly doubled (94%)

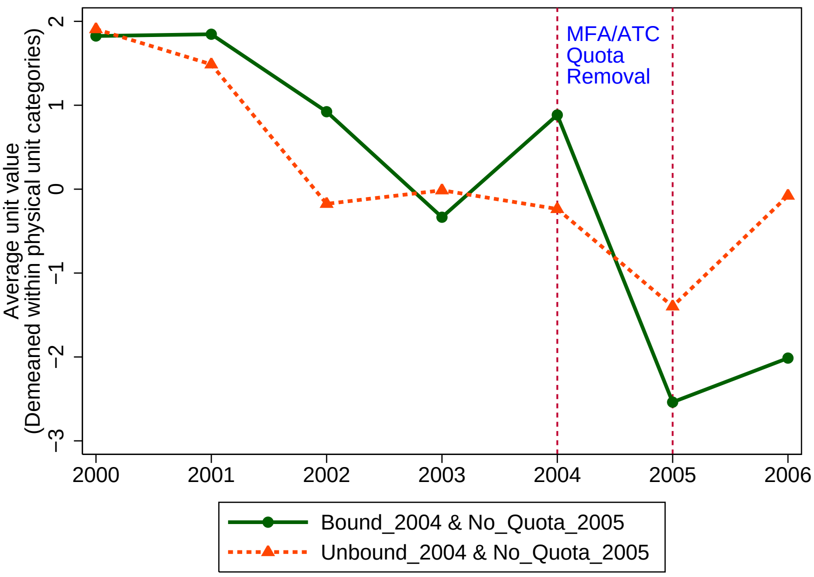


Fig 3.2. Unit value of products

in 2005 after the quotas were eliminated. But λ_{2005} further reveals that among these products, the growth rate was 60% higher for those products subject to binding quotas prior to the quota elimination, compared to those not. Similar results are found for quantity, but the magnitudes are larger. On average, the products experienced 106% growth in 2005 relative to 2004 in terms of quantity exported. Again, the growth is extremely uneven between the quota-bound and the quota-unbound products. As is captured by λ_{2005}, the quantity growth rate was 88% higher for a quota-bound product than for a quota-unbound product. This number is impressive and is consistent with the previous statistics and the finding in Harrigan and Barrows (2009).

Then, we move on to the other two specifications which impose fixed effects into the regression: measurement unit fixed effects and product fixed effects. One reason for the measurement unit fixed effects to be introduced is, as mentioned before, to avoid the difficulty in comparing prices among products measured by different physical units (e,g., kilograms versus square metres). The other reason is to correct the potential bias caused by pooling products measured by different

Table 3.3. Full result of the product-level estimates of the price effect of quota. Dependent variable: $\ln \mathbf{P}_{jt}$.

	Export value: $\ln V_{jt}$			Export quantity: $\ln Q_{jt}$			Export unit value: $\ln P_{jt}$		
	No FE	Meas. unit FE	Product FE	No FE	Meas. unit FE	Product FE	No FE	Meas. unit FE	Product FE
δ_{2000}	−0.417***	−0.545***	−1.023***	−0.517***	−0.622***	−1.081***	0.099*	0.076	0.060
	(0.146)	(0.142)	(0.144)	(0.158)	(0.155)	(0.157)	(0.053)	(0.051)	(0.049)
δ_{2001}	−0.536***	−0.647***	−1.105***	−0.594***	−0.722***	−1.203***	0.080	0.096*	0.109**
	(0.146)	(0.140)	(0.133)	(0.166)	(0.160)	(0.152)	(0.054)	(0.054)	(0.050)
δ_{2002}	−0.093	−0.179	−0.550***	−0.060	−0.118	−0.517***	−0.032	−0.060	−0.031
	(0.114)	(0.109)	(0.102)	(0.125)	(0.122)	(0.112)	(0.048)	(0.047)	(0.045)
δ_{2003}	0.139	0.094	−0.105	0.157	0.114	−0.108	−0.018	−0.019	0.002
	(0.101)	(0.098)	(0.089)	(0.112)	(0.108)	(0.096)	(0.040)	(0.038)	(0.039)
δ_{2005}	0.944***	0.954***	0.944***	1.059***	1.075***	1.059***	−0.114***	−0.120***	−0.114***
	(0.085)	(0.086)	(0.093)	(0.091)	(0.093)	(0.099)	(0.032)	(0.033)	(0.035)
δ_{2006}	1.395***	1.389***	1.328***	1.388***	1.388***	1.323***	0.007	0.000	0.005
	(0.096)	(0.096)	(0.103)	(0.106)	(0.107)	(0.114)	(0.036)	(0.036)	(0.038)
ρ	0.483	0.054		0.061	−0.400		0.422***	0.455***	
	(0.325)	(0.278)		(0.325)	(0.305)		(0.116)	(0.115)	
λ_{2000}	0.580*	0.319	0.292	0.581*	0.381	0.365	−0.001	−0.061	−0.075
	(0.339)	(0.303)	(0.299)	(0.331)	(0.308)	(0.293)	(0.093)	(0.089)	(0.082)
λ_{2001}	0.727***	0.599**	0.656***	0.710**	0.615**	0.731***	−0.005	−0.036	−0.086
	(0.278)	(0.243)	(0.228)	(0.287)	(0.262)	(0.242)	(0.093)	(0.090)	(0.087)
λ_{2002}	0.079	0.010	0.138	0.023	−0.062	0.099	0.056	0.072	0.037
	(0.218)	(0.199)	(0.201)	(0.227)	(0.212)	(0.210)	(0.070)	(0.066)	(0.068)
λ_{2003}	−0.203	−0.202	−0.158	−0.095	−0.081	−0.037	−0.108	−0.122	−0.121
	(0.220)	(0.206)	(0.200)	(0.216)	(0.208)	(0.191)	(0.077)	(0.076)	(0.076)
λ_{2005}	0.592***	0.581***	0.592***	0.878***	0.862***	0.878***	−0.286***	−0.280***	−0.286***
	(0.195)	(0.196)	(0.213)	(0.211)	(0.212)	(0.230)	(0.062)	(0.063)	(0.068)
λ_{2006}	0.570***	0.553***	0.571***	0.900***	0.868***	0.895***	−0.330***	−0.314***	−0.324***
	(0.203)	(0.201)	(0.217)	(0.221)	(0.219)	(0.238)	(0.069)	(0.069)	(0.075)
R^2	0.078	0.254	0.807	0.071	0.193	0.802	0.018	0.225	0.863

Notes. Products are six-digit HS products. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively.

physical units together. For example, suppose there are two different measurement units: grams and kilograms. Obviously the price of a product measured in grams will tend to be much less than one measured in kilograms. If, after quota removal, exports of products measured in grams increased by more than exports of products measured in kilograms, we would get an average price fall. This should be dealt with by measurement unit fixed effects. The inclusion of product fixed effects would do more than that: it modifies the above plain OLS estimates to be based on the time variation in the price specific to a given product. On the one hand, the inclusion of measurement unit fixed effects turns out to only reduce the size of estimates slightly. On the other hand, since the sample is a balanced panel of products between 2004 and 2005 (as seen in Table 3.2), the plain OLS and product fixed effects model produce identical estimates on λ_{2005}. Hence for convenience, here we just reply on the plain OLS results for interpretation.

The obviously lower magnitudes of growth for export values than for quantities imply decreasing product unit values following quota elimination. And indeed, the sign of λ_{2005} for the regressions of unit values are reversed. Unit values for textile products deceased 11% on average in 2005. As expected, the effect of binding quotas is sizable but in the opposite direction to what has been found for value and quantity. To be more precise, a binding quota lowered unit values as much as 29%.[17]

3.5.3 Firm-product-level analysis

Our data allows us to explore price variations at the firm-product level, and we now move on to implement various forms of the fixed effect component as outlined in Eq. (3.4.2). The fixed effect component could be specified at different levels. Par-

[17] It is only marginally lower than Harrigan and Barrows's (2009) finding for the price decrease, which is 32%.

ticularly, we are interested in how these specifications generate different results for the price variations. If the results from these specifications are significantly different from each other, the differences should suggest how the quota effect on price is driven by various factors embodied in these fixed effect components. Table 3.4 reports all the results together.

In the upper panel where there is no control for firm's market share of products, the first column "No FE" (the specification without any fixed effects) gives an estimate of the *average* effect of the quota removal on price. The figure is about -35%, slightly larger than found in Table 3.3. Because the variation of price is now at a more disaggregated firm-product level, we can see each firm-product combination as a "variety". Thus, the price drop of "varieties" here is also contributed by *firms* lowering price for each product, apart from a price drop at the product level. Further, the bigger magnitude found here suggests that "varieties" have sharper price decrease than found for (six-digit) products.

The role of firm-level heterogeneity in driving the price variation is also reflected in the difference between the specifications of No FE and Firm FE. After adding firm fixed effects, two thirds of the quota effect vanishes and the R^2 grows dramatically. By contrast, however, adding product fixed effects (Product FE) reduces the effect by less than one third and increases the R^2 by a much smaller magnitude. Together, these numbers suggest that firm-level adjustments alone explain the majority of the price reduction. More specifically, two thirds of the price drop is due to the increased share of new firms which generally produce lower-price products,[18] while one third is due to within-firm price fall. In the rest of the columns, the fixed effects are specified at increasingly disaggregated levels. As expected, as the fixed effects become more restrictive, the quota effect shrinks while R^2 grows gradually.

[18] Suppose if the sample was a balanced panel of firms, the result of the fixed effects model would be identical to the result of the OLS model without any fixed effects. However, since this is not the case, the difference in these results, as shown in Table 3.4, comes from changes in firm composition or net entry of firms in the export market.

The difference between the column of "Product FE" and the column of "Product FE + Firm FE" is interesting. The product fixed effects should rule out time-invariant factors that cause price differences among products, and the addition of firm fixed effects further makes the estimation a within-product and within-firm comparisons. Importantly, note that if the sample was a balanced panel of firms, that is, if each firm was observed for each of the sample years, we would expect to get identical results from these two specifications in a DD setup. However, if the sample was an unbalanced panel of firms, we would then expect a discrepancy between the results due to changes in the composition of firms over time. As a fact, it is seen that the inclusion of firm fixed effects further reduces λ_{2005} by a slightly more than half of the size. This delivers to us a message that for a given product, on average more than half of the price drop after the quota elimination was actually due to firm turnover in the export market. In other words, firm entry and exit (or *net entry* as the net effect) were important sources of the price effect of the quota removal even after taking into account the differences in prices across products.

The above findings provide evidence on the relative roles of firm entry and within-firm adjustments hidden behind the negative effect of quota removal on product price. Multi-product firm theories have made predictions on the micro-level adjustments of exporting following changes in trade costs. On top of generating other implications, the above empirical results shed light on these predictions. Insofar as quotas have similar effects to per unit transport cost, a novel implication of the model of Bernard *et al*. (2011) is that apart from entry of less productive firms, the quota removal would also induce continuing exporters to start exporting low-quality products. Nevertheless, since there is no explicit relationship between firm productivity and product quality in Bernard *et al*.'s (2011) model, it is unclear whether and how firm entry actually affects average product prices. However, if less productive firms generally export lower-quality products in the real world, we shall expect more firms to appear in the export market, export products of lower

Table 3.4. Estimates of the price effect of quota from DD specifications with different levels of fixed effects. Dependent variable: $\ln \mathbf{P}_{ijt}$.

	Without control for market share			
	No FE	Firm FE	Product FE	Product FE + Firm FE
λ_{2005}	-0.348^{***}	-0.121^{***}	-0.242^{***}	-0.112^{***}
	(0.028)	(0.021)	(0.022)	(0.017)
R^2	0.146	0.644	0.494	0.774
	With control for market share			
	No FE	Firm FE	Product FE	Product FE + Firm FE
λ_{2005}	-0.346^{***}	-0.120^{***}	-0.240^{***}	-0.111^{***}
	(0.028)	(0.021)	(0.022)	(0.017)
ω	0.394^{***}	0.165^{***}	0.419^{***}	0.165^{***}
	(0.038)	(0.031)	(0.035)	(0.028)
R^2	0.147	0.645	0.495	0.774

Notes. Products are six-digit HS products. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively. Coefficients on other explanatory variables are suppressed here to save space, but the full result is reported in Tables B2 and B3 of Appendix B.

prices than continuing exporters, and thus draw down the average prices of export products. This is exactly what we have found in Table 3.4.

In the lower panel of the table, firm's share in exports of each product from China, MSHARE, is included to control for changes in markups in price variations as in Manova and Zhang (2012). The argument behind it is that the quota removal could induce firms to lower product prices not only via quality downgrading effect but also because of more intensive competition from both incumbents and new exporters. The coefficient of MSHARE, ω, should be able to capture such competition effect if the changes in a firm's market power is well picked up by its market share. The result shows that ω is positive and highly significant across regressions of all specifications on fixed effects, indicating that, other things being equal, bigger market power allows firms to charge higher prices. But the net effect of the quota removal remains almost the same as in the upper panel.

3.5.4 Competition effect or quality change?

Although at least part of the price drop should be attributed to the removal of quotas, the nature of the decrease in price is still somewhat mysterious. Our control variable of the firm's share in the exports of a product has been introduced to capture the effect of changing markups on product prices. If a firm enjoys a bigger market share in the U.S. market compared to other Chinese firms, it is expected to be able to charge higher prices on a given product, other things equal. However, a problem with this control is that when there are changes in market conditions, these firms are not necessarily less vulnerable to more intensive competitions. Even if they are less likely to reduce their prices, we do not know to what extent this argument is true because the MFA/ATC quota removal applies to other developing countries which export to the U.S. as well. For this reason, simply including market share relative to other Chinese firms is probably not an ideal proxy to isolate the competition effect in the price fall, and therefore we are sure quite sure about the relative contributions of the competition effect and quality downgrading in the average price fall.

With such caveat borne in mind, here we take an indirect approach to see whether the significant price drop found above is more likely due to increased export competition or due to quality downgrading. This approach comes from our conjecture that in an extreme case where products are perfectly homogenous (these products are of the same quality in a physical sense),[19], and then any price drop should be due to a competition effect rather than changes in the physical characteristics of the good, in other words, changes in quality. At the other end of the spectrum where all products are differentiated in quality – product varieties are vertically different and involve different technology and cost, then we would expect quality changes to be more likely to happen because firms can switch between

[19]Some raw materials in the HS chapter of textiles can be considered as proximate to *homogeneous* products, e.g., HS 500100 "Silk-worm Cocoons Suitable for Reeling".

product varieties of different qualities. In other words, differentiated products have bigger scopes for altering product qualities than homogeneous goods. In the real world, if we can differentiate differentiated products from homogenous products or measure product quality heterogeneity by whatever means, then the above reasoning leads to a relevant and testable hypothesis for our interpretation of the price drop:

If price falls are due only to the effects of increased competition, then homogeneous products will have the same price falls as differentiated products; if there is also a genuine quality effect, differentiated products will have larger price falls.

Without having any direct or external measures of product quality at a reasonably disaggregated level, we rely on the standard deviation of a product's price in 2004 to identify differentiated products and homogeneous goods. More specifically, if a product's standard deviation of log price is above the median of all products in 2004, it is seen as a differentiated product; otherwise it is seen as a homogeneous product.[20] Such division of products enables us to implement an extra level of comparison on top of the baseline treatment-control comparison.

It would be helpful to first take a glance at the characteristics of these multiple-level comparison samples before going down to the formal estimation. As seen in Table 3.5, our definition of differentiated versus homogeneous products splits up the products into two groups of virtually equal number of products.[21] The price variation among the differentiated products is about 50% larger than that among homogenous products, whether within the treatment group or within the control group. Interestingly, products are more likely to be homogeneous products in the treatment group than in the control group, which may be due to the fact that the

[20]We also tried 25% and 75% percentiles of the standard deviation of price as thresholds to define homogeneous and differentiated products, and the result is more pronounced.

[21]Because we include the product of median price variation into the category of differentiated products, the group of differentiated products contains exactly one more product than the group of homogeneous products.

Table 3.5. Description of homogeneous and differentiated products in treatment and control groups in 2004

	Homogeneous products	Differentiated products	Total
Treatment	N = 53	N = 35	N = 88
	s.d.(p) = 0.767	s.d.(p) = 1.207	s.d.(p) = 0.954
Control	N = 153	N = 172	N = 325
	s.d.(p) = 1.129	s.d.(p) = 1.601	s.d.(p) = 1.524
Total	N = 206	N = 207	N = 413
	s.d.(p) = 1.005	s.d.=(p) = 1.581	s.d.(p) = 1.453

Notes. Products are six-digit HS products. "N" represents number of products, and "s.d.(p)" represents the standard deviation of log price. Differentiated products: products of which the standard deviation of log price is above the median level of all products in 2004. Homogeneous products: products of which the standard deviation of price variation is below the median level of all products in 2004. Treatment group: products bound by quotas in 2004 and not subject to quotas in 2005. Control group: products unbound by quotas in 2004 and not subject to quotas in 2005.

U.S. had bigger demand for relatively homogeneous goods from China and hence quotas on these goods were more likely to be filled.[22]

We then apply the DDD estimation setup of Eq. (3.4.3) to these two subsamples of products at the firm-product level. The results for the estimation with and without controlling for differences in measurement units across products are presented in Table 3.6. Apart from showing the ordinary regression result, it also presents the result with measurement unit fixed effects being included to make quantities and unit values comparable across products measured by different physical units. As before, the sign of the key coefficient λ_{2005} is always negative and significant for both of the heterogeneous products and the homogeneous products, which means price drop as a result of the quota removal was a common phenomenon across products of different levels of quality differentiation.

But more interestingly, the coefficients say that the competition effect reduced

[22] Also we observe that the numbers of products in both of the treatment group and the control groups here are smaller than in Table 3.2. This is because some products were exported only by a single firm in 2004, and thus the price variations across firms for these products are not available.

Table 3.6. DDD estimates of the price effect of quota for product differentiation. Dependent variable: $\ln \mathbf{P}_{ijt}$.

	Differentiated products		
	No FE	Meas. unit FE	Product FE
λ_{2005}^{dif}	-0.356^{***}	-0.311^{***}	-0.304^{***}
	(0.051)	(0.047)	(0.038)
R^2	0.018	0.157	0.470
	Homogenous products		
	No FE	Meas. unit FE	Product FE
λ_{2005}^{hom}	-0.166^{***}	-0.159^{***}	-0.098^{***}
	(0.035)	(0.030)	(0.024)
R^2	0.035	0.293	0.574
	Difference: dif. vs. hom. products		
	No FE	Meas. unit FE	Product FE
$\lambda_{2005}^{dif} - \lambda_{2005}^{hom}$	-0.190^{***}	-0.152^{**}	-0.206^{***}
	(0.065)	(0.059)	(0.048)

Notes. Products are six-digit HS products. Differentiated products: products of which the standard deviation of log price is above the median level of all products in 2004. Homogeneous products: products of which the standard deviation of log price is below the median level of all products in 2004. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively. Coefficients on other explanatory variables are suppressed here to save space.

prices by 16%, and the combined competition and quality effect reduced prices by 31%. So the quality effect is about equal to the competition effect. Of course, it is also possible that since homogeneous products are not really homogeneous, thus some of the price fall in that group can also be due to a quality effect. If this is the case, the quality effect estimated in this way is a lower bound: the actual quality effect was possibly stronger than the competition effect. In sum, this result lends support to our hypothetical statement above, suggesting that quality downgrading seems to have played an important role in the price drop. The removal of quotas lowered product prices significantly, but perhaps it was more because firms changed their product-mix to focus more on high-quality varieties than because they reduced prices on existing price labels in face of fiercer competition.

3.5.5 Heterogeneous effects across firms

(a) How were MFA/ATC quotas allocated in China?

Under the MFA quantity restrictions, quotas were extremely important and scarce economic resources in China. For a long time, all quotas were strictly controlled by the state and were allocated to production firms through pure bureaucratic forces. MFA quotas were first distributed from the bureau at the national level to its provincial and municipal branches, who then decided how the quotas were to be allocated among firms. Not surprisingly, the dominance of bureaucratic coordination lead to an entire lack of transparency in the quota allocation, which, as it turned out, inevitably caused active rent-seeking activities and inefficient allocation of quotas (Moore, 2002, Ch. 5).

In recognition of such obvious drawbacks with the quota management system, a series of reform measures were taken step by step by the government to rationalise the quota allocation and introduce market mechanism into it. First, the allocation of quotas through administrative departments became more based on firms' past performances. Firms which previously obtained higher quotas and utilised higher proportion of them were more likely to get a large size of quotas. Second, an auction system was introduced and gradually extended to some of the product categories. The auction system was comprised of two parts: "open bidding" and "bidding by agreement". Roughly speaking, under the first scheme, quotas were auctioned publicly and firms which bid the highest price would be allocated the quota at the price they bid, while under the second scheme, the price was determined by the auction committee and was normally lower than under the open bidding system to benefit more firms.

The shift of the quota allocation system from administrative coordination toward market coordination was far from being complete. Although the government was reluctant to release accurate data on the proportions of administrative allocations and auction allocations, by all accounts, auctions never played a major role in the allocations. For example, an estimate showed that the quotas allocated through the bidding system accounted for only 30% of all U.S. quotas by 2000 (Moore, 2002, Ch. 5). Meanwhile, for the administrative allocations, despite the fact these arrangements were claimed to be made mainly according to firms' past export record, political favourism was in fact toward large state-owned firms in the coastal regions (Yang, 1999), while foreign firms had to go through special administrative procedures to obtain quotas and often met unexpected difficulties in getting them (Moore, 2002, Ch. 5).

(b) Firm ownership type

Since state-owned firms had intimate political connections with the government and had enjoyed larger quotas in the past, the bias in allocating quotas among firms also existed in the auction system of "bidding by agreement". This type of bidding accounted for 70% of all auctioned quotas and these quotas were actually largely reserved for state-controlled firms (Moore, 2002, Ch. 5). Supportive evidence on the inefficiency in the allocation of quotas is also found in more rigorous studies. For example, in a study of Chinese textile and apparel exports which uses the same data as ours, Khandelwal *et al*. (2011) studied firm entry and exit in the export market when the MFA/ATC quotas were removed, and found entrants had lower prices than the incumbents and caused state-owned firms to exit. This finding is consistent with the above argument that the MFA/ATC quotas were particularly favoured toward state-owned firms away from economically efficient allocations.

The conjecture that state-owned firms were probably less restricted by quotas is supported by the figures in Table 3.7, where we compare state-owned firms with other domestic firms in the first two specifications without any fixed effects and with measurement unit fixed effects. The quota effect seems to be 13 to 15 percentage points smaller for state-owned firms than for other domestic firms. However, if we compare within each product, the difference does not exist any more. But this is still consistent with the above explanation as differences in these results suggest that products exported by these two types of firms were different. State-owned firms may have particularly focused on certain products which were probably less restrained by quotas especially for these firms of state ownerships.

We also distinguish foreign-owned firms (wholly owned by foreign investors) from others. According to the estimates in the table, it is found that the quota effect is nearly 20 percentage points larger than non-state domestic firms. At first glance, it seems a bit strange as foreign firms are usually thought to export higher quality products and have much closer and constant relationships with foreign markets (especially their mother countries), for example through within-firm trade with parental companies in a foreign country. By the nature of such trade modes, foreign firms are less likely to lower their product prices. And as a result, their quota effect should have been smaller instead of larger than non-state domestic firms. But consider how the mechanism of quality downgrading could in fact come about here. It is possible that these firms had been producing a larger variety of vertically differentiated products and therefore were able to change the composition of their export products by shifting weights towards low-price products after the expiration of the MFA/ATC quotas. If such quality downgrading outweighs the price reduction effect, the negative differential effect found here is not surprising.

(c) Firm size

Analogously, the heterogeneity of the price effect of quotas may also exist among firms of different sizes. An important reason to look at the firm size lies in the potential role of the firm productivity behind firm adjustments. What is already known

Table 3.7. DDD estimates of the price effect of quota for firm ownership type. Dependent variable: $\ln \mathbf{P}_{ijt}$.

	State-owned firms		
	No FE	Meas. unit FE	Product FE
λ_{2005}^{state}	-0.204^{***}	-0.239^{***}	-0.232^{***}
	(0.056)	(0.051)	(0.037)
R^2	0.030	0.212	0.589
	Foreign firms		
	No FE	Meas. unit FE	Product FE
$\lambda_{2005}^{foreign}$	-0.546^{***}	-0.565^{***}	-0.386^{***}
	(0.067)	(0.064)	(0.051)
R^2	0.023	0.115	0.472
	Other domestic firms		
	No FE	Meas. unit FE	Product FE
λ_{2005}^{dom}	-0.349^{***}	-0.372^{***}	-0.213^{***}
	(0.043)	(0.041)	(0.032)
R^2	0.029	0.140	0.493
	Difference: state-owned vs. other domestic		
	No FE	Meas. unit FE	Product FE
$\lambda_{2005}^{state} - \lambda_{2005}^{dom}$	0.145^{**}	0.134^{**}	-0.018
	(0.072)	(0.067)	(0.052)
	Difference: foreign vs. other domestic		
	No FE	Meas. unit FE	Product FE
$\lambda_{2005}^{foreign} - \lambda_{2005}^{dom}$	-0.197^{**}	-0.192^{**}	-0.172^{***}
	(0.082)	(0.077)	(0.061)

Notes. Products are six-digit HS products. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively. Coefficients on other explanatory variables are suppressed here to save space.

Table 3.8. DDD estimates of the price effect of quota for firm size. Dependent variable: $\ln \mathbf{P}_{ijt}$.

	Large exporters		
	No FE	Meas. unit FE	Product FE
λ_{2005}^{large}	-0.280^{***}	-0.315^{***}	-0.217^{***}
	(0.030)	(0.028)	(0.021)
R^2	0.023	0.170	0.536
	Small exporters		
	No FE	Meas. unit FE	Product FE
λ_{2005}^{small}	-0.573^{***}	-0.524^{***}	-0.428^{***}
	(0.125)	(0.116)	(0.100)
R^2	0.014	0.147	0.433
	Difference: large vs. small exporters		
	No FE	Meas. unit FE	Product FE
$\lambda_{2005}^{large} - \lambda_{2005}^{small}$	0.293^{***}	0.209^{**}	0.211^{***}
	(0.109)	(0.100)	(0.081)

Notes. Products are six-digit HS products. Large firms: firms with export sales above median averaged over years . Small firms: firms with export sales below median averaged over years. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively. Coefficients on other explanatory variables are suppressed here to save space.

from theories is that more productive firms are more likely to enter the export market. But what remains unclear is how productivity affects firms' price adjustment behaviour in response to changes in quotas. Unfortunately, our data contains no information for measuring firm productivity directly. However, we can take firm size as a reasonable proxy for firm productivity since most empirical studies have documented an unambiguously positive correlation between these two variables. Here, we split the sample of firms into large firms and small firms according to their export sales relative to the sample median. To see how large firms behave differently from small firms, like before, we adopt the DDD approach by taking the difference between two DD regressions. The results are reported in Table 3.8.

Small firms are shown to be more responsive than large firms. Roughly, the small firms reduced their product prices twice as much as the large firms did in percentages. And this result holds for all specifications. Particularly, the small firms lowered product prices 21 percentage points more than the large firms even when we compare price reductions within each six-digit product. That is to say, taking away the time-invariant differences across products, small firms still seem to be significantly more flexible in adjusting product prices. To put it more precisely, once the quotas were gone, it seems relatively easier for small firms to take advantage of the new export opportunities by switching to export low-price products. If small firms are less productive firms compared to large firms, it implies that low-price products produced by less productive firms may have been crowded out because of quotas. And as a result, quota removal would lead to more obvious price drop among firms of low productivity.

(d) New exporters vs. continuing exporters

While the baseline analysis has established the evidence of the price-reducing effect of quota removal, we do not know yet whether such price effect is homogeneous for new exporting firms and incumbents in the export market. As the firm-level extensive margin of exporting, the firm entry induced by the quota removal influences the average price of products if the changes in quotas have different effects on these new exporters from those on existing exporters. Empirically, the overall price drop observed could be because new exporters in general export products of lower qualities than existing exporters, or because the quota removal has stronger negative effect on new exporters. The evidence above has already confirmed the first channel, and we will now take a look at the second channel to see how the new firms and continuing firms in the export market respond to the quota removal differently by adjusting product prices.

The estimation strategy is based on Eq. (3.4.3), with the two subsamples being new exporters and continuing exporters defined by each year. Note that here new exporters and continuing exporters are defined by the information of the beginning year (2000) and the ending year (2006) of our sample. Thus, new exporters are those who started exporting after 2000 and continued to export in 2006, while continuing exporters exported in both 2000 and 2006. For each regression, λ_{2005} captures the effect of the quota removal on prices for each of the subsamples. The difference between the two λ_{2005}, i.e., $\lambda_{2005}^{\text{new}} - \lambda_{2005}^{\text{cont}}$, from the two separate regressions reflects the differential effect of the quota removal on the entering exports as opposed to the continuing firms. If the difference is negative and significant, it then indicates a larger price effect of the quota removal on the entering exporters than on the continuing exporters.

Indeed, it seems to be the case in the first two columns of Table 3.9. The first column does not specify any fixed effect components and therefore simply reveals the *average* effect across all firms and products. In the second column, the inclusion of the fixed effects of measurement unit restricts comparisons to be within groups of products of the same physical measurement units. The results from both specifications are more or less the same: the elimination of quotas induced the entering exporters to lower product prices about 13 to 14 percentage points more than the continuing exporters did. Therefore, the conjecture that the price effect of the quota removal is more pronounced for new exporters is supported. However, the inclusion of more disaggregated fixed effects, product-level fixed effects, makes the difference insignificant. Our explanation is that different from established exporters, new exporters deliberately selected to export products that had especially large price reductions in 2005 to meet the increasing demand for these products. The negative coefficient in the first two specifications could contain such selection bias, and by the same reason, the inclusion of product-specific factors can mitigate such endogeneity in estimation. The differences in these results suggest the above argument is likely to be the case.

Table 3.9. DDD estimates of the price effect of quota for firm entry. Dependent variable: $\ln \mathbf{P}_{ijt}$**.**

	New exporters		
	No FE	Meas. unit FE	Product FE
λ_{2005}^{new}	-0.304^{***}	-0.326^{***}	-0.202^{***}
	(0.040)	(0.038)	(0.030)
R^2	0.017	0.141	0.492
	Continuing exporters		
	No FE	Meas. unit FE	Product FE
λ_{2005}^{cont}	-0.174^{***}	-0.185^{***}	-0.163^{***}
	(0.060)	(0.056)	(0.040)
R^2	0.039	0.185	0.602
	Difference: new vs. continuing exporters		
	No FE	Meas. unit FE	Product FE
$\lambda_{2005}^{new} - \lambda_{2005}^{cont}$	-0.130^{*}	-0.141^{**}	-0.039
	(0.075)	(0.070)	(0.054)

Notes. Products are six-digit HS products. New exporters: firms which started exporting after 2000 and also exported in 2006. Continuing exporters: firms which exported in both 2000 and 2006. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively. Coefficients on other explanatory variables are suppressed here to save space.

3.6 Robustness and Further Discussions

3.6.1 Selection across countries

The basic identification strategy of this study is to compare quota-bound products (treatment group) with quota-unbound products (control group) in order to assess the causal effect of binding quotas. As we restrict our sample to Chinese exports solely to the U.S. market, a problem that potentially could have caused bias to our result is export destination selection by firms due to cross-country differences in changes of quota coverage and restrictiveness. For example, if quota-unbound products in the U.S. experienced larger quota reductions than in the E.U., the slower growth of quota-unbound products (if any) relative to quota-bound products after quota abolishment could be at least partly due to more exports being diverted to the E.U.. And in this case, the effect of the quota removal on export value would have been overestimated.

Although unfortunately it is impossible to get detailed quota fill rates for each country, the lower panel of Table 3.10 suggests that the above conjecture is not likely to be the case. For products never bound by U.S. quotas, the U.S. share in China's exports to the world turned out to increase from 10.5% to 15.5% in 2005 after the expiration of the MFA/ATC. Meanwhile, all other major destinations did not see any significant increases in their shares. The observation that the exports of quota-unbound products grew relatively more rapid to the U.S. than to other economies demonstrates the fact that there was no obvious evidence of exports of these products being diverted away from the U.S. market. Instead, the phenomenon observed here illustrates some degree of export diversion in the other way round: more exports were shipped to the U.S. instead of other destinations. If such bias could be corrected, it would further strengthen the treatment effect we have found instead of weaken it.

Table 3.10. Distribution of Chinese textile and clothing exports in different economies

	Products bound by U.S. quotas					
Year	U.S.	E.U.	Hong Kong	Japan	Others	Total
2000	7.8%	10.0%	24.4%	32.2%	25.6%	100.0%
2001	5.8%	7.8%	16.7%	45.6%	24.1%	100.0%
2002	3.9%	5.0%	23.7%	35.9%	31.4%	100.0%
2003	2.5%	8.0%	22.6%	21.9%	45.0%	100.0%
2004	2.7%	6.4%	21.0%	32.9%	36.9%	100.0%
2005	15.1%	13.4%	10.9%	22.1%	38.6%	100.0%
	Products never bound by U.S. quotas					
Year	U.S.	E.U.	Hong Kong	Japan	Others	Total
2000	9.3%	6.1%	31.0%	26.3%	27.2%	100.0%
2001	9.0%	6.4%	28.3%	28.8%	27.5%	100.0%
2002	8.4%	7.2%	28.7%	24.9%	30.9%	100.0%
2003	9.6%	7.6%	26.7%	22.0%	34.0%	100.0%
2004	10.5%	8.4%	23.1%	20.6%	37.4%	100.0%
2005	15.5%	11.5%	18.3%	17.1%	37.6%	100.0%
2006	16.3%	12.3%	16.6%	14.3%	40.5%	100.0%

Notes. Quota products are those textile and clothing products subject to U.S. quotas. Quota-bound products are those textile and clothing products subject to U.S. quotas with fill rates larger than 90%. Fill rate of a product is the ratio of actual quantity imported by the end of calendar year to quota level of that year. An exception is the year 2005, in which quotas were reimposed on some products after the middle of the year and the fill rates are calculated based on periods shorter than 7 months in stead of a whole calendar year.

3.6.2 Restrictiveness of quotas on firms

An underlying assumption of our estimation exploring the firm-product-level variations is that binding quotas at the product level are binding for all firms which export these products. While it might be arguable that the 90% fill rate is somewhat subjective when used as the criterion to tell binding quotas from unbinding quotas,[23] it could be even more problematic if we consider the fact that some firms may not really be constrained by quotas even if these quotas are fully filled. Especially, if firms are not equally able to obtain quota permissions from quota authorities, the fill rate of a product could matter differently for different firms. For the reasons already discussed, some firms could simply have easier access to quotas irrespective of their production and export efficiency, while some could not even if they qualify to do so by any efficiency criterion (for example, productivity and export capacity).

The most prominent factor for such heterogeneous restrictiveness of quotas on firms is perhaps firm ownership type. As mentioned before, for textile exports, all anecdotal accounts point to the fact that state-owned firms were particularly favoured when quotas were allocated among firms by administrative decisions. In an extreme case, some state-owned firms could use their political ties with the authorities to eventually get the quota amount as much as they want, and thus the quota is not restrictive for them at all even if the quota is binding at the product level for whatever fill rate threshold we use. By contrast, some foreign and private domestic firms could find it much harder to get quota amounts, thus severely constrained by the quota even if the quota is far from being fully filled at the national

[23] In practice, the E.U. regards quotas more than 95% filled as binding, while the United States International Trade Commission (USITC) adopted 90% as the divided line (United States International Trade Commission, 2002). Besides, according to the study of Evans and Harrigan (2005), 90% fill rate is the threshold to define a binding quota, which was later adopted by both Harrigan and Barrows (2009) and Brambilla *et al.* (2010). But as Harrigan and Barrows (2009, footnote 15) admitted, because of complex technical issues with the quota management system, a quota is rarely fully filled. In this sense, we can not exclude the possibility that an 85% fill rate for a particular product could somehow be equally binding to a 90% fill rate for another product.

level.

If the above reasoning is indeed the case, then the above product-level quota fill rates will not be relevant for distinguishing the restrictiveness of these quotas on individual firms. Instead, what would matter more for firms is whether they can get quota permissions to export products. This means we should turn to define the restrictiveness of exporting a product for a firm according to the product's quota status rather than its fill rate. To see if this makes a difference, we first need to have an idea of the distribution of quota fill rates in 2004, which is depicted in Figure 3.3, where the horizontal axes represent the quota fill rates of products while the vertical axes measure their shares in terms of number of products and/or export value. This figure shows that the majority (nearly 80% in terms of number of products and 95% in terms of value of products) of the products are quota products. Further, virtually all these quota products have fill rates above 70%. In other words, 70% fill rate can roughly be used as a threshold to tell quota products from non-quota products. However, quota products are not equally important: products with fill rates higher than 88% account for three quarters of value and half of the number of products, which means that exports are skewed towards products relatively constrained by quotas at the aggregate level.

Because of the above reasons, we need to check to which extent our baseline results depend on the choice of threshold fill rate to define a treatment group. Specifically, We experiment with three groups of treatment groups here, which are products with fill rates in 2004 falling in the ranges of 70%-80%, 80%-90%, and 90%-100% respectively, while the control group is comprised of products which were not subject to quotas (or equivalently, with fill rates below 70%) either in 2004 or in 2005.

Table 3.11 displays the results of the robustness check by estimating the DD coefficient at the product level. We find that when quotas for the treatment group

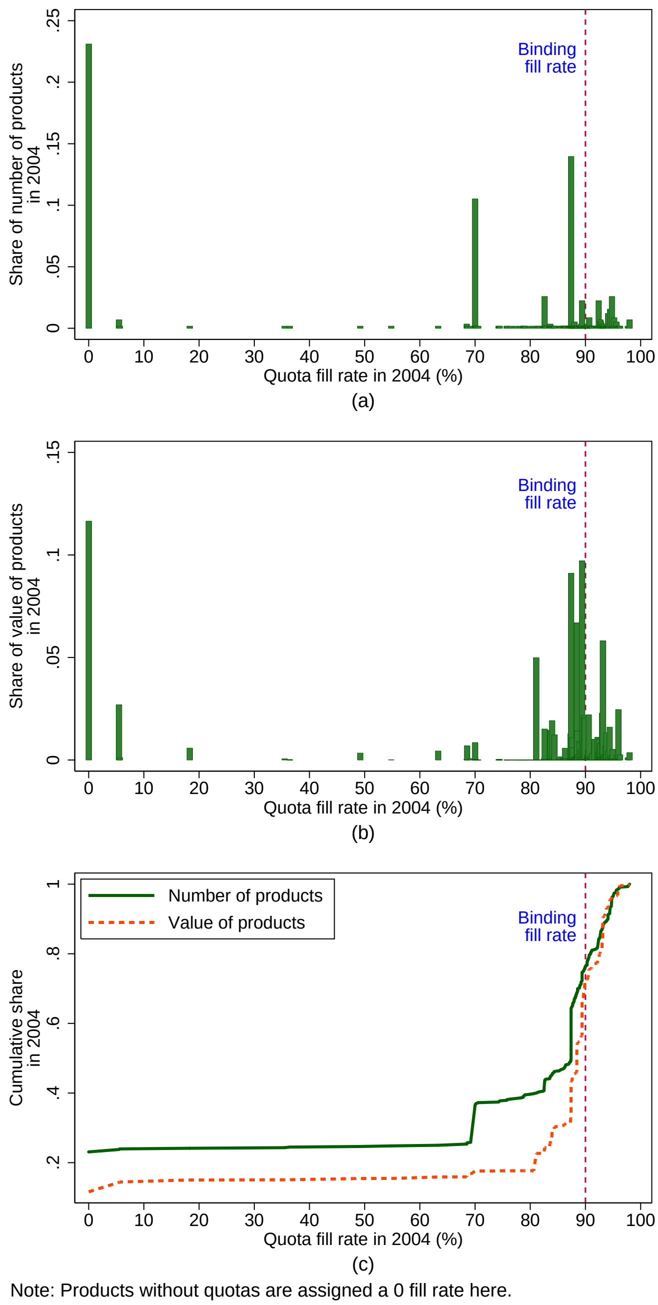


Fig 3.3. Distribution of U.S. quota fill rates at the product level in 2004

become increasingly restrictive at the aggregated product level, the price effect of quota become increasingly pronounced across all specifications of the fixed effects. This result is not surprising as it demonstrates that the fill rate is a reasonable index for the restrictiveness of quotas for products. But is it so for quotas on individual firms? The answer is: not always. We could see this by doing the similar robustness check as above to estimate the DD coefficient at the *firm-product* level. The results are reported in Table 3.12. It is seen that when the fill rates for the treatment group increase from the range of 70%-80% to 80%-90%, the price fall does not always get bigger. Especially, when we control for time-invariant firm-specific effects, the size of the price effect reduces dramatically. However, if we compare the results of the fill rates of 70%-80% to those of 90%-100%, the difference in the "Product FE" column implies that for a given product, quotas more fully filled are indeed more restrictive on firms. This relationship still holds even if we make the comparison within firms and products. Thus, the overall message here is that more fully-filled quotas at the product level only tend to be more restrictive on firms when the difference in fill rates are big. Particularly, it provides further evidence to justify our choice of 90% fill rate as the criterion to define a binding quota, although a caveat is also seen that restrictive quotas are not necessarily restrictive for all individual firms.

A more careful investigation requires that we should detect firm-level factors which may affect how a firm is constrained by quotas in general. Although it is not easy to do so, there are some specific types of firm characteristics which are suspected to have correlations with firms' capability of getting quotas at desired levels. Ownership type, firm size, and firm's exporting history, among others, are probably most likely to be correlated with unobservable or hard-to-observe factors that affect the firm-level restrictiveness from quotas. In this regard, Section 3.5.5 has already provided supporting evidence for these concerns. On the one hand, all the results seem to be unanimously consistent with our conjecture that firms of

Table 3.11. Product-level estimates of the price effect of quota using alternative treatment groups defined by different fill rate ranges. Dependent variable: $\ln \mathbf{P}_{jt}$.

	Treatment 1: 70% <=fill rates< 80%		
	No FE	Meas. unit FE	Product FE
λ_{2005}	0.037	−0.075	−0.119
	(0.119)	(0.117)	(0.122)
R^2	0.020	0.133	0.832
	Treatment 2: 80% <=fill rates< 90%		
	No FE	Meas. unit FE	Product FE
λ_{2005}	−0.020	−0.208**	−0.175**
	(0.088)	(0.086)	(0.081)
R^2	0.018	0.227	0.864
	Treatment 3: 90% <=fill rates<= 100%		
	No FE	Meas. unit FE	Product FE
λ_{2005}	−0.241**	−0.392***	−0.396***
	(0.095)	(0.092)	(0.090)
R^2	0.021	0.146	0.847

Notes. We experiment with three groups of treatment groups here, which are products with fill rates in 2004 falling in the ranges of 70%-80%, 80%-90%, and 90%-100% respectively, while the control group is comprised of products which were not subject to any quotas either in 2004 or in 2005. Products are six-digit HS products. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively. Coefficients on other explanatory variables are suppressed here to save space, but the complete results are available from the authors upon request.

different characteristics are affected differently by textile quotas. To be concrete, state-owned firms, large firms, continuing exporters, all prove to be less affected by the dramatic changes in quotas in general. On the other hand, if such potential bias in omitted variables could be corrected, the heterogeneity in the quota effect on firms of different characteristics found in Section 3.5.5 would be even bigger.

Table 3.12. Firm-product-level estimates of the price effect of quota using alternative treatment groups defined by different fill rate ranges. Dependent variable: $\ln \mathbf{P}_{ijt}$.

	Treatment 1: 70% <=fill rates< 80%			
	No FE	Firm FE	Product FE	Product FE + Firm FE
λ_{2005}	−0.099	−0.149***	−0.100*	−0.118**
	(0.070)	(0.057)	(0.054)	(0.047)
R^2	0.092	0.676	0.472	0.795
	Treatment 2: 80% <=fill rates< 90%			
	No FE	Firm FE	Product FE	Product FE + Firm FE
λ_{2005}	0.007	0.005	−0.117***	−0.048**
	(0.034)	(0.026)	(0.027)	(0.021)
R^2	0.162	0.664	0.487	0.779
	Treatment 3: 90% <=fill rates<= 100%			
	No FE	Firm FE	Product FE	Product FE + Firm FE
λ_{2005}	−0.303***	−0.119***	−0.323***	−0.160***
	(0.035)	(0.027)	(0.027)	(0.022)
R^2	0.099	0.670	0.466	0.795

Notes. We experiment with three groups of treatment groups here, which are products with fill rates in 2004 falling in the ranges of 70%-80%, 80%-90%, and 90%-100% respectively, while the control group is comprised of products which were not subject to quotas (or equivalently, with fill rates below 70%) either in 2004 or in 2005. Products are six-digit HS products. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively. Coefficients on other explanatory variables are suppressed here to save space, but the complete results are available from the authors upon request.

3.7 Conclusions

This study provides an empirical assessment of the effect of quota restrictions on firms, throwing new light on both the classical literature on quotas and the recently emerging theories on multi-product firms. To that end, we use a unique and comprehensive firm-product-level data set of Chinese textile and clothing firms to look into details how they actually responded to the elimination of the MFA/ATC quotas on 1 January, 2005 in the U.S. market.

Three features of our data make the identification of the quota effects possible and convincing. First, the event of the MFA/ATC quota removal was large-scale and clear-cut in terms of timing and product coverage. Second, a linkage is built by us between the U.S. import quotas and Chinese textile and clothing products at a considerably disaggregated level. Third, collapsed from the original firm-transaction-level customs records, our firm-product-level data offers valuable export product information within exporting firms with sufficient variations over time and cross products of broad categories.

By employing a “Difference-in-Differences” estimation strategy, we find an average price drop of about 30% due to the removal of the MFA/ATC quotas. For this overall drop in price, more than half was found to be caused by the firm turnover or the changes in the firm composition in the export market, indicating that quotas probably affect more on firm entry than on product composition within existing firms in the export market. Admittedly, the price drop could be a mixed consequence of several jointly working forces. Especially, the quota removal could probably lead to increased competition in exporting from larger exports of some existing exporters and the entry of new exporters. But our analysis shows that the quality downgrading is more likely to have played a dominant role than the competition effect in the fall of prices because differentiated products exhibited significantly larger price reduction compared to homogeneous products.

We also find huge heterogeneity in the quota effect across firms. State-owned and large firms were also shown to be more immune to the shock of the expiration of the quotas. Continuing exporters were also less affected by the removal of the quotas than new exporters. The main reason is perhaps that it had been easier for these firms to obtain quotas from quota-distribution authorities in China, and thus had been less constrained by the quotas during the time when the MFA/ATC was still in force.

To a large extent, how trade policies work on heterogeneous firms still remains an under-explored area. Given the increasingly easier access to disaggregated micro-level data, investigations into issues in this wide area are expected to produce richer results which could push forward our current understanding of the effects of trade policies on firm behaviour. One future direction in our agenda is to take a careful look into the "black box" of multi-product firms to see how they actually adjust their product mix in terms of adding and dropping products as well as changing the relative shares of exiting products in response to changes in quotas. Another interesting topic is made feasible by the fact that the monthly information in our raw data allows us to investigate how speedily the firms reacted to the sudden and massive change in quotas, and how such change impacted the market structure and the distribution of firms across geographical space. These future research topics touch some under-explored areas and will definitely enrich our current understandings of the relationship between firms and trade policies.

CHAPTER 4

Quota Restrictions and Intra-firm Reallocations: The Effect of the MFA Termination

4.1 Introduction

In Chapter 3, we estimated the price effect of the MFA quota removal on firms. This chapter takes a further look into the firm response to the quota elimination by studying the patterns of *intra-firm* adjustments. The focus is thus placed more on the *multi-product* firm (MPF) behaviour compared to the last chapter. There are several reasons why MPFs have received considerable attentions from trade economists recently. First of all, compelling evidence has shown that MPFs are the main participants in the cross-border trade activities and they dominate international trade in many aspects (e.g. Bernard *et al.*, 2011, 2010c). Second, the heterogenous firm model of Melitz (2003) highlights the resource reallocation across firms induced by changes in trade conditions. However, its assumption that each firm produces only a single product contradicts the prevalence of MPFs in reality. MPFs, by their nature, produce and also export multiple products to other countries, which makes them distinct from single-product firms. The recent MPF models incorporate this feature into the Melitz model and thus push the theory further by deliberately looking into how resources are reallocated *within* firms which produce more than one product, as well as the reallocation across firms. Finally, the increasing availability of firm-product-level micro data makes empirical studies in this area feasible, not only providing evidence to the newly developed theories but also documenting new stylised facts that inspire theoretical explorations.

The importance of MPFs in exports is also reflected in Chinese customs data. Table 4.1 shows that during the period 2002-2006, about 60% of the exporting firms of textiles exported more than one product (defined by HS8 categories), and this proportion was rising slightly each year. Even more impressive is the high share of these firms in export value – nearly 90% of export value of these goods were contributed by multi-product exporters, also with an increasing share over the years. These figures are quite comparable with those found for developed countries, such as the U.S. (see Bernard *et al.*, 2010c), and those for developing countries, such as India (see Goldberg *et al.*, 2010).[1] The dominant role of multi-product exporters in the exports of textiles strongly backs up the notion that one cannot properly understand firm export bahaviour without considering MPFs.

This chapter provides the first empirical evidence on how multi-product exporting firms respond to changes in textile quotas by reallocating resources across products within firms.[2] We use comprehensive and detailed records of the transactions of Chinese firms with other countries via customs. On the one hand, this data set covers the period 2000–2006, during which the long-existing Multifibre Arrangement (MFA) quotas on textiles and clothing were eventually removed globally on 1st January 2005. On the other hand, when these MFA quotas were still valid, they only applied to certain types of products as well as to certain countries. Thus,

[1] According to Bernard *et al.* (2010c), multi-product firms accounted for 39% and 87% in number of firms and value of output respectively in the U.S., while they are 47% and 80% in India by the calculation of Goldberg *et al.* (2010). Note that their focuses are on firm production rather than exports, and products are defined by 5-digit SIC categories or similar-level classification, more aggregated than HS8 categories that we use in this study.

[2] For simplicity of expression, in this chapter the broad term "textile(s)" represents both textile and clothing products without explicit indication.

Table 4.1. Distribution of single-product and multi-product exporters in Chinese exports to the U.S.

	Share of number of firms			Share of export value		
Year	Single-product exporters	Multi-product exporters	Total	Single-product exporters	Multi-product exporters	Total
2002	42.93%	57.07%	100%	12.37%	87.63%	100%
2003	42.46%	57.54%	100%	10.51%	89.49%	100%
2004	41.71%	58.29%	100%	10.23%	89.77%	100%
2005	39.22%	60.78%	100%	10.15%	89.85%	100%
2006	38.74%	61.26%	100%	10.69%	89.31%	100%

Notes. This table presents by year the shares of single- and multi-product exporters in all Chinese exporting firms, calculated from the database of the Chinese Customs Trade Statistics. Products here are defined by HS8 codes.

the removal of MFA quotas provides a unique and ideal setting for examining how multi-product firms make adjustments in response to quota restrictions since we have variations of policy over time, across products, and across destinations.

The prevalence of MPFs found above is also seen in the textile industry in Table 4.2, where we look at the sample of Chinese textile exporters in the U.S. market who export only textiles to the U.S.. The figures are quite similar to Table 4.1, but a more interesting finding is for the year 2005, the year when all MFA quotas terminated. The proportion of MPFs increased dramatically by 15 percentage points, and the share jumped up by 5 percentage points, implying that MPFs became even more dominant without export quantity restraints.

Several interesting results stand out in this study. First, we find that the removal of MFA quotas induced firms to expand their export product scopes (numbers of products exported) by one third on average. This is the result of firms suddenly adding new product categories into their export product bundles. Second, the evidence shows that firms tend to reduce their concentration on the best-sales product in exports following the quota elimination. The size of the reduction is about 10%, and is mainly caused by the emergence of new export products. Third, a

Table 4.2. Distribution of single-product and multi-product exporters in the sample of pure Chinese textile exporters exporting to the U.S.

	Share of number of firms			Share of export value		
Year	Single-product exporters	Multi-product exporters	Total	Single-product exporters	Multi-product exporters	Total
2002	52.34%	47.66%	100.00%	16.71%	83.29%	100.00%
2003	49.92%	50.08%	100.00%	12.32%	87.68%	100.00%
2004	54.05%	45.95%	100.00%	14.75%	85.25%	100.00%
2005	40.21%	59.79%	100.00%	9.24%	90.76%	100.00%
2006	41.94%	58.06%	100.00%	11.14%	88.86%	100.00%

Notes. This table presents by year the shares of single- and multi-product exporters in the sample of Chinese textile exporters in the U.S. market who exported only textiles to the U.S., calculated from the database of the Chinese Customs Trade Statistics. Pure textile exporters are defined as exporters who only exported textiles to the U.S., and products here are defined by HS8 codes.

further look across firms of different ownership types produces a robust finding, that is, state-owned firms were largely irresponsive to the massive changes in quotas, while foreign-owned responded most strongly in terms of adjustments in both produce scope and concentration. We attribute this phenomenon to the quota allocation inefficiency that is believed to have existed in China during the MFA period, which refers to the fact that state-owned firms were given preferences in getting quota allowances through administrative allocations regardless of their efficiency. Finally, the above findings are reconfirmed by comparing exports to two destination countries – the U.S., a major MFA country, and Japan, a major non-MFA country –, and more importantly, firms' focus on markets is found to have shifted towards the U.S. and away from Japan. These findings reveal the patterns of *intra-firm* resource reallocations triggered by abrupt changes in quota restrictions, and shed light on some newly emerging theories.

Our study first contributes to the recent literature on multi-product firms. A key insight of this literature, notably the models of Baldwin and Gu (2009), Eckel and Neary (2010), Bernard *et al*. (2011), and Mayer *et al*. (2011), highlights firms' decision on product mix following changes in market conditions: firms tend to concentrate more on their "core products", which reflect the firms' cost advantages in production, when the market size increases or the trade cost decreases, or, more generally, when the competition becomes tougher. Thus, changes in economic conditions not only lead to the entry and exit of firms but also trigger resource reallocations within firms.

These theoretical predictions have received support from empirical evidence which depicts the patterns how external economic conditions affect resource reallocations within firms. For example, Bernard *et al.* (2011) study the effect of the introduction of the Canada-U.S. Free Trade Agreement (CUSFTA) in 1988 on U.S. firms. Their result shows that U.S. firms experiencing higher Canadian tariff reductions exhibited a rise in the concentration of production in their largest products, relative to firms experiencing lower Canadian tariff reductions. Using Mexican manufacturing firms data, Iacovone and Javorcik (2010) examine product-level dynamics within firms in the context of Mexican trade liberalisation under NAFTA. They find evidence that the introduction of NAFTA triggered intense product churning (simultaneous adding and dropping of products) within firms. Goldberg *et al.* (2010) investigate how Indian firms adjusted their product mix by adding and/or dropping products in production during a period of major market reforms. Without finding any evidence of tariff cuts impacting MPFs' product mix, they attribute this result to the fact that the high industrial regulation in India had made firms reluctant to withdraw established product lines once their large entry costs were sunk. For Canadian firms, Baldwin and Gu (2009) find reduction in product diversification caused by tariff cuts, although it is more so for non-exporting plants than for exporting plants.

While the above empirical evidence is broadly consistent with theoretical predictions, the changes in economic conditions in these studies are either a mixture of some forms of trade cost reduction and other factors, or only specific at the industry level. Thus, it is hard to link these external changes to products within firms.

Since MPF theories specify trade costs at the product level, an ideal empirical context would involve policy variations across products. In this chapter, we explore a special policy shock – the elimination of MFA quotas. Compared to the above cases of trade liberalisation, the MFA quota removal have nicer features of being specific to products, having clear schedule which fits perfectly with the time periods of our data, and being exogenous to firms. Apart from these, the coverage of MFA quotas also varies greatly across countries, as some countries imposed MFA quotas against some Chinese imports while others did not. This additional level of variation is in line with the theories, since in the theoretical models multi-product firms should also be able to export to multiple destinations (such as in the models of Bernard *et al*. (2011) and Mayer *et al*. (2011)). Overall, the event of the MFA removal encompasses essential elements of a clear-cut policy experiment with rich variations within firms, thus enabling one to study the behaviour of multi-product firms more thoroughly and precisely.

Our study is also closely related to the previous studies on the quota effect. The theory that quotas lead to the product quality upgrading dates back to Alchian and Allen (1964) and Falvey (1979), who emphasised the shift in demand towards higher-quality goods when the quota rent amounts to imposing the same extra price for each physical unit of goods. This argument has found its support in the empirical studies of Feenstra (1988) and less directly Hummels and Skiba (2004). Using product-level U.S. import data, recent studies by Harrigan and Barrows (2009) and Brambilla *et al*. (2010) found the elimination of MFA quotas in 2005 caused significant quality drop of the U.S. imports of textile and clothing products from other countries, especially China. However, despite the evidence that quotas do lead to quality upgrading via changes in the shares of products of different costs/prices, the above evidence is only limited to the demand side and nothing is known about the supply side. Using the firm-product-level Chinese customs data, Khandelwal *et al*. (2011) look into the extensive margins of the export price drop of Chinese textile and clothing exports to the U.S., and found that the price drop after the MFA quota phaseout is predominantly due to the firm-level churning – the entry of firms with relatively low prices at the expense of incumbent state-owned enterprises. While this study has documented convincing evidence on how firm entry and exit explain the observed price drop, we still lack information on how existing exporting firms actually make *intra-firm* adjustments in response to changes in quotas. In Chapter 3, we examine the issue of how firms changed their export product prices as a result of quota removal, but we have not explicitly investigated *intra-firm* adjustments either.

In this chapter, we fill this blank by looking into how quotas affect firms' decision on product scope and concentration. Our customs data enable us, for the first time, to produce micro-level evidence of how firms actually adjust the structure of their export product bundle in face of a massive and sudden removal of all quantity restrictions. Because of this, our findings supplement the results of Khandelwal *et al*. (2011) as we open the "black box" of firms and place our focus on intra-firm reallocations instead of firm entry and exit. We also try to answer the question of how the changes in the product mix have influences on the concentration of export products. In this way, our study not only sheds light on the theories of MPF behaviour, but also extends the current knowledge about the effect of quota policy to the internal side of firms.

The remainder of the paper proceeds as follows. In Section 4.2 we introduce the institutional background of this study. In Section 4.3 we review the most relevant theories and propose testable relationship;s. Section 4.4 describes the data and empirical methodology, and Section 4.5 contains and analyses the results. Section 4.6 concludes the main findings and point out future directions. Additional tables not presented in the main text are contained in Appendix B.

4.2 Institutional Background

4.2.1 The termination of MFA quotas

The general background of the MFA has already been introduced in Section 3.2 of Chapter 3. However, relevant to the study of this chapter, it is worth noting that only the U.S., E.U., Turkey, and Canada had quotas against Chinese textile imports after during the MFA quota phaseout era.[3] Interestingly, despite being the top destination market of Chinese textile exports, Japan did not impose any quantity restrictions on Chinese goods even before 2005, mainly because of its declining domestic industry and heavy reliance on imports from neighbouring countries (about 70% textile imports were from China in 2004).

4.2.2 The reality of quota allocations in China

As explained in detail in Section 3.5.5 of Chapter 3, for quota allocation in China, preference was in fact given to large state-owned firms in the coastal regions for the administratively allocated part of quotas (Yang, 1999), while in contrast foreign firms had to go through special administrative procedures to obtain quotas and often met unexpected difficulties in getting them (Moore, 2002, Ch. 5). If such statements are true, quotas were then not allocated efficiently as some less efficient state-owned firms could in any case get quota licences regardless of their performances while some more efficient foreign and private firms could not get the desired amount of quotas simply because they have weaker political connections with the authorities.

The inefficient or distorted quota allocation is in contrast with the existing multi-product firm theories where the market- and product-specific trade costs are

[3] An exception is Norway which is not part of the E.U., but it dismantled all quotas in 2000.

the same for all firms and the market entry conditions are solely determined by trade costs and firm productive efficiency. In other words, in the theoretical world quotas are allocated perfectly efficiently, whilst for China in reality it is probably far from being the case. This contradiction implies that firms' responses to the quota removal should be heterogeneous across different ownership types. Embedding the assumption efficient quota allocation into a multi-product firm model, Khandelwal *et al*. (2011) derived implications for how firms would respond to removal of quotas, that is less productive firms enter into the export market while price drop is explained by incumbent exporters. With Chinese customs data, however, what they found empirically is the opposite: the average price fall is mainly driven by low-price (high-productivity) entrants at the expense of the exit of incumbent state-owned enterprises. Their finding thus lends support to the above suspicion that MFA quotas were allocated inefficiently in China. In the following analysis with a new angle of looking into the adjustments within firms, we also test the conjecture of quota allocation inefficiency by investigating how firms of different ownership types respond differently to the quota removal.

4.3 Theoretical Benchmark

The quota allocation system in China implies there are some firm-level barriers to obtaining quota licences. Firms first need to meet some criteria in order to be able to get quota licences, whether through administrative allocation or open auctions. Apart from that, because quota licences are issued separately for individual product categories and the quantity permission can vary greatly across products, barriers also exist at the product level. Given the circumstance, it is therefore reasonable to believe that the MFA quota system creates some kind of firm-product specific trade cost to firms in China. There are two ways of thinking about the economic role of such a trade cost. First, as mentioned, a firm needs to overcome some barriers to qualify for applying for quotas or participating in auctions. Some costs must be sunk regardless of the result of quota application or auction. In this sense, a quota has a fixed cost component. Second, theoretical analyses have demonstrated that a quantity restriction in effect works in a similar way to a per (physical) unit cost in that it gives rise to a specific increase in per unit cost (see, for example, Falvey, 1979; Feenstra, 2003; Demidova *et al.*, 2009). Thus, a quota also brings about a variable trade cost proportional to the units exported.

Despite the mixed nature of the quota in terms of trade cost interpretation, the model of Bernard *et al.* (2011) (BRS hereafter) provides a theoretical benchmark for understanding how the removal of quotas would induce resource reallocations. In the BRS model, each exporting firm can ship multiple products to multiple foreign countries. For a given destination market, besides market entry cost (set-up cost), a firm will also have to pay a fixed cost for supplying each product in that market, plus the variable trade cost of exporting goods which takes the "iceberg" form. Importantly, for a reduction in trade cost in a given market, whether it is the fixed or variable trade cost associated with each product, the model generates qualitatively the same predictions concerning the direction of resource reallocations across and within firms. Since these results hold for both reductions in fixed and variable trade cost, the BRS model offers unambiguous predictions on the intra-firm effect of the MFA quota elimination which removes quota-imposed trade costs specific to firm, product, and market.

First, because the elimination of quotas greatly removes barriers of exporting previously quota-restraint products, firms do not need quota licences any more to export these products. Thus those products which were previously only supplied to the domestic market or other non-MFA countries can now be profitably exported to that market which has quotas lifted. This not only is a straightforward result of quota elimination, but also corresponds to the implication regarding product extensive margin in the BRS model.

Another related model is Eckel and Neary (2010) (EN hereafter), which, with an assumption of oligopolistic market structure, allows strategic interplay between multi-product firms producing similar goods. This is a feature that distinguishes this model from the BRS model. Globalisation takes place through two channels here: (a) the market-size effect, by which firms face larger markets, and (b) the competition effect, by which existing firms are exposed to more competition from new firms. They find that the market-size effect does not affect firms' product scope, while the competition effect induces firms to drop product lines of relatively high marginal production costs and produce a higher proportion of products of "core competence". By this mechanism, the net effect of globalisation is that firms become "leaner and meaner" in the sense that their product range contracts with a sharper focus on their "core competence". Nevertheless, the implications of this model are only about the production side of firms. If these predictions can also be extended to the export side of firms, then this model would predict, on the contrary to the BRS model, a decline in product scope as a result of the MFA quota elimination, since the removal of quotas induce more firms to enter the export market while the market size is fixed. However, given the reality that there are a large number of medium- and small-sized textile firms in China producing similar goods, the market structure of this industry is unlikely to be oligopolistic. Despite these different predictions derived different model settings, we can examine the relationship between the MFA quota removal and the firm's export product scope as Relationship 1.

Relationship 1 *Intra-firm product scope: existing exporters export more products to a former MFA country relative to the MFA period and relative to non-MFA countries.*

Second, if the BRS prediction holds, which implies an expanded product scope as a result of the fact that quota removal induces the firm to diversify their product mix by adding more products into their export product bundle, there could be a reduction in firms' focus on products that previously enjoyed highest revenue shares because some resources are reallocated towards these new export products.

However, a different implication might be drawn from the model of Mayer *et al.* (2011) (MMO hereafter), where firms increase the skewness of product sales due to tougher competition. In their framework, the toughness of competition is modelled as positively related to market size (number of consumers) and bilateral trade cost (ice-berg type trade cost). Larger market size and higher trade cost induce firms to skew their exports toward their core products. Although the removal of MFA quotas fits quite closely into the case of trade liberalisation (reductions in fixed and/or variable trade cost) in the BRS model, it is not clear in the MMO framework how the lifting of quotas would change market toughness, because (a) there is no obvious reason to believe the end of the MFA would change the market size in a given destination, and (b) quotas do not exactly resemble ice-berg type trade cost. However, if the removal of quotas does not change the market size while it does significantly reduce the bilateral trade cost, then the market becomes "less tough" in the MMO model. If this is the case, then by the MMO model we should also expect a reduction in product skewness following the elimination of quotas. Again, as seen above, this prediction goes against that of the EN model: if the latter can be extended to firms' exports, we should expect an increase in firms' concentration on "core products" due to the competition from the entry of new exports. Since it is not clear from the theories which prediction is more likely to hold in reality, we summarise a testable statement as Relationship 2.

Relationship 2 *Intra-firm product concentration: the distribution of export sales revenue is more even (less skewed) among products within existing exporters, with a decreasing concentration on certain products.*

Third, in respect of the reality of the quota allocation system in China (see, for example, Moore, 2002, Ch. 5; Yang, 1999; Khandelwal *et al.*, 2011), state-owned firms could obtain quota licenses more easily than other firms, regardless of their actual export performance, due to the political preference given by quota allocation authorities. They were initially less constrained by quotas and therefore the removal of quotas should have less impact on these firms. Khandelwal *et al.* (2011) tested the implication of the inefficiency in quota allocation by looking at the firm entry and exit in the export market. They found that after the MFA state-owned firms were crowded out in the export market by the entry of other firms, thus lending support to the quota allocation inefficiency conjecture. However, this conjecture has not yet been tested from, the perspective of intra-firm reallocations. This leads to Relationship 3.

Relationship 3 *Firm ownership type and responsiveness: state-owned firms are on average less responsive to the MFA quota removal in terms of intra-firm adjustments in product scope and product concentration.*

4.4 Data and Methodology

4.4.1 Data source

We use the same micro database as used in Chapter 3 – the Chinese Customs Trade Statistics (CCTS). However, we only use the data from 2002 to 2006 here to avoid any inconsistency in product codes due to the upgrade of the commodity coding system - Harmonised System (HS) - in 2002.[4] Besides, this selection of years also prevents unnecessary complication because 2002 is exactly the beginning year

[4]Note that in Chapter 3 we use this data from 2000 to 2006, because the six-digit-level HS codes for textiles were virtually unaffected by the upgrade of the coding system. But at the eight-digit level, the level of aggregation we use in this study in order to link Chinese source of quota categories with trade data, more codes were likely to have been affected. Keeping only data after 2002 rules our this complication.

of the last phase of MFA quota relaxation and hence the composition of quota products should remain basically unchanged from 2002 through 2004, making the year 2004 the only breakpoint in data and thus facilitating a clear-cut comparison of what happens before and after the expiration of MFA quotas. As before, imports, service trade, and trade intermediaries are excluded from our data so that it only contains commodities exported by *production firms* to other countries, and the data is also collapsed to the year level to facilitate our analysis. Each observations in the data is thus identified by the combination of firm code, eight-digit product code, destination, and year.

To identify eight-digit-level quota products, we resort to the booklet of *Quota-Restrained Textiles and HS Catalogue (Revised Version)* (China Chamber of Commerce for Import and Export of Textiles, 2002), which publishes the full list of the HS10 codes of Chinese textile and clothing products subject to MFA quotas set by different importing countries, i.e. the U.S., the E.U., Canada, and Turkey. These quotas were effective from 2002 through 2004. We further aggregate this list to the HS8 level so that it can be precisely linked to the HS8 codes in the above micro-level data.[5]

4.4.2 Analytical samples

For the purpose of studying firms' exporting behaviour, what is missing in the customs data are domestic firms who do not export or who only export through trade intermediaries. In other words, the firms we observe in the customs data is a self-selected sample of firms who engage in exporting directly. Admittedly, this sample is not appropriate for studying the determinants of firm entry into the export market. But this is not quite an issue here since to empirically investigate the

[5]We do this by assuming that an HS8 category is a quota-restrained category as long as it contains one or more HS10 codes listed in the booklet of China Chamber of Commerce for Import and Export of Textiles (2002).

Table 4.3. Number of firms exporting to the U.S.

Year	Others	Exporting in 2004 and 2005	Total
2002	10,205	15,862	26,067
2003	10,720	21,984	32,704
2004	8,355	33,105	41,460
2005	22,015	33,105	55,120
2006	35,854	27,896	63,750

Notes. This table lists by year the number of firms which ever exported in both 2004 and 2005, and the numbers of other firms as well as all firms.

theoretical predictions regarding *intra-firm* adjustments, which is the main target of this chapter, one only needs to look at continuing exporters in the export market. Besides, for studying the role of the ownership type, if the differences do exist across firms of different ownership types, the differences should also be observed for the sample of existing exporters.

Existing exporters, or continuing exporters, are those firms which exported before to a given market. By construction, this sub-sample of firms does not include any entering or exiting exporters, thus the estimated economic effects are purely *intra-firm* effects for existing exporters, perfectly corresponding to those relationships we proposed concerning the bahaviour of these firms.

Practically, to drop as few firms as possible, instead of keeping firms which exported each year during the sample period, all firms are included as long as they exported in both 2004 and 2005. It turns out that, as seen in Table 4.3, there are 33,105 such firms. Besides, it is seen again that in 2005 a large number of new firms started exporting, and the number of net entry is 13,750 ($22,105 - 8,355 = 13,750$) out of a total of 41,460 firms in 2004. As expected, this net entry is much more marked than any other year.

4.4.3 Construction of comparison groups

For the purpose of constructing appropriate comparison groups at the firm level for the econometric estimation that follows, firms are grouped according to the types of products they export. One reasonable way to do so is classify firms according to whether or not they only export textile products. Since there also exist a number of firms which export both textiles and other products (e.g., leather shoes), we group firms into three types:

- pure textile firms, i.e., firms who exported nothing other than textile products (*treatment group, "P1"*);
- pure non-textile firms, i.e., firms who exported nothing other than non-textile products (*control group, "C1"*);
- mixed-industry firms, i.e., firms who ever exported both textile and non-textile products (*treatment group, "M1"*).

The classification is, by definition, exhaustive and mutually exclusive, and thus any firm should fall into one of the three types.[6]

Since the main trade barriers of interest here are imposed by U.S. quotas, a more convincing comparison would distinguish between firms exporting only quota products and firms exporting other textile products. Restricting the sample only to *pure textile firms* defined above, we therefore further define three sub-categories of firms:

- pure quota firms, i.e., firms who exported nothing other than U.S.-quota products (*treatment group, "P2"*);

[6] For the analysis of firms exporting to the U.S. market, the above classification is based on products a firm exports to the U.S., whilst for the analysis of firms exporting both to the U.S. and Japanese markets, the classification is based on products a firm exports to both markets.

- pure non-quota firms, i.e., firms who exported nothing other than non-U.S.-quota products (*control group, "C2"*);
- mixed-product firms, i.e., firms who ever exported both U.S.-quota and non-U.S.-quota products (*treatment group, "M2"*).

By definition, any pure textile firm is classified as belonging to one of these three categories.

Table 4.4 describes by year the number of these firms exporting to the U.S. market. Unsurprisingly, we find a huge influx of new textile exporters into the U.S. in 2005 in the left block of the table. Despite a general trend of increase in the number of firms across all firm types in that year, this increase is extraordinary – about one and half times for pure textile firms, much bigger in proportion than for other firm types. This is because the termination of MFA quotas greatly reduces the U.S. market entry cost and induces many previously domestic Chinese firms to start exporting to the U.S. The right block of the table gives a description of our *first analytical sample*, Analytical Sample I, of firms which ever exported to the U.S. both in 2004 and 2005, which is exactly the existing exporters sample described in Table 4.3. By construction, this sample is balanced in 2004 and 2005 for each of the firm categories.

Firms in the sub-categories of pure textile exporters are described in the left block of Table 4.5. Since pure quota firms are much more constrained by U.S. quotas than pure non-quota firms, a difference in firm entry between these categories should give us a sense of the degree to which quota had imposed trade barriers on firms. Comparing the figures of 2005 relative to 2004, indeed an astonishingly steep growth – about four-time growth – is found for pure quota exporters, making their number well overtake all others overnight. The result again illustrates a sizable, positive effect of the quota removal on firm entry. The sample summarised in the right block is our *second analytical sample*, Analytical Sample II. It excludes

Table 4.4. Number of textile vs. non-textile exporters exporting to the U.S.

	All exporters				**Analytical sample I:** Exporters exporting in 2004 and 2005			
					(M1)	(P1)	(C1)	
Year	Mixed	Textile	Non-textile	Total	Mixed	Textile	Non-textile	Total
2002	3,776	1,391	20,900	26,067	3,007	535	12,320	15,862
2003	5,114	1,835	25,755	32,704	4,239	883	16,862	21,984
2004	6,761	2,446	32,253	41,460	6,141	1,776	25,188	33,105
2005	9,349	6,001	39,770	55,120	6,141	1,776	25,188	33,105
2006	9,730	6,624	47,396	63,750	5,315	1,348	21,233	27,896

Notes. “Mixed” refers to firms who ever exported both textile and non-textile products, “Textile” refers to firms who exported nothing other than textile products, and “Non-textile” refers to firms who exported nothing other than non-textile products. Textile products are those products included in the HS chapters 50-63.

all pure textile exporters which did not export executively in 2004 and 2005. The number of firms reduces dramatically compared to Analytical Sample I, but this sample allows for more extreme treatment-control comparisons.[7]

4.4.4 Estimation strategy

We use regression tools to reveal the effect of the MFA quota removal on firms. The methodology is quite straightforward. We have a clear time point when all the quotas were removed, which provides us a before-after variation. We also have firms which were severely bound by quotas and those which were not, and this provides us a cross-sectional variation. Thus the estimation can be carried out by making comparisons in a "difference-in-differences" (DD) manner by exploring the variations both over time and across groups of firms.

The DD regression function takes the following form:

$$\mathrm{Y}_{it} = \alpha + \mathbf{T}_t'\delta_t + \mathbf{D}_i'\rho_i + (\mathbf{TD}_{it})'\lambda_{it} + \varepsilon_{it}, \tag{4.4.1}$$

where i and t index firm and year, respectively, and $t \in \{2002, 2003, 2005, 2006\}$; Y_{it} is the outcome variable; α is the constant term; $\mathbf{T}_t$ contains year dummies with the omitted year being 2004; $\mathbf{D}_i$ contains dummies indicating different groups of firms constrained differently by MFA quotas; $\mathbf{TD}_{it}$ contains all possible interactions between the elements of $\mathbf{T}_t$ and $\mathbf{D}_i$; ε_{it} is the error term assumed to be uncorrelated

[7] An even more extreme comparison is between pure quota firms who only export binding-quota textiles and pure quota firms who only export non-binding-quota textiles. However, after further splitting the sample of pure quota firms into these two groups, we find, averaged over years, only more than 20 firms fall into the group of pure binding-quota textile firms, which makes the sub-sample highly unrepresentative and the comparison result unprecise. Besides, as we discuss later on, product-level quota restrictiveness does not matter that much down at the firm-level, mainly because different firms are restrained differently by the same product quota, no matter how big its fill rate turns out to be. For these two reasons, we do not consider this comparison here.

Table 4.5. Number of quota vs. non-quota textile exporters

	All pure textile exporters				**Analytical sample II:** Pure textile exporters exporting in 2004 and 2005			
Year	Mixed	Quota	Non-quota	Total	(M2) Mixed	(P2) Textile	(C2) Non-quota	Total
2002	573	415	403	1,391	335	86	114	535
2003	811	498	526	1,835	524	151	208	883
2004	1,093	656	697	2,446	950	410	416	1,776
2005	1,970	3,071	960	6,001	950	410	416	1,776
2006	2,003	3,425	1,196	6,624	780	282	286	1,348

Notes. “Mixed” refers to firms who ever exported and only exported both quota-textile and non-quota-textile products, “Quota” refers to firms who exported nothing other than quota-textile products, and “Non-textile” refers to firms who exported nothing other than non-quota-textile products. Textile products are those products included in the HS chapters 50-63. Quotas refer to U.S. MFA quotas on China.

with the covariates and have a zero mean; all other parameters are coefficients to be estimated. In what follows, group indicators in $\mathbf{D}_i$ are consistent with the classifications in Section 4.4.3, and one of the groups will be seen as the comparison group while others are treatment groups. Thus, in comparison 1 using Analytical Sample I, $\mathbf{D}_i = \{P1, M1\}$ with $C1$ as the base (control) group. In comparison 2 using Analytical Sample II, $\mathbf{D}_i = \{P2, M2\}$ with $C2$ as the control group. In the spirit of difference-in-differences approach, δ_t captures the general trend of changes over time, while ρ_i reflects the differences across different groups of firms. The key coefficients of interest are λ_{it}, which are the estimates of how the differences between firm groups are different over time; particularly, $\lambda_{i,2005}$ reflects how the difference changed in 2005 relative to 2004, which is then attributed to the MFA quota removal.

4.5 Empirical Results

4.5.1 Product scope

Regarding the quota effect on product scope, we estimate Eq. 4.4.1 with the number of products as the dependent variable. The control group $C1$ is pure non-textile firms, against which both pure textile firms $P1$ and mixed-industry firms $M1$ are to be compared. In practice, this comparison is done by running a difference-in-differences regression with a full set of interaction terms between year and treatment dummies, as outlined in Eq. (4.4.1). The omitted year is 2004, the last year of the MFA. The result is plotted in Figure 4.1, with the full regression output shown in Table B4 of Appendix B. In this figure, each dot represents the estimate of the number of export products for each group of firms in each year, and the bars indicate 95% confidence intervals, all recovered from the DD regression coefficients and covariances.[8] Note that, for simplicity in exposition, we do not include mixed-industry firms in the figure; however, the result for this type of firms can be found in Table B4.

The figure reveals a lot of information. For firms of all ownership types, the number of products exported is very similar between pure textile firms and pure non-textile firms within the periods before 2005, constantly between 3 to 4 products on average. However, the divergence happened in 2005: an unprecedentedly big gap was created one-off by a large jump in the number of products exported by pure textile firms which does not occur in the control group. On average, pure textile firms increased their number of export products by 2 (from 2.90 to 4.96), while the increase with pure non-textile firms was only 0.3 (from 3.06 to 3.34), resulting directly in the stark difference in the product scope after 2005. It is also seen in Table B4 that an even bigger discrepancy emerged between mixed-industry firms and pure non-textile firms, which is probably because the mixed-industry firms exported a wider range of goods to start with, although, as will be seen later, its proportion increase was smaller. The timing of the divergence exactly coincides the termination of MFA quotas, and the clear-cut DD results give us much confidence that the expansion in export product scope was indeed caused by the removal of quotas, thus lending support to Relationship 1.

The remaining three panels of Figure 4.1 show the effect of quota removal on the number of products exported to the U.S. separately by firm ownership type. Induced by the quota removal, among pure textile firms, foreign-owned firms expanded their product scope by far the most in the U.S. market, nearly 3 products (from 2.85 to 5.58), and private firms increased their number of products a bit less, nearly 2 products (from 2.92 to 4.81), while by contrast we do not have such statistically significant evidence of expansion in product scope for state-owned firms. In comparison, the increase the number of exported products by firms in the control

[8]In these regressions, the dependent variables are all *unlogged* number of products.

group is small for all firm types, as we would expect.

These differences found here are completely consistent with the institutional background of quota allocations in China, and hence Relationship 3 regarding the relative responsiveness of state-owned firms. Given that state-owned firms could be issued quota licences regardless of their export performance while other firms, especially foreign firms, would find it more difficult to get as much quota allowances, the complete removal of quotas would trigger a process of resource reallocation toward better-performing firms, and the process would then be determined more by their economic efficiency than by their connections with the government. In terms of product scope, a natural result of such reallocation would be that better-performing firms started exporting products which they had not been able to due to extra constraints caused by their disadvantageous ownership types. When the distortion was corrected, ownership did not matter as much as before, and previously discriminated firms would respond more strongly.

Changes in the number of products are straightforward for interpretation, but proportional changes may better reflect the responsiveness of firms. Thus, alternative to showing changes in raw numbers, we also repeat the DD regressions for *logged* number of exported products. The results are presented in Table B5, where it is seen that the above conclusions hold qualitatively with a proportional change interpretation, with a take-away message that the quota removal increases the number of products exported by about one-third.

An even more convincing comparison is between firms exporting only quota textiles and those only exporting non-quota textile products, albeit at the price of a much smaller sample. By intuition, the former group of firms are those constrained the most by MFA quotas, while the latter are constrained the least. We thus narrow down the sample to only pure textile firms, who are then further classified into three subgroups: pure quota firms (firms only exporting quota textiles), pure non-

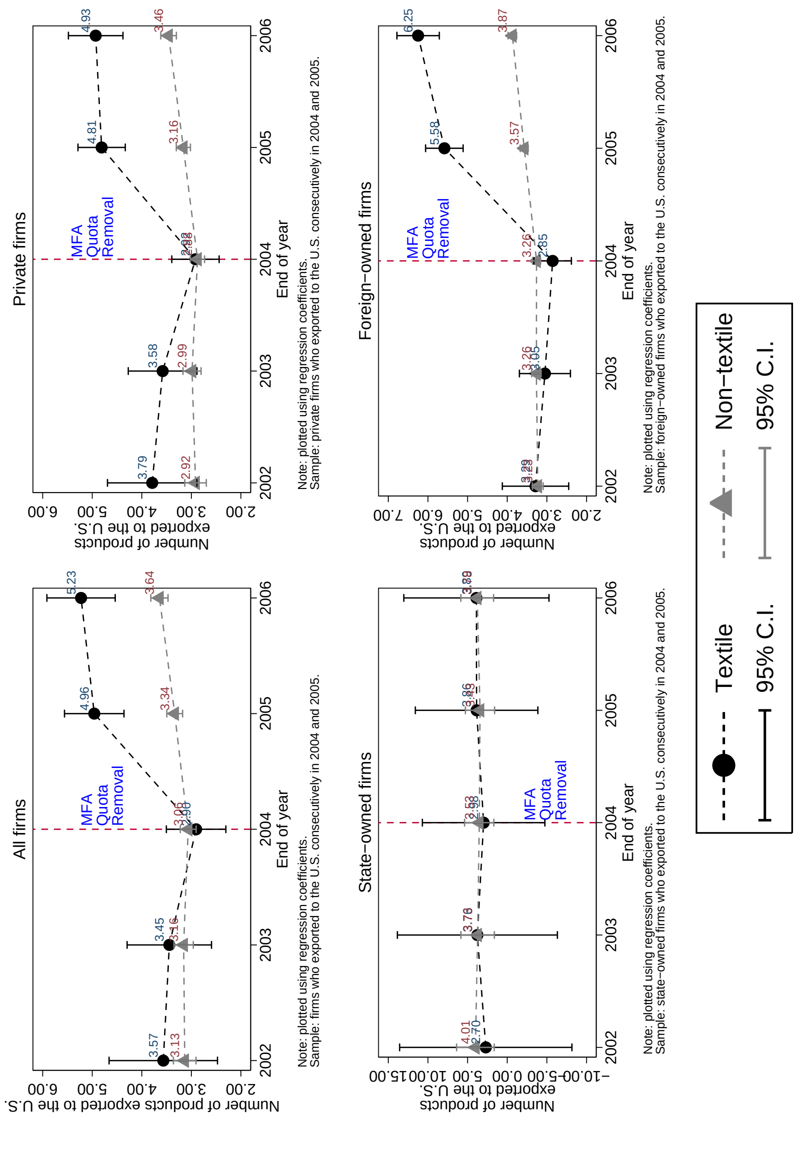


Fig 4.1. Regression result (Table B4) by firm ownership type: average number of products exported by firms to the U.S., textile vs. non-textile firms, 2002-2006

quota firms (firms only exporting non-quota textiles), and firms who ever exported both quota and non-quota textiles. The regression takes the same form as before, only that comparison groups are changed: the key comparison is now between pure quota firms and pure non-quota firms. According to the results displayed in Figure 4.2 (and correspondingly, Table B6 of Appendix B), not only the story revealed is qualitatively the same as before, but also the estimated size of the quota effect on product scope is quantitatively more or less unchanged for all firms in general and for each ownership type individually. Again, the conclusions here are robust in interpretation if we turn to proportional changes estimates in Table B7, where the estimated effect on product scope is still one-third as in Table B5.

4.5.2 Product concentration

Now we turn to look at what the data reveals with regard to Relationship 2. To measure product concentration, we could use second-order measures such as Herfindahl index, or entropy measures such as Theil index, as in the empirical parts of the BRS and MMO papers. But a problem with these measures is that they do not work sensibly for a single observation; they usually require at least two data points to have a distribution to produce a reasonable measure.[9] Thus, to adopt these measures single-product firms would have to be dropped, which could bias our result as single-product firms make up a non-trivial proportion of our firm sample (refer to Table 4.1). In order to include all firms regardless of the number of products they export, we measure product concentration here by simply looking at the value share of the top product in a firm's total export sales. For example, if a firm exports 10 products, and the shares of these products in the firm's total export sales range from 0.05 to 0.5, then we take the value 0.5 as the index for the firm's export product concentration. A bigger value of this measure means a higher degree of

[9]This is why MMO exclude the sample of single-product firms to calculate their measures of product concentration.

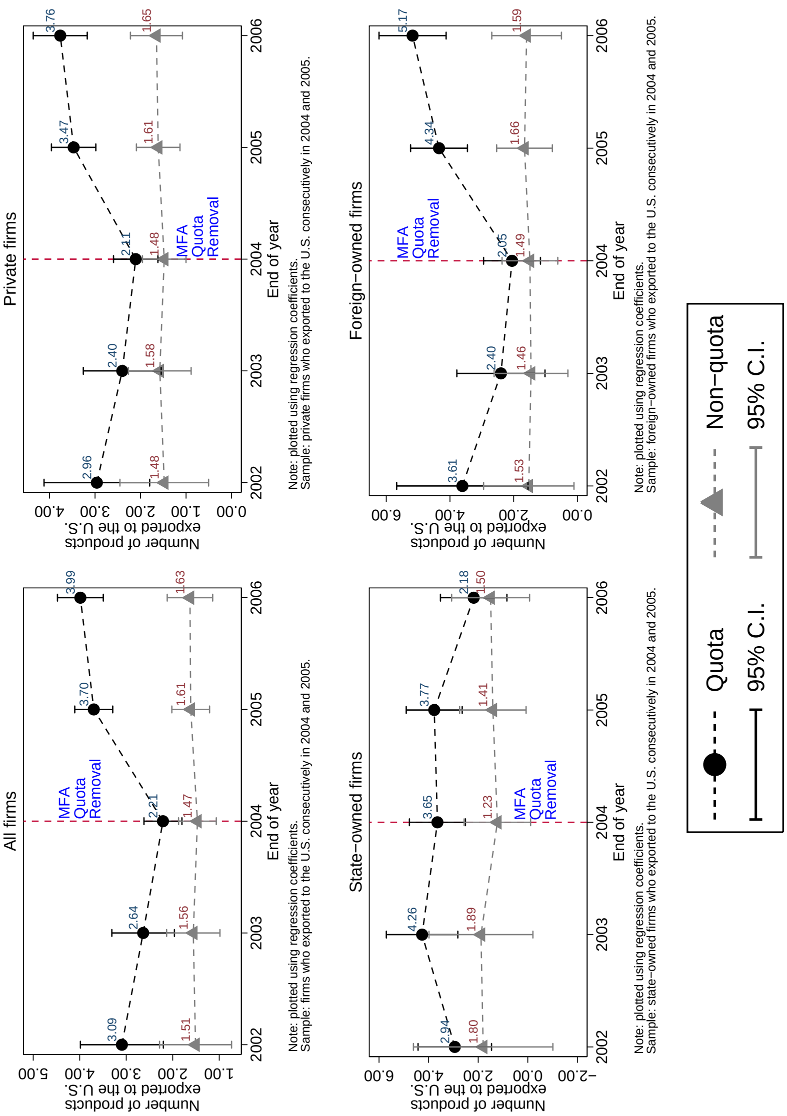


Fig 4.2. Regression result (Table B6) by firm ownership type: average number of products exported by firms to the U.S., quota vs. non-quota firms, 2002-2006

concentration of exports on a firm's best-sales product.

Figure 4.3 (refer to columns 1-4 of Table B8 for the details) confirms the conjecture given by Relationship 2. With the specification still being Eq. (4.4.1), the dependent variable is now the share of the top product in a firm's total export sales. As shown in Figure 4.3, the average value of this share is about 0.85 for non-textile firms in 2004, and only slightly lower for textile firms. In 2005, however, textile firms had significantly larger (about 8 percentage points) decrease in this share compared to non-textile firms, implying that the removal of quotas induced firms to concentrate *less* on their core product.

To address the question of how the above finding is driven by single-product exporters, we repeat the regression exercise on the subsample of multi-product firms which exported multiple products in each year. We find the quota removal effect on product concentration is 5 percentage points, which suggests that nearly 40% ($(8-5)/8 \times 100\% = 37.5\%$) of the product concentration drop is attributed to the adjustments of single-product exporters. This means ignoring single-product firms could cause a non-trivial bias to our result.[10]

Further splitting the sample into different ownership types, very similar over-time changes are found for private and foreign firms, compared to all firms; remarkably in Figure 4.3, there is a common sharp dip for textile firms in the product concentration measure in 2005, of size of 10 percentage points, while the decrease for non-textile firms is negligible. By contrast again, we do not find any significant effect for state-owned firms. Taken together, the evidence here means the average decline in product concentration was driven by the response of private and foreign firms whilst state-owned firms remained irresponsive to the removal of quotas. The implication is that state-owned firms were not efficient enough to soak up the new export opportunities brought about by the expiration of MFA quotas while firms of

[10]This regression result is unreported but available from the author upon request.

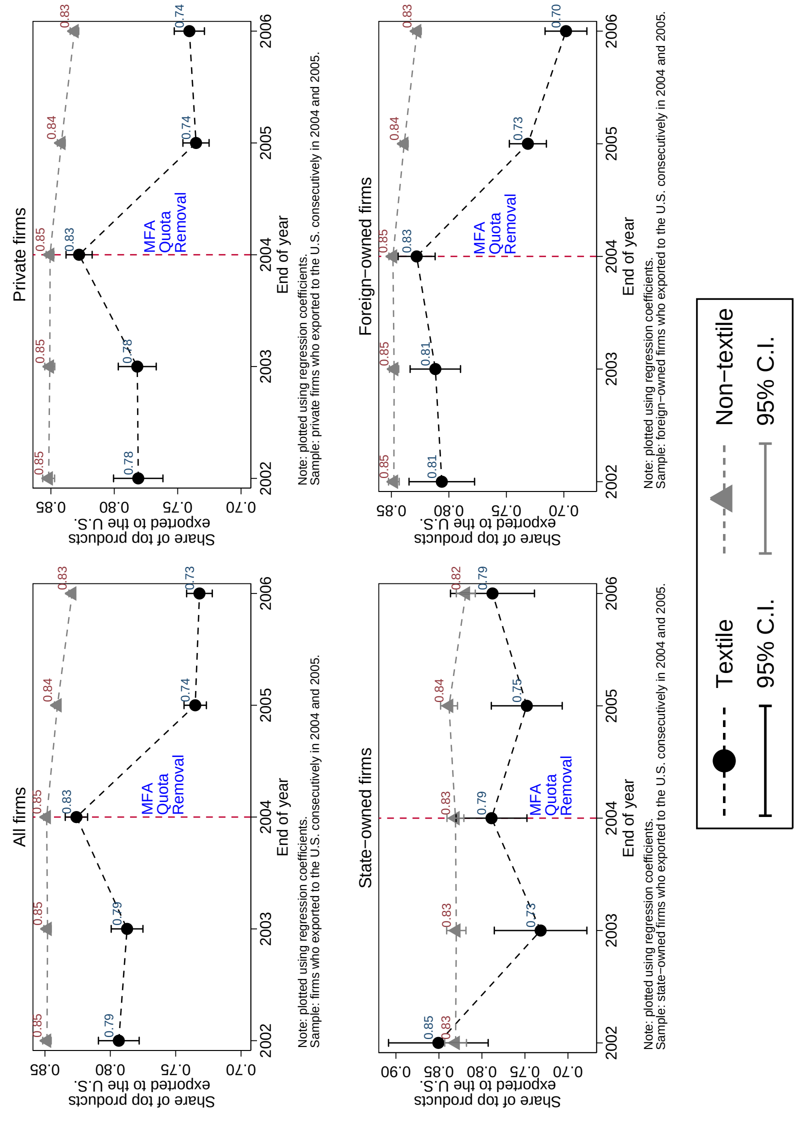


Fig 4.3. Regression result (columns 1-4, Table B8) by firm ownership type: share of top products exported by firms to the U.S., textile vs. non-textile firms, 2002-2006

other ownership types actively captured the opportunities by evening out their sales proportions of export products. This finding is supportive of the patterns described in Relationship 3.

A question which naturally arises is how this fall in product concentration came about. Note that it did not occur because of the entry of new exporters (which largely drove the results in Chapter 3), because the sample is restricted to firms which exported to the U.S. in both 2004 and 2005. However, it could still be driven by firms adding or dropping products or by firms changing the share of existing products. If a firm adds or drops products into the export market, the concentration of products is likely to go down or go up respectively, if the sales of other products remain stable. One way to wipe out these confounding influences is to simply focus on products which firms exported consecutively in 2004 and in 2005. We call these firm-specific "continued products" for convenience. As seen in Figure 4.4 (and columns 5-8 of Table B8 for the detailed regression output), when the sample is restricted to the continued products exported by existing exporters, all the effects found above become insignificantly different from zero. This suggests that the decline of concentration is mainly due to the diversification of product mix caused by firms exporting new products.

Together, the evidence from Figures 4.3 and 4.4 reveals an important mechanism of firms in responding to the quota removal: private and foreign firms respond actively to the quota removal by exporting new products and thus lowering their focus on the previous core product, while, by contrast, state-owned firms remain irresponsive to the change in economic conditions due to their lack of ability to make swift adjustments in face of more intensive market competition. As before, a plausible explanation is that these state-owned firms had initially been least bound by the quota system since they were most likely to get as much quota as they wanted despite the low efficiency of many of them, and as a result they were least affected by the liberalisation of quotas and were also least able to cope with new export

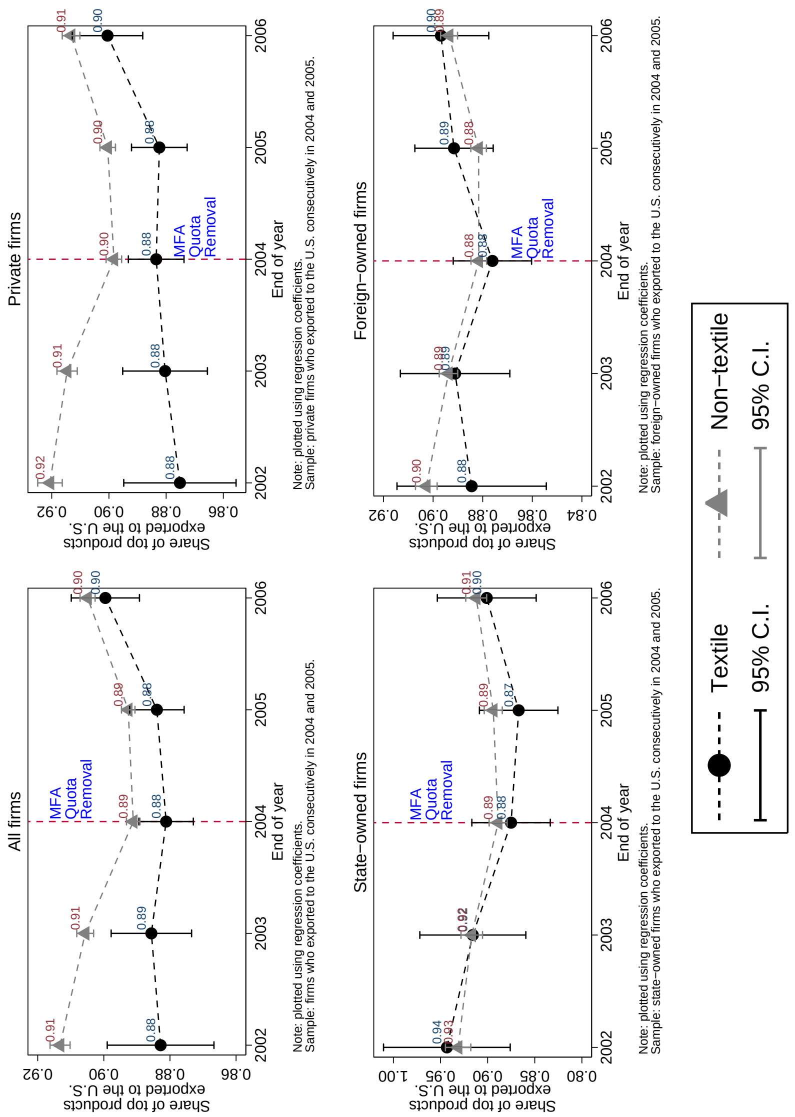


Fig 4.4. Regression result (columns 5-8, Table B8) by firm ownership type: share of top continued products exported by firms to the U.S., textile vs. non-textile firms, 2002-2006

situations.

In resemblance to Figures 4.3 and 4.4, Figures 4.5 and 4.6 (corresponding to columns 1-4 and 5-8 of Table B9, respectively) present the results for the sample containing only pure textile firms, and compare quota-textile firms against non-quota-textile firms. The above conclusions remain robust: the key message of Figure 4.5 is that the quota removal brought down product concentration by 9 percentage points on average, while, by contrast, the reduction is insignificantly different from zero in Figure 4.6 where the sample is restricted to continued products only. The difference between Figures 4.3 and 4.4 suggests, again, that the reduction in product concentration was caused mainly by the exporting of new products within existing exporters. As before, the above patterns are observed for all firm ownership types except state-owned firms.

4.5.3 Alternative comparisons: U.S. versus Japan as destinations

As the U.S. is a major MFA quota country for China while Japan is a major non-quota country, another way to pin down the above effects is to treat the U.S. as the treatment group while Japan as the control group. Here we simply restrict the sample to pure textile firms which ever exported and exported only textiles to the U.S. or Japan. In other words, we are comparing the exporting behaviour of firms which exported only textile products to the U.S. with firms which exported only textile products to Japan.

Since many of these firms can export to both countries at the same time, they can actually be the same firm in the comparison. This means that we can perform a within-firm comparison which provides an even tighter comparison group, since it eliminates possible unobserved firm-specific differences between the treatment

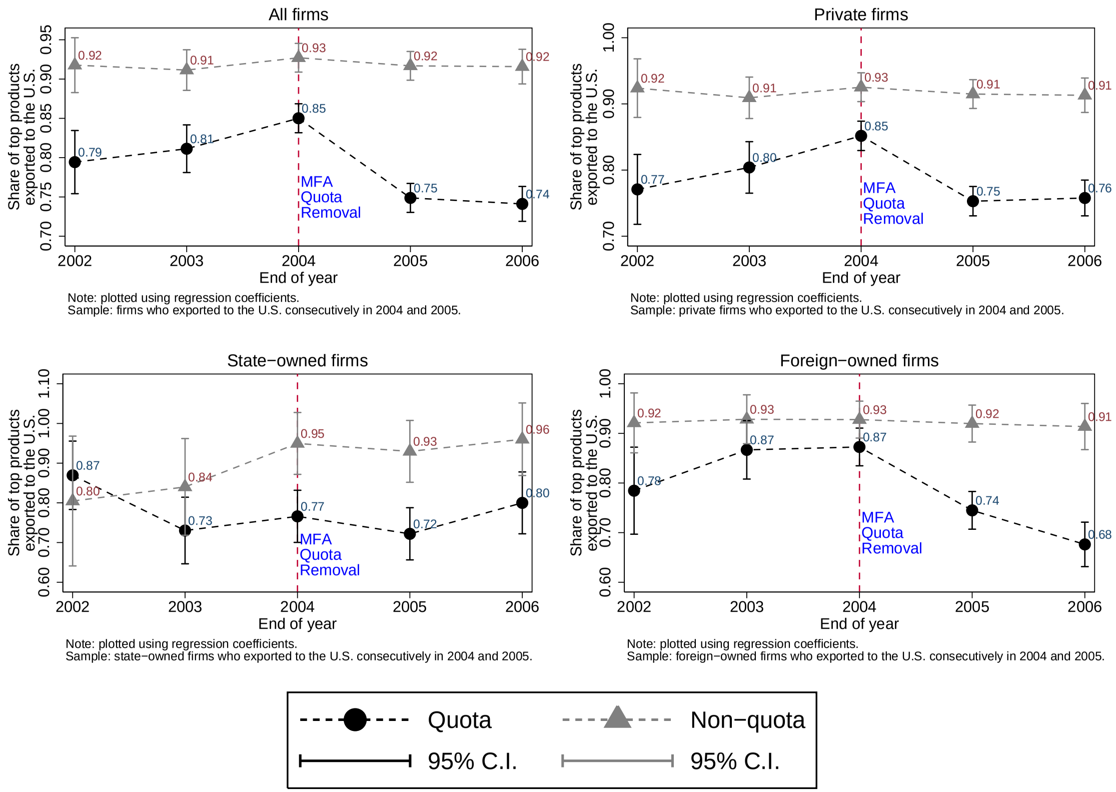


Fig 4.5. Regression result (columns 1-4, Table B9) by firm ownership type: share of top products exported by firms to the U.S., quota vs. non-quota firms, 2002-2006

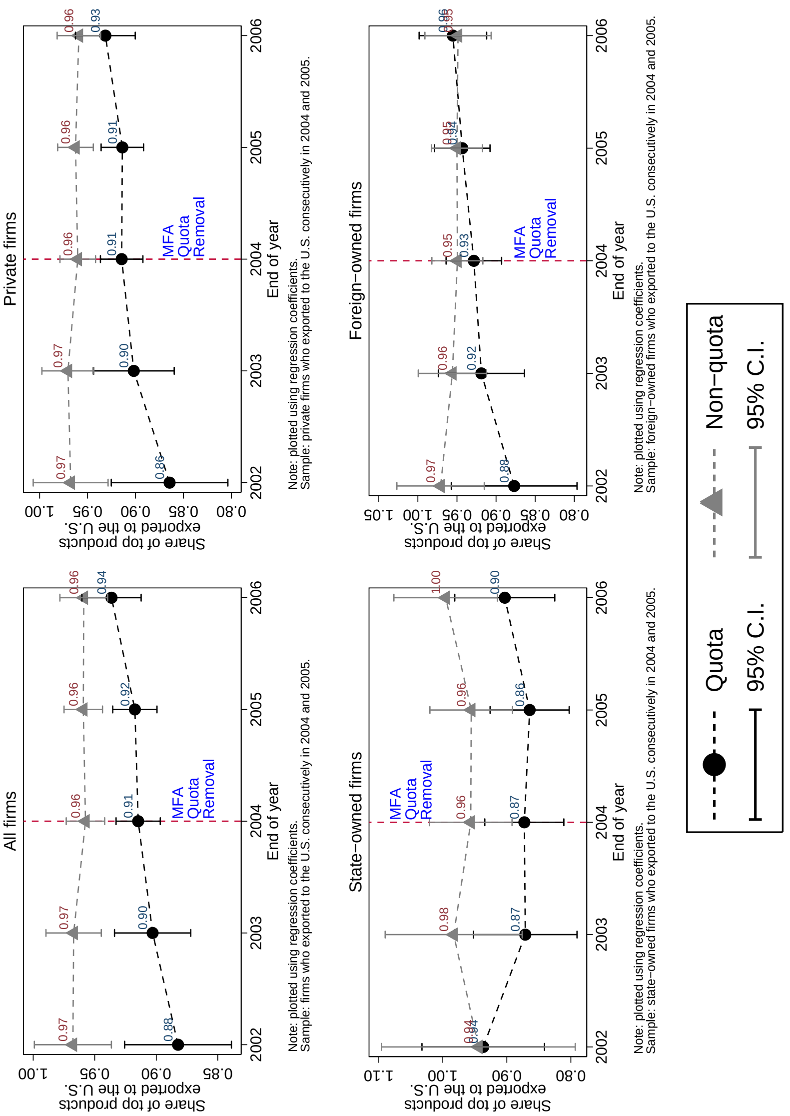


Fig 4.6. Regression result (columns 5-8, Table B9) by firm ownership type: share of top continued products exported by firms to the U.S., quota vs. non-quota firms, 2002-2006

and control groups. We therefore introduce firm fixed effects into Eq. (4.4.1), where each observation is now identified by a firm code (i), a destination country code (c), and a year indicator (t). Thus, the regression model now takes the form of:

$$Y_{ict} = \alpha + \mathbf{T}_t'\delta_t + \mathbf{D}_c'\rho_c + (\mathbf{TD}_{ct})'\lambda_{ct} + \varphi_i + \varepsilon_{ict}, \tag{4.5.1}$$

where φ_i is the firm fixed effect, and $\mathbf{D}_c$ is reduced to a dummy for the U.S. – it takes on the value of one if the destination is the U.S. and zero if it is Japan. The key coefficient of interest is $\lambda_{c,2005}$, which captures the differential effect of the quota removal on the U.S. compared to on Japan.

First of all, Figure 4.7 (see also columns 1-4 of Table B10) presents the difference-in-differences regression results for the number of products firms export to each of the destination markets. It is shown that from 2004 to 2005, there is a general trend of rise in the number of export products among pure textile firms, but this is more so for the U.S. than for Japan. For the Japanese market, the average number of products increased by 0.2 (from 5.37 to 5.60) but is insignificantly different from zero, while in the U.S. the number of products increases by 2.2 (from 3.95 to 6.16). Splitting the sample by ownership type, we find such expansion in product range in the U.S. market is the strongest for foreign firms, where the product scope expanded from 3.74 to 7.09, almost doubled. In other words, half of the product categories an average firm exported to the U.S. in 2005 were newly added into this export market. The expansion is a bit less remarkable for private domestic firms, though still as much as by 2 products (from 4.07 to 5.96). Not surprisingly, the change is insignificant at all for state-owned firms. This finding accords with the patterns we observed before about product scope within the U.S. market. Foreign and private firms actively reacted to the removal of quotas by adding more products into their export bundle while state-owned firms turned out to be very irresponsive.

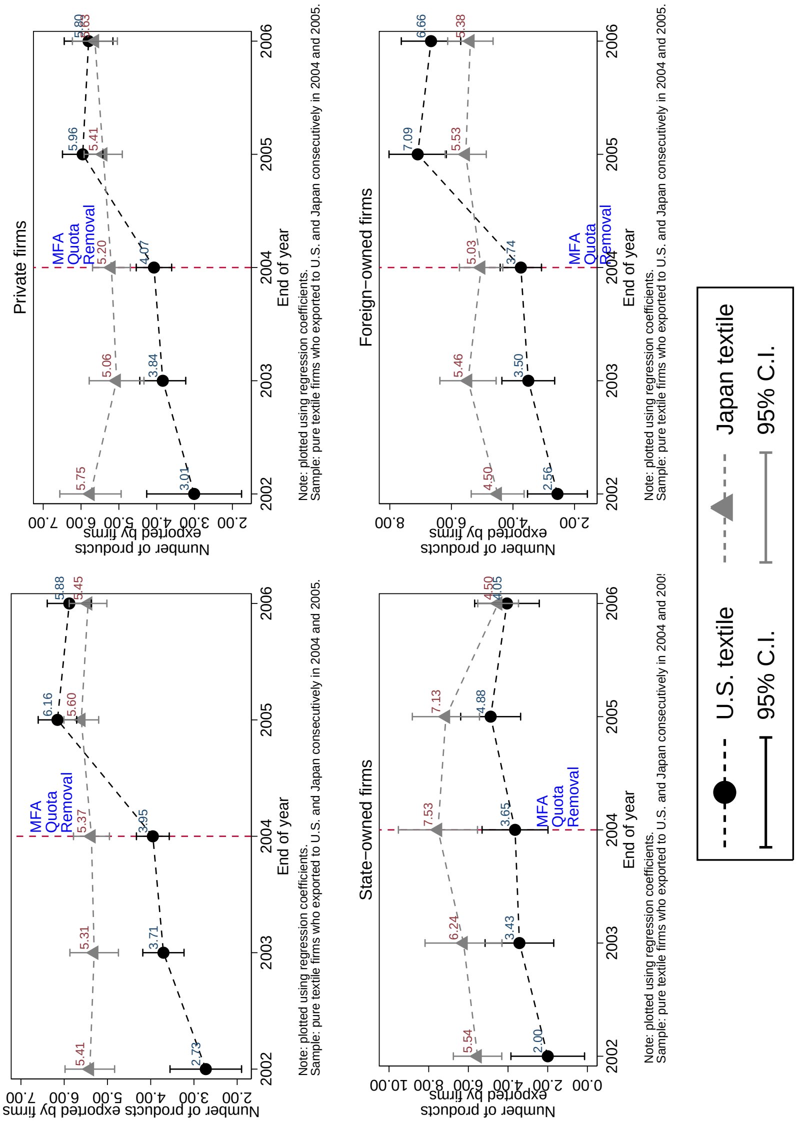


Fig 4.7. Regression result (columns 1-4, Table B10) by firm ownership type: average number of products pure textile firms exported to the U.S. and Japan, 2002-2006

Besides, intra-firm variations across countries also allow us to evaluate how restrictive product quotas were in the U.S. market relative to other non-quota countries. Our hypothesis is that if the MFA quotas were indeed restrictive (imposing additional costs) for firms, then after the quota expiration in 2005, firms should have incentive to add more products to the U.S. than to Japan. To test this relationship, for product scope we now only count the number of those products in the two markets – products which firms exported at least to Japan in 2004.[11] For these products in 2004, they were not constrained by any quotas in Japan but were mostly subject to MFA quotas in the U.S.. However, in the first half of 2005, all quotas were lifted in the U.S. and firms exporting to the U.S. were freed from the obligation to obtain quota licences. We thus would expect firms to start exporting some of these products which they had exported only to Japan in 2004. In other words, for each firm the increase in the number of these products should be larger in the U.S. than in the Japanese market.

Indeed, this is exactly what we find in Figure 4.8 (column 5-8 of Table B10), and all results turn out be more pronounced. Overall, in 2005, firms exported 0.5 more product categories (from 1.54 to 2.03) to the U.S., but meanwhile contracted the scope of products exported to Japan by 2 (from 5.34 to 3.29). The gap found here ($0.5+2=2.5$) is 0.5 larger than found in Figure 4.7, where the gap is $2.2-0.2=2.0$. To have a sense of the relative size of the difference between the two gaps, we turn to the results from regressions of *logged* number of products in Table B11. The estimates show that the estimated effect on the product scope is 21 percentage points bigger ($0.521-0.315=0.206$) in the second sample of products than in the first sample, a strong indication of an important intra-firm activity: firms shifted resources from Japan to the U.S. when quotas were lifted. As straightforward as it may be, this can be seen as the evidence of the existence

[11] To put it another way, we only count the number of products for each firm and for each market if they were exported by the firm to Japan in 2004; it does not matter whether they were exported to the U.S. or not in 2004.

of product-specific barriers in the U.S. market. The differences across ownership types are more or less the same as before: caused by the ultimate liberalisation of quotas, foreign firms added most products while there is no significant evidence of state-owned firms expanding their product scopes.

Parallel to the cross-firm comparisons in the U.S., cross-country comparisons provide another way of investigating the effect of the quota removal on product concentration in a difference-in-difference fashion. Not surprisingly, a similar story is found for product concentration in Figure 4.9 (full results are contained in columns 1-4 of Table B12). On the whole, the removal of quotas in the U.S. induced firms to focus a bit less on their core product, resulting in a 3 percentage-point reduction in the share of top product. However, the reductions are not statistically significant if we look at each ownership type individually. Interestingly, as Figure 4.10 (equivalently, columns 5-8 of Table B12) indicates, even the overall statistical significance of the above pattern of decreased concentration vanishes if one only looks at the sample of products firms exported consecutively in 2004 and 2005 to both countries. This is what we expect since it would imply that the reduction in product concentration is mainly driven by the fact that firms started exporting new products and hence the sales share of their previous core product dropped.

4.6 Conclusions

How multi-product firms respond to trade policies is an area on the frontier of recent trade studies. In this chapter, we contribute to this line of research by studying the effect of the elimination of MFA quotas on resource reallocation within multi-product firms. Specifically, we investigate how Chinese exporting firms altered their export product scope and concentration before and after the MFA quota removal in the U.S. market, as well as across countries with and without quotas against Chinese textiles.

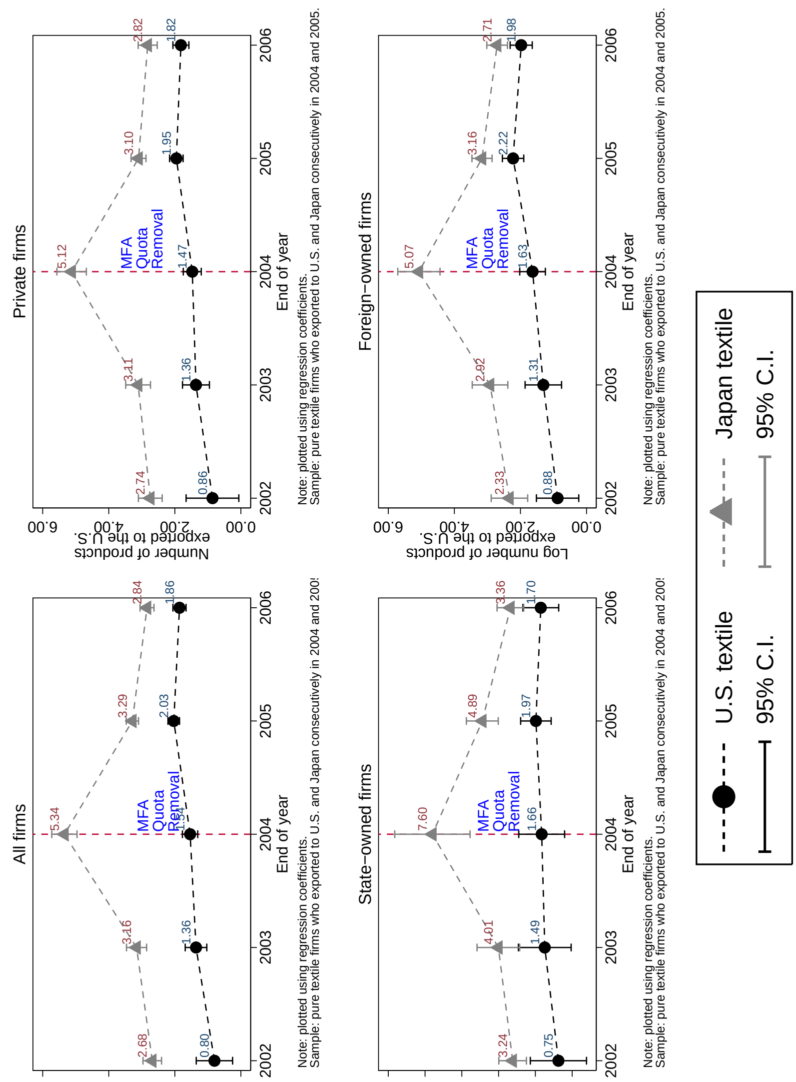


Fig 4.8. Regression result (columns 5-8, Table B10) by firm ownership type: average number of products (exported to Japan in 2004) pure textile firms exported to the U.S. and Japan, 2002-2006

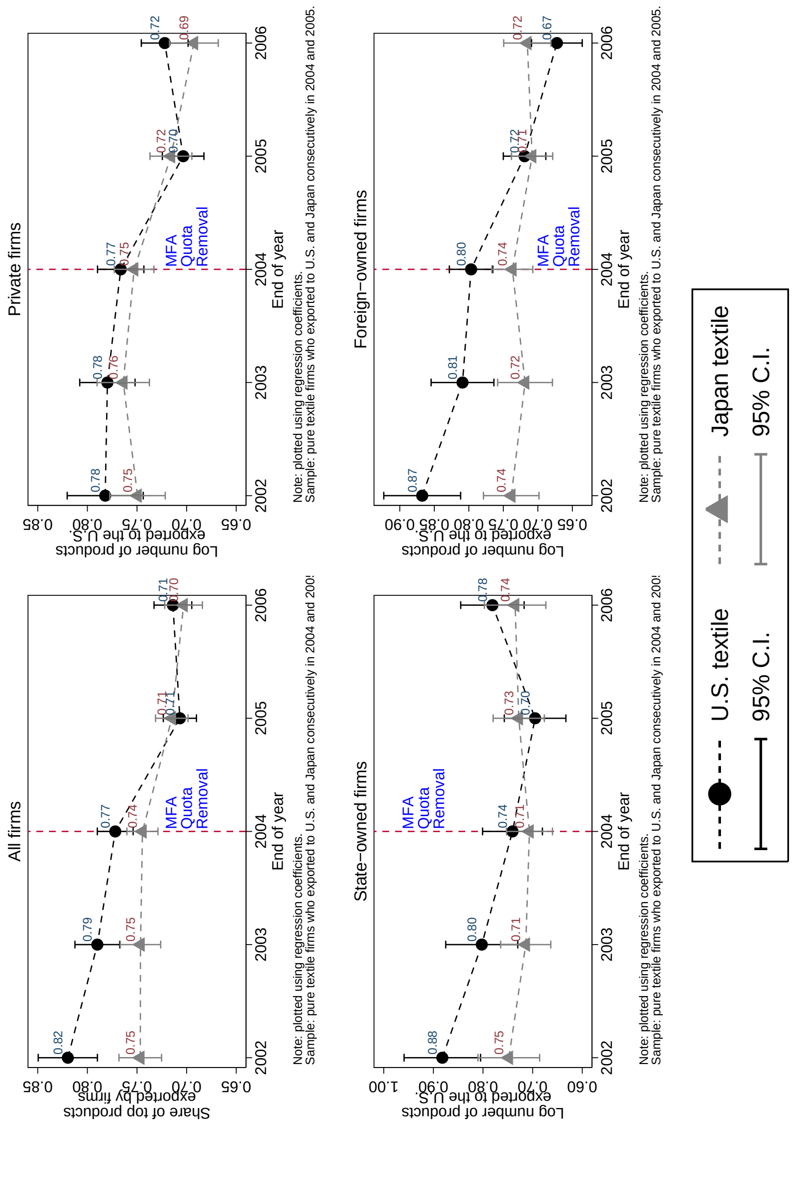


Fig 4.9. Regression result (columns 1-4, Table B12) by firm ownership type: share of top products exported by pure textile firms to the U.S. and Japan, 2002-2006

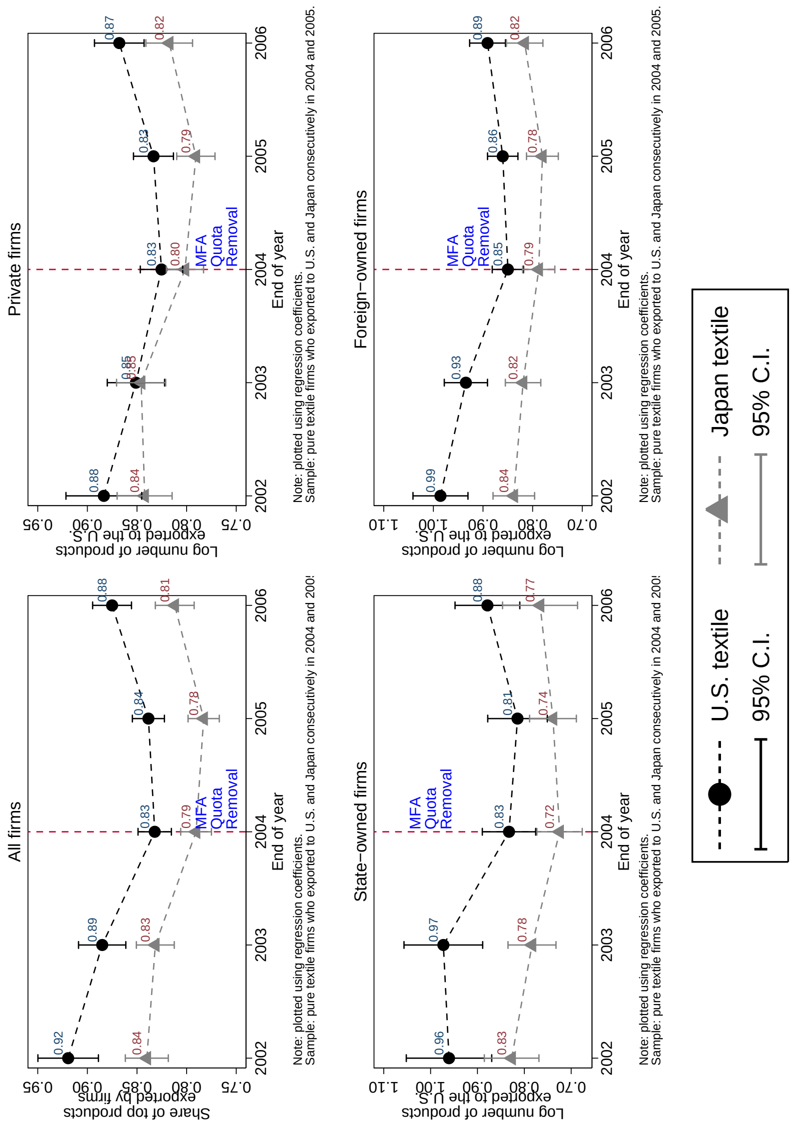


Fig 4.10. Regression result (columns 5-8, Table B12) by firm ownership type: share of top products (exported to Japan in 2004) exported by pure textile firms to the U.S. and Japan, 2002-2006

For export product scope, our results show that, on average, firms would increase their number of products exported by one third due to the quota removal. This is because quota removal creates new export opportunities for firms who now find it profitable to export new product categories they once needed licences to do so. For product concentration, we find the reduction in the share of top product is nearly 10%, but it is not significantly different from zero if we only look at products firms export consecutively before and after the quota elimination. This implies that the abrupt lifting of quotas caused firms to reduce their focus on previously top-sales product to create room for newly added export products.

Interestingly, these findings are highly heterogeneous across firm ownership types. While the above conclusions hold for private and foreign-owned firms, they are not obvious for state-owned firms. We believe this difference could be explained by the inefficiency in the allocation of quotas when the MFA was still valid. The reason is that when other firms needed to pay a considerable amount of costs to get quota licences, state-owned firms could get quota allowances easily because their political connections with the quota allocation authorities, so the removal of quotas did not mean as much to state-owned firms. Apart from the above, we also find evidence of intra-firm shift of market focus away from Japan to the U.S. after the MFA terminated, which highlights the existence of product-level barriers created by the U.S. MFA quotas.

This chapter sheds light on some recently emerging theories regarding MPF behaviour in that our study gives clear-cut results on intra-firm adjustments in response to changes in clearly identified trade policies. But the analysis of the MFA and firm behaviour could also be extended to some other interesting topics. One of them is to look into how firms try to get around quotas by transshipping goods via third countries or by direct investment in other countries that are eligible for quota-free exports, which is currently being under study by us.

CHAPTER 5

Conclusions

This thesis has studied the relationships between trade liberalisation and firm bahaviour, with a special focus on Chinese textile and other manufacturing firms during the period 2000-2007, a time when China integrated with the world economy more than ever since it started to transit from a centrally planed economy to a market economy in 1978. However, the issues addressed here are not only specific to China; instead, given the general background of China's entry into the WTO, the setting of China *vis-à-vis* the world trade offers rich opportunities for studying more generally how firms engage in trade in an environment of declining trade barriers.

Chapter 2 attempts to explain the nature and sources of China's recent rapid export growth. We improve the method proposed by Hummels *et al*. (2001) by taking into account the fact that processing trade is prevalent in China. For that purpose, we link a firm-level data set to a transaction-level data set to match firms' production information with their trade records. We find that on average China's own value-added only accounted for 30% in its exports. While coastal firms and foreign firms were the major sources of the increase in foreign content share, non-state domestic firms were the main contributor to the decrease in domestic content share over time. Entering firms had lower domestic content than others, while existing firms had much higher foreign content than others. This implies that engaging in processing trade could probably greatly reduce not only entry costs of exporting but also variable costs of exporting. Then we use different measures of technology intensity to examine the technology content of Chinese exports evaluated both at the final value and domestic value-added. The results demonstrate that the skill intensity has increased over time, but the overall level is lower when the exports are evaluated by domestic value-added rather than by final value. This finding is novel and implies that the prevailing perception of "over-sophistication" of Chinese exports should be discounted.

Chapter 3 looks specifically at firms which export textile products. It studies the response of Chinese textile firms to the end of the the Multifibre Arrangement (MFA) in 2005. The MFA had long been a protectionist agreement which allowed developed countries to impose import quotas to protect their domestic producers from the competition from developing countries' textile and clothing products. The elimination of MFA quotas provides an unusual opportunity to examine the effects of a trade policy shock on firm behaviour. It was massive in scale, discrete in timing and exogenous to firms and consumers in the textile industry. Since the MFA did not affect all textile products, we use a "difference-in-difference" approach to estimate the causal effects of the MFA termination. Using transaction-level data from the Chinese Customs Trade Statistics over the period 2000-2006, we find that the MFA removal reduced average export prices by about 30%, which is very consistent with other findings in the literature. A distinguishing feature of our study is that our data allows us to examine the *sources* of the price reductions. It shows that more than half of the price drop was due to firm entry and that the MFA had a smaller effect on the pricing behaviour of state-owned firms. The latter finding has an interpretation regarding the efficiency of the quota allocation system in China. It accords with the notion that, other things equal, state-owned firms had been able to obtain quota licences more easily and hence quotas were not as restrictive for them as for other firms.

Chapter 4 looks further into resource reallocations *within* firms. It presents the first clear-cut evidence on how multi-product firms adjusted their product structure in response to MFA quota elimination. We find that the removal of MFA quotas induced firms to radically expand their export product scope (number of export products) by as much as one third, and meanwhile caused firms to reduce the sales share of the core product by nearly 10 percentage points as a result of a more diversified product mix. While these effects are obvious for private and foreign-owned firms, they are completely insignificant for state-owned firms, probably because the latter were not as constrained by quotas due to their closer political connections to the quota allocation authorities. This further supports the interpretation of the quota allocation inefficiency in Chapter 3. Finally, the above findings are reconfirmed by comparing exports to two destination countries – the U.S., a major MFA country, and Japan, a major non-MFA country. More importantly, firms' focus on markets is found to have shifted towards the U.S. and away from the Japanese market within exporting firms, thus highlighting the trade barriers created by U.S. quotas. The results shed light on some recent theories regarding the intra-firm adjustments in response to changes in trade policies.

Studies in this thesis work can be extended to studying some other interesting topics. For instance, most trade studies looking at the effects of trade costs use official trade statistics. However, some large volumes of trade actually take place through illicit activities such as smuggling and illegal transshipment. A fundamental reason behind such cross-border economic activities is to do with trade costs created by formal and informal trade barriers. The incentive of trade cost evasion is particularly strong in illicit activities. Thus, this largely ignored "dark side" of international trade offers a unique and fantastic opportunity for studying into the relationship between trade cost and economic activities, a task that has proven to be difficult because of too many confounding mechanisms/factors if one simply looks at official trade records. Related studies include Fisman *et al*. (2008) and Fisman and Wei (2004, 2009).

As an extension of the studies on MFA quotas in this thesis, a joint research project has been initiated by the author and some colleagues. During the Multifibre Agreement (MFA), strict import quotas were imposed on Chinese textiles and apparel. As a result, some Chinese exporters illegally transshipped their products destined to the U.S. and the E.U. via third countries to avoid the quotas. We study the case of transhipment via African countries, and show that Chinese apparel exports to African countries predicted U.S. imports from the same countries but only for apparel products with binding quotas in the U.S. and for countries with preferential access to the U.S. market. We also provide some preliminary evidence of transshipment to the E.U. via Bulgaria and Romania by comparing different sources of trade statistics before and after these countries joined the E.U.. In addition, we try to find factors that could help explain variations in the prevalence of transshipment across countries, including, for example, regional trade agreements, geographical proximity, and density of ethnic Chinese population.

Another possible research direction in our agenda is to study the role of intermediation in trade. Quite recently, there has been a new literature in this area (see, for example, Antràs, 2011; Akerman, 2010; Ahn *et al*., 2011; Bernard *et al*., 2010a,b). Among many other mechanisms, intermediaries match sellers with buyers, help break into more markets, provide trade credits, and build up extensive business networks. In this area, not only theoretical models are just emerging, but also empirical studies are quite limited, partly due to data availability. As far as we are concerned, there are only some stylised facts on how intermediaries facilitate trade and how the intermediated trade is related to firm productivity. Little is known about how intermediaries actually play their role in terms of reducing trade costs or overcome trade barriers. To identify the underlying mechanisms empirically, exogenous and massive changes in trade costs are needed so that one can establish a convincing causal link between trade cost and intermediation.

A plausible case is again the MFA quota removal. MFA quotas created enormous barriers and restrictions for Chinese textile and clothing exports. However, since some countries/areas neighbouring to China could export to the U.S./E.U. quota free, one of many intermediaries' businesses was to help Chinese firms to transship textiles to developed countries via these neighbouring countries. We have already found evidence that during the MFA period, Hong Kong was one of the most important "entrepôts" for transshipment of Chinese textiles. The abolishment of MFA quotas in 2005 provides a quasi-experiment setting for studying the role of intermediaries in transshipment, since the incentive for using intermediaries as middlemen to transship does not exist any more when any firm can export without quota licenses. Interestingly, our evidence shows that the termination of U.S. MFA quotas in 2005 caused the share of indirect exports of textiles from China to Hong Kong by nearly 40 percentage points, which is a strong indication that intermediaries had played an important role when quotas were in force. As a next step, we try to find what kinds of firms chose to export via intermediaries instead of exporting directly, and hope to establish evidence that could be compared against predictions in recent theories.

APPENDIX A

Data Preparation

A.1 Firm-level Data: The CASIF

Table A1 describes the number of firms in the CASIF data. A growth pattern is clearly documented. Since we are only interested in the manufacturing sector, some data cleaning is needed. The industries in the CASIF are coded by a unique coding system known as the National Standards of China (GB/T). Each firm in the CASIF reports their main industry by a four-digit GB/T code. The coding rule was changed after 2003 when a new version of G-B/T was introduced. Because this change makes the industry codes inconsistent over time, we construct our own concordance table to create a consistent set of three-digit industry codes throughout the sample period.[1]

Table A1. Number of firms in the CASIF

Year	Number of firms
2000	162,885
2001	169,031
2002	181,557
2003	196,222
2004	279,092
2005	271,835
2006	301,961
2007	336,768

[1] It is not possible to create a consistent set of four-digit codes. The constructed concordance table is available from us upon request.

We exclude several industries from the sample, based on two-digit industry codes: mining (codes: 06, 07, 08, 09, 10, 11), energy (codes: 44, 45, 46) tobacco (code: 16), handicrafts (code: 42) and recycling (code: 43). We exclude tobacco because the production and sales of tobacco in China is still highly regulated by the government and was not open to foreign investment even after China's entry into the WTO. We exclude handicrafts because products from this industry are potentially extremely heterogeneous, as it includes, for example, production of artworks. Recycling firms are excluded because most of the four-digit industries classified under recycling before 2003 were integrated into other two-digit manufacturing industries in the new industry coding system after 2003.

To further obtain a clean sample which is suitable for analysis, we delete from the data those observations for which any of the following conditions is satisfied:

- Observations which report their *location* information in wrong formats.
- Observations which have missing or non-positive values on any of the variables related to *output*, *sales*, *capital* and *intermediate inputs*.
- Observations whose *number of employees* is missing or less than eight.
- Observations which have missing or negative values on any of the variables related to *ownership structure* and *export value of shipments*.
- Observations whose value of *product sales* is less than *export value of shipments*.

All key variables are deflated to make them comparable over time.

A.2 Deflators

Output and export values are both deflated by an *ex-factory price index* at the two-digit industry level when necessary. Because the deflator for intermediate inputs is not directly available for each two-digit industry, we impute it by combining information from two sources: the year-specific *purchasing price index of materials, fuels and power* and *China Input-Output Table 2002*. Since the *purchase price index of materials, fuels and power* is available for eight broadly defined categories,[2] we then use information from *China*

[2]They are ferrous metals, non-ferrous metals, chemical materials, wood and paper pulp, construction materials, agriculture products and textile materials.

Input-Output Table 2002 to construct a matrix that defines the input weights of these eight intermediate input categories for each two-digit industry.[3] With these weights, we then get the weighted-average of price index (deflator) of intermediate inputs for each two-digit industry.

All the deflators mentioned above can be found in *China Statistical Yearbooks* of various years. The 122-sector *China Input-Output Table 2002* is from the NBSC. We treat the price in the initial year (2000) as the numeraire for all price indices.[4]

A.3 Transaction-level Data: The CCTS

Table A2 describes the number of firms in the CCTS data. It shows that the number of firms engaging in trade grew hugely from 2000 to 2006. Since the focus of our study is on manufacturing exports, an ideal, clean trade data should only contain all exports of manufactures and their corresponding imports. However, the reality is that many manufacturing firms not only use imports of manufactures but also imports of primary (agricultural) goods to produce manufactures (for example, many firms in China import soy beans from abroad to produce cooking oils), we therefore only exclude service trade from the raw CCTS data, leaving all agricultural and manufactured goods in the trade data. Service trade corresponds to the two-digit HS codes of 98 and 99.

Table A3 summarises the different customs regimes which apply to the trade data. Relevant to our study are ordinary and processing trade regimes.

Table A3. Definitions of the Chinese customs regimes

Regime code	Regime name	Definition
10	Ordinary trade	Unilateral imports or exports through customs.
11	International aid	Aid or donations given gratis between governments or by international organisations.
12	Donation by overseas Chinese	Donations given by overseas Chinese or compatriots in Hong Kong, Macau or Taiwan.

[3]There are three input-output tables available for the sample period from 2000 to 2007, which are input-output tables for 2000, 2002 and 2005. However, the input-output table for 2002 is the most disaggregated (122 sectors versus 40 sectors for 2000 and 17 sectors for 2005), and therefore enables us to aggregate the those sectors to two-digit GB/T industries more precisely in order to be in line with the CASIF industries.

[4]All these deflators are available from us upon request.

Table A3. (Continued)

Regime code	Regime name	Definition
13	Compensation trade	Imports of equipment supplied by foreign firms or by using foreign export credit under a contractual arrangement for the supplier to recover the cost with the subsequent exportation of products in installment.
14	Processing and assembling	The type of inward processing in which foreign suppliers provide raw materials, parts or components under a contractual arrangement for the subsequent re-exportation of the processed products. Under this type of transaction, the imported inputs and the finished outputs remain property of the foreign supplier.
15	Processing with imported materials	The type of inward processing other than processing and assembling in which raw materials or components are imported for the manufacture of the export-oriented products, including those imported into Export Processing Zone and the subsequent re-exportation of the processed products from the Zone.
16	Goods on consignment	Goods traded by arrangement in which a seller sends goods to a buyer or reseller who pays the seller only as and when the goods are sold. The seller remains the owner (title holder) of the goods until they are paid for in full and, after a certain period, takes back the unsold goods.
19	Border trade	Petty trade carried out in the border towns of China, between the departments or enterprises designated by the governments of provinces or autonomous regions and the border towns on the other side, as well as to the mutual market trade between the border inhabitants of the two neighbouring countries.
20	Equipment imported for processing trade	Imports of equipment for processing trade activities under the customs regimes of processing and assembling and processing with imported Materials.
22	Contracting projects	Exports of equipment or materials to be used for China-invested turnkey projects or constructing projects.
23	Goods on lease	Imports or exports under the financial lease arrangement with the duration of the lease for one year or more.
25	Equipment/materials investment by a foreign-invested enterprise	Imports of equipment, parts or other materials by a foreign-invested enterprise as part of it is total initial investment.
27	Outward processing	Exports of raw materials, parts or components under a contractual arrangement for processing or assembling abroad and the re-imports of the processed products.
30	Barter trade	Exported goods directly exchanged with the equivalent in imported goods without any currency medium.
31	Duty-free commodity	Duty-free import commodities sold in the specific shops to the specific individuals on payment of foreign currency according to the specific customs regulations.
33	Warehousing trade	Goods imported into or exported from the customs bonded warehouses located outside a Bonded Area.
34	Entrepot trade by bonded area	Goods imported into a Bonded Area for storage and the re-exports of the goods from the Area.

Table A3. (Continued)

Regime code	Regime name	Definition
39	Others	Others

Notes. Definitions are from the General Administration of Customs of China.

A.4 Matching the CASIF to the CCTS

Merging the two data sets described above allows one to link records of firm production activities with firm customs trade. This requires matching the observations in the two data sets.

Each firm in the CASIF and the CCTS has a unique registration code. However, different coding systems are used in each data set – the firm codes in the CASIF are designated by the local administrative authorities and are of nine digits, while those in the CCTS are given by the customs and are of ten digits. This fact invalidates the firm code as an effective variable to link the two data sets.

Our principal solution is to use firm name, which is unique to the firm,[5] as a means of identifying the common firms in both data sets, and then construct a concordance of their firm codes in these two data sets. However, since there exit cases where a firm changed its names or reported it differently over time, we record all the names once used by a firm and expand the set of firm names as match variables. Apart from firm name, there are also other common variables which could help identify the same firm in the two data sets. Concretely, we combine telephone number and name of contact person as the secondary match variable to build the linkage between the two data sets. After the construction of the firm-code concordance, we check the credibility of the matched linkage by looking at firms' location information from the two data sources. A successful matched firm should have the same location information in the two sources. The detailed matching procedures with basic descriptive statistics are elabourated as follows.

[5]The registration of firm in local administrative authorities does not allow any repetition of firm name in the same local administrative region. This means there exists the possibility that firms in different administrative regions can share the same name. However, after checking the data carefully, we find virtually all firms have the local region name (e.g., "Beijing City") as part of their firm name. This fact reduces the possibility of mismatching due to firm name repetition to a minimum level.

Table A2. Number of firms in the CCTS

Year	Number of firms
2000	82,064
2001	89,660
2002	104,245
2003	124,299
2004	153,779
2005	177,494
2006	208,425

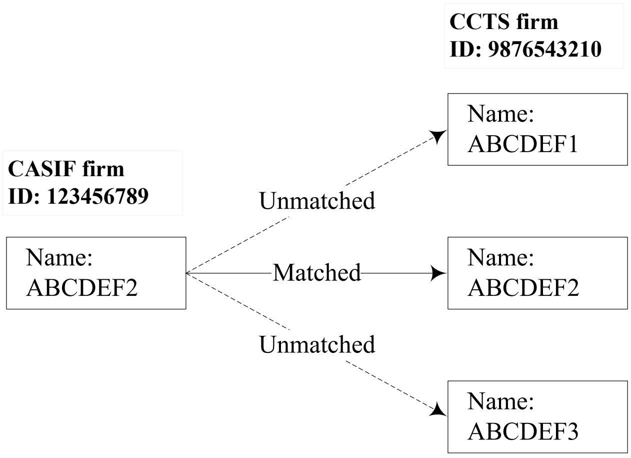


Fig A1. Matching Approach I

A.4.1 Matching Approach I: strictly by firm name

In this matching, a firm is matched if and only if it has identical name in the CASIF and in the CCTS for a given year. A feature of this approach is that, for each year, a firm corresponds to only one observation (hence one name) in the CASIF while it can correspond to multiple observations (hence multiple names) in the CASIF. Although a firm can appear multiple times in the CCTS in a year, this matching approach can still link a firm in the CASIF to the CCTS as long as it has the same name for at least once in the CCTS in that given year. However, if none of the names of a firm in the CCTS can be matched with an identical name in the CASIF, it is not identified. Some times, when firms registered in the customs or reported its name in the customs differently to its name in the CASIF, or the customs staff slightly mistyped its name into computer, this could make the firm unmatched by this approach. This matching approach is illustrated in Figure A1.

Table A4. Number of firms matched: simply by firm name

	Province inconsistency		Postcode inconsistency		
Year	0	1	0	1	Total
2000	18,451	134	15,125	3,460	18,585
2001	21,503	80	17,445	4,138	21,583
2002	24,929	7	20,530	4,406	24,936
2003	28,888	10	24,360	4,538	28,898
2004	44,365	19	35,099	9,285	44,384
2005	44,869	10	34,457	10,422	44,879
2006	53,734	14	47,051	6,697	53,748

Notes. Here 1 indicates inconsistency and 0 otherwise.

Table A4 gives the number of firms matched for each year. Apart from giving the total number of firms, we also check the locations of these firms by information from both data sets. Both data sets contain a variable indicating firms' postcodes, although there are quite a few missing values. The province information in the CASIF is the first two digits of the administrative region code, and is the first two digits of firm code in the CCTS.[6] The location check breaks the total number of firms matched into two parts: those with inconsistent location (province or postcode) codes and the rest.[7]

A.4.2 Matching Approach II: by complete set of used firm names

We try to enhance the success rate of matching by exploring all names ever used by a firm in both the CASIF and the CCTS. For example, if a firm has up to six different names in the whole sample of the CASIF, and has up to five different names in the whole sample of the CCTS, we then try thirty times ($5 \times 6 = 30$) of matching to see if each of these names can be matched to a name in the other data set.

This matching strategy is illustrated in Figure A2, and is adopted by Wang and Yu

[6] In fact the administrative region code in the CASIF contains at least six digits and the first four digits of firm codes in the CCTS indicate location information, but these codes from the two data sources are only consistent at the first two-digit level, that is, province level.

[7] We define two location codes are inconsistent if and only if (a) their original variables (administrative region codes) are not missing and of the right length, and (b) the two location codes are different. Therefore location codes not identified as inconsistent are not necessarily consistent.

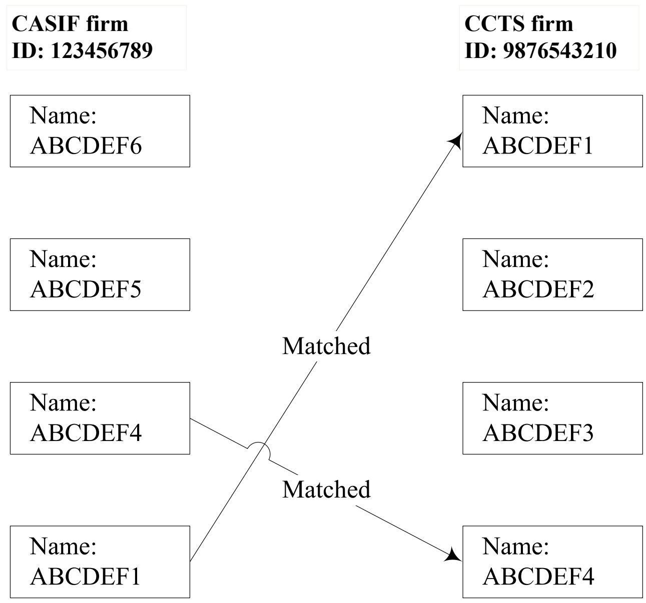


Fig A2. Matching Approach II

(forthcoming). Compared to Approach I, this approach allows the largest flexibility in variations of firm names and reduce the possibility of dismatch simply due to changes in firm names for whatever reason. In a simple word, by this matching method, a firm in the CASIF can always be linked to itself in the CCTS (or the other way round) as long it used a common name for at least once in both data sets. This approach does lead to more firms matched, according to the result summarised in Table A5, even if we exclude firms with inconsistent location information.

A.4.3 Matching Approach III: by complete set of telephone numbers plus contact person's names

In this matching, we combine telephone number (the primary telephone number of firm) and contact person's name together as the key to identify the common firms in both data sets. This matching strategy is illustrated in Figure A3. Despite large numbers of missing values and incorrectly reported formats[8], the concurrent matches of contact person's name and telephone number potentially provides additional matched firms apart from the above methods. Table A6 describes the matched result. Not surprisingly, much less firms are now

[8]For instance, some telephone numbers are reported with full numbers while some lack region codes.

Table A5. Number of firms matched: by complete set of used firm names

	Province inconsistency		Postcode inconsistency		
Year	0	1	0	1	Total
2000	23,499	171	19,203	4,467	23,670
2001	27,623	150	22,372	5,401	27,773
2002	32,712	17	27,030	5,699	32,729
2003	38,731	26	32,680	6,077	38,757
2004	55,966	34	44,816	11,184	56,000
2005	56,758	24	44,581	12,201	56,782
2006	61,535	25	53,535	8,025	61,560

Notes. Here 1 indicates inconsistency and 0 otherwise.

matched because of the reasons explained above. However, they can expand our previous matched result, albeit at a small degree.

A.4.4 Matching Approach IV: combination of Approaches II and III

Now we add the matched result of Approach III to the result of Approach II, drop repetitions, and get a more comprehensive matched result. Also, we check the location information from two different sources and report the result in Table A7.

A.5 Identification of Trading Agents

There exit a large number of firms in the CCTS, whose principal business is importing and exporting goods, or temporarily storing or shipping goods, for other firms. Manova and Zhang (2009, 2012) call these firms *trading firms*, while Ahn *et al*. (2011) name them as *intermediary firms*. For convenience, we call these firms trading agents. Ignoring these firms could cause problems if one wants to study the behaviour of production firms, because these trading agents described above generally do not engage in production. Perfectly identifying these trading agents is not easy as these are no official indicators for these firms.

One practical method used by Manova and Zhang (2009, 2012) and Ahn *et al*. (2011) is

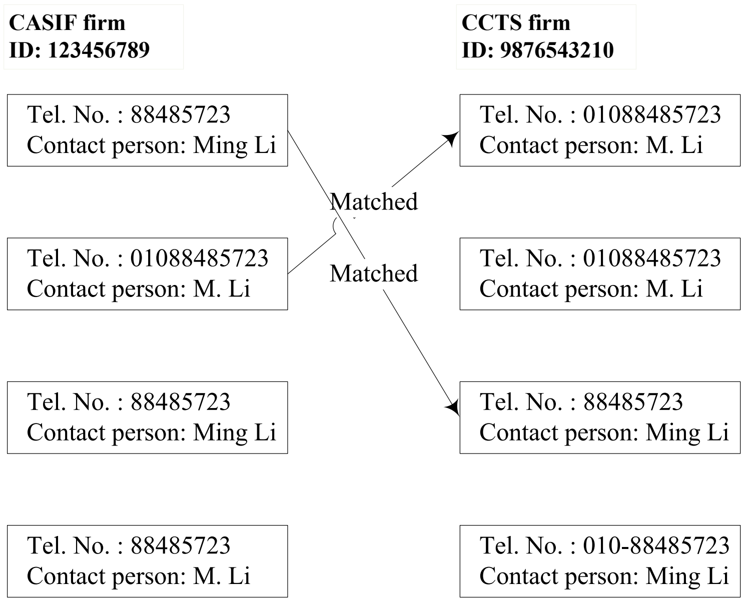


Fig A3. Matching Approach III

Table A6. Number of firms matched: by complete set of telephone numbers plus contact person's names

	Province inconsistency		Postcode inconsistency		
Year	0	1	0	1	Total
2000	196	0	156	40	196
2001	201	0	163	38	201
2002	201	0	160	41	201
2003	197	0	148	49	197
2004	310	0	242	68	310
2005	319	0	237	82	319
2006	284	0	214	70	284

Notes. Here 1 indicates inconsistency and 0 otherwise.

Table A7. Number of firms matched: by combination of complete set of used firm names and complete set of telephone numbers plus contact person's names

	Province inconsistency		Postcode inconsistency		
Year	0	1	0	1	Total
2000	23,569	171	19,261	4,479	23,740
2001	27,679	150	22,422	5,407	27,829
2002	32,765	17	27,078	5,704	32,782
2003	38,776	26	32,717	6,085	38,802
2004	56,044	34	44,875	11,203	56,078
2005	56,840	24	44,635	12,229	56,864
2006	61,603	25	53,583	8,045	61,628

Notes. Here 1 indicates inconsistency and 0 otherwise.

to search some specific keywords in firms' names to decide whether they are trading agents or not. Manova and Zhang (2009, 2012) identified 23,073 such firms for the period of 2000 to 2005, but they did not mention what these keywords were. Ahn *et al*. (2011) used four Chinese keywords to identify the "intermediary firms": 进出口, 经贸, 贸易, 科贸, and the number of these firms for each year from 2000 to 2005 are 9,009 for 2000, 9,815 for 2001, 10,862 for 2002, 13,964 for 2003, 20,418 for 2004, and 22,099 for 2005. By contrast, we use our own, more comprehensive list of keywords which are typically used by various kinds of trading agents. The Chinese characters for these keywords we use are:

服务，贸易，投资，经发，经济发展，运储，储运，仓储，运输，物资，货运，代理，物资，经贸，进口，出口，物流，合作，外贸，商社，供销，科贸，外经.

Table A8 lists the number of trading agents identified for each year. We finally identify 58,482 such firms for the period of 2000 to 2006, of which 31,021 firms are for the period of 2003 to 2005, much more than the result of Manova and Zhang (2009, 2012). For each year from 2000 to 2005, the numbers of these agents identified by us are also larger than by those by Ahn *et al*. (2011).

Table A8. Number of trading agents identified in the CCTS

Year	Number of firms
2000	10,519
2001	11,680
2002	13,256
2003	17,071
2004	23,963
2005	22,834
2006	43,194

A.6 Identification of Intermediate Inputs in Ordinary Imports

Identifying imported intermediate inputs is important for computing vertical specialisation in exports. It is already clear that all processing imports are used as intermediate inputs as they could only be used for the purpose of processing exports. Another group of imported intermediate inputs are in the category of ordinary imports. Since only some of those ordinary imports are used as intermediate inputs in production, it is necessary to identify these intermediates from others (namely, consumption goods or capital goods) in ordinary imports. Following Dean *et al*. (2007), we first use the detailed classification of the Broad Economic Categories (BEC) to identify the BEC codes for intermediates as in Table A9. Then, we employ the BEC-HS concordance table from the United Nations to further identify intermediates in the HS system.

Table A9. Intermediate goods classified under the Broad Economic Categories (BEC) and the Harmonised Commodity Description and Coding System (HS)

BEC code	Description	HS code
111	Primary food and beverages mainly for industry	See the BEC Rev.3 - HS 2002 correspondence table
121	Processed food and beverages mainly for industry	As above
21	Primary industrial supplies not elsewhere specified	As above
22	Processed industrial supplies not elsewhere specified	As above
31	Primary fuels and lubricants	As above
322	Other processed fuels and lubricants	As above
42	Parts and accessories of capital goods (except transport equipment), and parts and accessories thereof	As above
53	Parts and accessories of transport equipment, and parts and accessories thereof	As above

Notes. The BEC classification of intermediate goods is from United Nations Statistics Division (2003). The BEC Rev.3 - HS 2002 correspondence table can be downloaded on the UN Statistics Division website, at `http://unstats.un.org/unsd/cr/registry/regdnld.asp?Lg=1`.

APPENDIX B

Additional Tables

Table B1. Chinese textile and clothing products exported to the U.S. and their MFA/ATC status, 2004 (HS 50-63, the CCTS Data)

HS chapter	Product description	Number of MFA/ATC products	Number of other products	Value share of MFA/ATC products (%)	Value share of other products (%)
50	Silk	6	2	99.86	0.14
51	Wool, fine/coarse animal hair, horsehair yarn & fabrics	14	3	92.59	7.41
52	Cotton	73	2	97.14	2.86
53	Other vegetable textile fibres; paper yarn & woven fabrics	11	0	100.00	0.00
54	Man-made filaments	42	4	90.1	9.9
55	Man-made staple fibres	70	1	99.88	0.12
56	Wadding, felt & nonwoven; yarns; twine, cordage, etc.	23	8	54.68	45.32
57	Carpets and other textile floor coverings	20	1	81.87	18.13
58	Special woven fabrics; tufted tex fabrics; lace; tapestries etc.	35	2	99.23	0.77
59	Impregnated, coated, cover/laminated textile fabric etc.	22	1	99.98	0.02
60	Knitted or crocheted fabrics	6	30	2.99	97.01
61	Art of apparel & clothing access, knitted or crocheted	96	11	90.53	9.47
62	Art of apparel & clothing access, not knitted/crocheted	110	6	96.28	3.72
63	Other made up textile articles; sets; worn clothing etc.	52	7	88.08	11.92
50-63	All	580	78	91.63	8.37

Notes. Textile and clothing products here are six-digit products from chapter 50 to chapter 63 in the HS. MFA/ATC products: products with their six-digit HS codes covered in the ATC Annex. Other products: products with their six-digit HS codes not covered in the ATC Annex.

Table B2. Full result of estimates from DD specifications with different levels of fixed effects. Dependent variable: $\ln \mathbf{P}_{ijt}$.

	Without control for market share			
	No FE	Firm FE	Product FE	Product FE + Firm FE
δ_{2000}	0.251***	0.106***	0.141***	0.102***
	(0.024)	(0.021)	(0.019)	(0.016)
δ_{2001}	0.252***	0.065***	0.151***	0.061***
	(0.023)	(0.019)	(0.018)	(0.015)
δ_{2002}	0.048**	−0.044***	−0.007	−0.051***
	(0.019)	(0.015)	(0.015)	(0.012)
δ_{2004}	−0.010	−0.035***	−0.038***	−0.044***
	(0.017)	(0.013)	(0.013)	(0.010)
δ_{2005}	−0.022	0.053***	−0.077***	0.037***
	(0.014)	(0.011)	(0.011)	(0.009)
δ_{2006}	0.097***	0.111***	0.044***	0.093***
	(0.014)	(0.011)	(0.011)	(0.009)
ρ	0.777***	0.347***		−0.815*
	(0.025)	(0.019)		(0.460)
λ_{2000}	−0.290***	−0.075**	−0.184***	−0.066**
	(0.047)	(0.036)	(0.036)	(0.029)
λ_{2001}	−0.215***	−0.016	−0.119***	−0.007
	(0.046)	(0.034)	(0.036)	(0.027)
λ_{2002}	−0.039	0.045	0.002	0.053**
	(0.040)	(0.030)	(0.031)	(0.024)
λ_{2003}	−0.034	0.011	0.008	0.027
	(0.037)	(0.027)	(0.028)	(0.022)
λ_{2005}	−0.348***	−0.121***	−0.242***	−0.112***
	(0.028)	(0.021)	(0.022)	(0.017)
λ_{2006}	−0.374***	−0.158***	−0.261***	−0.136***
	(0.028)	(0.021)	(0.022)	(0.017)
R^2	0.146	0.644	0.494	0.774

Notes. Products are six-digit HS products. *,**,*** indicate significant at 10%, 5%, and 1% levels respectively.

Table B3. Full result of estimates of the price effect of quota with different fixed effects. Dependent variable: $\ln \mathbf{P}_{ijt}$.

	With control for market share			
	No FE	Firm FE	Product FE	Product FE + Firm FE
δ_{2000}	0.231***	0.098***	0.119***	0.094***
	(0.024)	(0.021)	(0.019)	(0.017)
δ_{2001}	0.234***	0.058***	0.132***	0.054***
	(0.023)	(0.019)	(0.018)	(0.015)
δ_{2002}	0.041**	−0.046***	−0.014	−0.054***
	(0.019)	(0.015)	(0.015)	(0.012)
δ_{2003}	−0.012	−0.036***	−0.040***	−0.045***
	(0.017)	(0.013)	(0.013)	(0.010)
δ_{2005}	−0.017	0.055***	−0.071***	0.039***
	(0.014)	(0.011)	(0.011)	(0.009)
δ_{2006}	0.102***	0.114***	0.051***	0.095***
	(0.014)	(0.011)	(0.011)	(0.009)
ρ	0.775***	0.346***		−0.780*
	(0.025)	(0.019)		(0.460)
λ_{2000}	−0.279***	−0.072**	−0.174***	−0.063**
	(0.047)	(0.036)	(0.036)	(0.029)
λ_{2001}	−0.208***	−0.014	−0.112***	−0.005
	(0.046)	(0.034)	(0.036)	(0.027)
λ_{2002}	−0.038	0.045	0.003	0.053**
	(0.040)	(0.030)	(0.031)	(0.024)
λ_{2003}	−0.034	0.010	0.008	0.026
	(0.037)	(0.027)	(0.028)	(0.022)
λ_{2005}	−0.346***	−0.120***	−0.240***	−0.111***
	(0.028)	(0.021)	(0.022)	(0.017)
λ_{2006}	−0.371***	−0.158***	−0.258***	−0.135***
	(0.028)	(0.021)	(0.022)	(0.017)
ω	0.394***	0.165***	0.419***	0.165***
	(0.038)	(0.031)	(0.035)	(0.028)
R^2	0.147	0.645	0.495	0.774

Notes. Products are six-digit HS products. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively.

Table B4. Estimates of changes in export product scope (textile vs. non-textile firms)

	Dependent variable: number of products			
	All firms (1)	Private firms (2)	State firms (3)	Foreign firms (4)
YR2002	0.071	0.040	0.482	−0.031
	(0.169)	(0.158)	(1.827)	(0.103)
YR2003	0.092	0.110	0.203	0.004
	(0.153)	(0.141)	(1.702)	(0.095)
YR2005	0.272**	0.285**	−0.096	0.312***
	(0.137)	(0.123)	(1.586)	(0.087)
YR2006	0.580***	0.584***	0.254	0.610***
	(0.143)	(0.129)	(1.684)	(0.090)
Mixed	10.200***	8.217***	31.492***	4.282***
	(0.219)	(0.189)	(1.914)	(0.163)
Textile	−0.159	0.041	−0.552	−0.405
	(0.378)	(0.303)	(4.829)	(0.294)
YR2002*Mixed	−0.259	−2.236***	−1.624	−1.401***
	(0.382)	(0.358)	(2.978)	(0.266)
YR2002*Textile	0.591	0.833	−0.754	0.463
	(0.777)	(0.641)	(8.308)	(0.594)
YR2003*Mixed	0.623*	−0.591*	2.083	−0.501**
	(0.343)	(0.308)	(2.832)	(0.246)
YR2003*Textile	0.449	0.552	0.585	0.190
	(0.651)	(0.531)	(7.912)	(0.495)
YR2005*Mixed	2.985***	3.648***	2.456	1.837***
	(0.310)	(0.267)	(2.707)	(0.231)
YR2005*Textile	1.783***	1.608***	0.981	2.418***
	(0.534)	(0.429)	(6.829)	(0.416)
YR2006*Mixed	1.574***	1.847***	0.424	1.813***
	(0.322)	(0.280)	(2.827)	(0.235)
YR2006*Textile	1.741***	1.429***	0.656	2.783***
	(0.574)	(0.462)	(7.474)	(0.443)
Constant	3.064***	2.876***	3.529***	3.260***
	(0.097)	(0.087)	(1.122)	(0.062)
R^2	0.078	0.120	0.110	0.081
No. of obs.	131,952	72,424	10,308	49,220

Notes. "YR" refers to years, with the omitted year being 2004. "Mixed" are those firms who ever exported textile and other products, and "Textile" are those firms who exported only textile products, with the omitted firms being those who only exported products other than textiles and clothing. Textile products are those products included in the HS chapters 50-63. State firms are those reported as state-owned enterprises, foreign firms are those reported as either wholly foreign-owned enterprises or Sino-foreign joint ventures, while the rest are all roughly classified as (domestic) private firms. Numbers in parentheses are standard errors of coefficients estimated. *,** ,*** indicate significance at 10%, 5%, and 1% levels respectively.

Table B5. Estimates of proportional changes in export product scope (textile vs. non-textile firms)

	Dependent variable: log number of products			
	All firms (1)	Private firms (2)	State firms (3)	Foreign firms (4)
YR2002	0.028***	0.022*	0.039	0.015
	(0.010)	(0.013)	(0.045)	(0.014)
YR2003	0.030***	0.035***	0.035	0.012
	(0.009)	(0.012)	(0.042)	(0.013)
YR2005	0.068***	0.073***	−0.017	0.074***
	(0.008)	(0.010)	(0.039)	(0.012)
YR2006	0.146***	0.148***	0.063	0.152***
	(0.008)	(0.011)	(0.041)	(0.012)
Mixed	1.023***	0.998***	1.794***	0.717***
	(0.013)	(0.016)	(0.047)	(0.022)
Textile	−0.083***	−0.034	−0.121	−0.149***
	(0.022)	(0.026)	(0.118)	(0.040)
YR2002*Mixed	−0.187***	−0.332***	−0.036	−0.235***
	(0.022)	(0.030)	(0.073)	(0.036)
YR2002*Textile	0.124***	0.182***	−0.094	0.069
	(0.045)	(0.054)	(0.203)	(0.081)
YR2003*Mixed	−0.051**	−0.119***	0.069	−0.079**
	(0.020)	(0.026)	(0.069)	(0.034)
YR2003*Textile	0.122***	0.144***	0.293	0.037
	(0.038)	(0.045)	(0.193)	(0.068)
YR2005*Mixed	0.207***	0.254***	0.060	0.197***
	(0.018)	(0.023)	(0.066)	(0.032)
YR2005*Textile	0.362***	0.343***	0.243	0.435***
	(0.031)	(0.036)	(0.167)	(0.057)
YR2006*Mixed	0.080***	0.100***	−0.045	0.135***
	(0.019)	(0.024)	(0.069)	(0.032)
YR2006*Textile	0.312***	0.262***	0.116	0.485***
	(0.033)	(0.039)	(0.182)	(0.061)
Constant	0.755***	0.704***	0.832***	0.814***
	(0.006)	(0.007)	(0.027)	(0.008)
R^2	0.185	0.191	0.395	0.101
No. of obs.	131,952	72,424	10,308	49,220

Notes. "YR" refers to years, with the omitted year being 2004. "Mixed" are those firms who ever exported textile and other products, and "Textile" are those firms who exported only textile products, with the omitted firms being those who only exported products other than textiles and clothing. Textile products are those products included in the HS chapters 50-63. State firms are those reported as state-owned enterprises, foreign firms are those reported as either wholly foreign-owned enterprises or Sino-foreign joint ventures, while the rest are all roughly classified as (domestic) private firms. Numbers in parentheses are standard errors of coefficients estimated. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively.

Table B6. Estimates of changes in export product scope (quota vs. non-quota textile firms)

	Dependent variable: log number of products			
	All firms (1)	Private firms (2)	State firms (3)	Foreign firms (4)
YR2002	0.040	−0.001	0.573	0.036
	(0.532)	(0.660)	(1.894)	(1.013)
YR2003	0.089	0.098	0.662	−0.034
	(0.427)	(0.510)	(1.513)	(0.882)
YR2005	0.144	0.133	0.182	0.170
	(0.349)	(0.411)	(1.153)	(0.752)
YR2006	0.161	0.171	0.273	0.104
	(0.386)	(0.453)	(1.256)	(0.851)
Mixed	2.364***	2.420***	2.273**	2.212***
	(0.296)	(0.349)	(1.046)	(0.628)
Quota	0.741**	0.626	2.418**	0.562
	(0.350)	(0.415)	(1.066)	(0.760)
YR2002*Mixed	0.515	0.798	−1.358	0.250
	(0.620)	(0.763)	(2.171)	(1.210)
YR2002*Quota	0.843	0.855	−1.273	1.523
	(0.799)	(1.010)	(2.207)	(1.701)
YR2003*Mixed	0.506	0.686	−0.075	0.187
	(0.507)	(0.606)	(1.831)	(1.042)
YR2003*Quota	0.337	0.198	−0.044	0.382
	(0.641)	(0.786)	(1.878)	(1.334)
YR2005*Mixed	2.993***	2.766***	1.848	3.743***
	(0.418)	(0.494)	(1.479)	(0.889)
YR2005*Quota	1.344***	1.231**	−0.053	2.122**
	(0.495)	(0.587)	(1.507)	(1.074)
YR2006*Mixed	2.999***	2.530***	3.269**	4.148***
	(0.456)	(0.538)	(1.617)	(0.983)
YR2006*Quota	1.615***	1.487**	−1.736	3.018**
	(0.548)	(0.651)	(1.647)	(1.195)
Constant	1.469***	1.480***	1.227	1.490***
	(0.247)	(0.291)	(0.815)	(0.532)
R^2	0.139	0.132	0.153	0.167
No. of obs.	6,318	4,355	331	1,632

Notes. The sample here only contains pure textile firms, i.e., firms only exported textile products. "YR" refers to years, with the omitted year being 2004. "Mixed" are those pure textile firms who ever exported quota and and non-quota products, and "Quota" are those pure textile firms who exported only quota products, with the omitted firms being those pure textile firms who only exported non-quota textile products. Textile products are those products included in the HS chapters 50-63. State firms are those reported as state-owned enterprises, foreign firms are those reported as either wholly foreign-owned enterprises or Sino-foreign joint ventures, while the rest are all roughly classified as (domestic) private firms. Numbers in parentheses are standard errors of coefficients estimated. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively.

Table B7. Estimates of proportional changes in export product scope (quota vs. non-quota textile firms)

	Dependent variable: log number of products			
	All firms (1)	Private firms (2)	State firms (3)	Foreign firms (4)
YR2002	0.032	0.005	0.353	0.033
	(0.085)	(0.106)	(0.365)	(0.158)
YR2003	0.046	0.050	0.408	−0.027
	(0.068)	(0.082)	(0.291)	(0.137)
YR2005	0.071	0.070	0.100	0.065
	(0.056)	(0.066)	(0.222)	(0.117)
YR2006	0.085	0.091	0.115	0.059
	(0.062)	(0.073)	(0.242)	(0.133)
Mixed	0.624***	0.628***	0.798***	0.579***
	(0.047)	(0.056)	(0.202)	(0.098)
Quota	0.250***	0.224***	0.714***	0.192
	(0.056)	(0.067)	(0.205)	(0.118)
YR2002*Mixed	0.079	0.173	−0.614	−0.010
	(0.099)	(0.122)	(0.418)	(0.188)
YR2002*Quota	0.192	0.219	−0.543	0.378
	(0.128)	(0.162)	(0.425)	(0.265)
YR2003*Mixed	0.113	0.150	−0.180	0.076
	(0.081)	(0.097)	(0.353)	(0.162)
YR2003*Quota	0.102	0.075	−0.155	0.114
	(0.103)	(0.126)	(0.362)	(0.208)
YR2005*Mixed	0.520***	0.500***	0.305	0.603***
	(0.067)	(0.079)	(0.285)	(0.138)
YR2005*Quota	0.352***	0.340***	0.019	0.492***
	(0.079)	(0.094)	(0.290)	(0.167)
YR2006*Mixed	0.463***	0.384***	0.497	0.664***
	(0.073)	(0.086)	(0.312)	(0.153)
YR2006*Quota	0.402***	0.385***	−0.352	0.686***
	(0.088)	(0.104)	(0.317)	(0.186)
Constant	0.280***	0.283***	0.144	0.299***
	(0.040)	(0.047)	(0.157)	(0.083)
R^2	0.217	0.214	0.237	0.243
No. of obs.	6,318	4,355	331	1,632

Notes. The sample here only contains pure textile firms, i.e., firms only exported textile products. "YR" refers to years, with the omitted year being 2004. "Mixed" are those pure textile firms who ever exported quota and and non-quota products, and "Quota" are those pure textile firms who exported only quota products, with the omitted firms being those pure textile firms who only exported non-quota textile products. Textile products are those products included in the HS chapters 50-63. State firms are those reported as state-owned enterprises, foreign firms are those reported as either wholly foreign-owned enterprises or Sino-foreign joint ventures, while the rest are all roughly classified as (domestic) private firms. Numbers in parentheses are standard errors of coefficients estimated. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively.

Table B8. Estimates of changes in export product concentration (textile vs. non-textile firms)

	Dependent variable: sales share of top product							
	All products				Continued products exported in 2004 and 2005			
	All firms (1)	Private firms (2)	State firms (3)	Foreign firms (4)	All firms (5)	Private firms (6)	State firms (7)	Foreign firms (8)
YR2002	−0.000	0.001	−0.000	−0.001	0.022***	0.022***	0.042***	0.021***
	(0.002)	(0.003)	(0.010)	(0.004)	(0.002)	(0.003)	(0.010)	(0.003)
YR2003	−0.001	0.000	−0.001	−0.001	0.015***	0.016***	0.028***	0.012***
	(0.002)	(0.003)	(0.009)	(0.003)	(0.002)	(0.003)	(0.009)	(0.003)
YR2005	−0.008***	−0.009***	0.007	−0.010***	0.002	0.002	0.005	0.000
	(0.002)	(0.003)	(0.008)	(0.003)	(0.002)	(0.002)	(0.008)	(0.003)
YR2006	−0.019***	−0.019***	−0.012	−0.021***	0.014***	0.015***	0.023***	0.012***
	(0.002)	(0.003)	(0.009)	(0.003)	(0.002)	(0.002)	(0.009)	(0.003)
Mixed	−0.196***	−0.205***	−0.307***	−0.117***	−0.156***	−0.155***	−0.274***	−0.108***
	(0.003)	(0.004)	(0.010)	(0.006)	(0.003)	(0.004)	(0.010)	(0.005)
Textile	−0.023***	−0.023***	−0.042	−0.021**	−0.010*	−0.015**	−0.014	−0.005
	(0.005)	(0.007)	(0.026)	(0.010)	(0.005)	(0.006)	(0.026)	(0.010)
YR2002*Mixed	0.044***	0.072***	−0.001	0.041***	0.047***	0.069***	0.021	0.040***
	(0.005)	(0.008)	(0.016)	(0.009)	(0.005)	(0.007)	(0.016)	(0.008)
YR2002*Textile	−0.032***	−0.048***	0.062	−0.021	−0.020*	−0.031**	0.026	−0.013
	(0.011)	(0.014)	(0.044)	(0.020)	(0.011)	(0.014)	(0.049)	(0.021)
YR2003*Mixed	0.012**	0.025***	−0.027*	0.013	0.027***	0.043***	−0.010	0.022***
	(0.005)	(0.007)	(0.015)	(0.008)	(0.005)	(0.006)	(0.015)	(0.008)
YR2003*Textile	−0.038***	−0.046***	−0.056	−0.015	−0.010	−0.019*	0.013	0.003
	(0.009)	(0.011)	(0.042)	(0.017)	(0.009)	(0.011)	(0.044)	(0.017)
YR2005*Mixed	−0.035***	−0.043***	−0.025*	−0.025***	0.002	0.004	−0.009	0.001
	(0.004)	(0.006)	(0.014)	(0.008)	(0.004)	(0.005)	(0.014)	(0.007)
YR2005*Textile	−0.083***	−0.083***	−0.048	−0.087***	0.001	−0.003	−0.013	0.015
	(0.008)	(0.009)	(0.036)	(0.014)	(0.007)	(0.009)	(0.037)	(0.014)
YR2006*Mixed	−0.006	−0.007	0.001	−0.016*	0.029***	0.034***	0.020	0.018**
	(0.005)	(0.006)	(0.015)	(0.008)	(0.004)	(0.006)	(0.015)	(0.007)
YR2006*Textile	−0.075***	−0.068***	0.011	−0.109***	0.005	0.002	0.003	0.009
	(0.008)	(0.010)	(0.040)	(0.015)	(0.008)	(0.010)	(0.042)	(0.015)
Constant	0.849***	0.851***	0.831***	0.849***	0.891***	0.898***	0.889***	0.882***
	(0.001)	(0.002)	(0.006)	(0.002)	(0.001)	(0.002)	(0.006)	(0.002)
R^2	0.116	0.127	0.295	0.046	0.079	0.078	0.265	0.035
No. of obs.	13,1952	72,424	10,308	49,220	117,251	62,840	8,795	45,616

Notes. "YR" refers to years, with the omitted year being 2004. "Mixed" are those firms who ever exported textile and other products, and "Textile" are those firms who exported only textile products, with the omitted firms being those who only exported products other than textiles and clothing. Textile products are those products included in the HS chapters 50-63. State firms are those reported as state-owned enterprises, foreign firms are those reported as either wholly foreign-owned enterprises or Sino-foreign joint ventures, while the rest are all roughly classified as (domestic) private firms. Numbers in parentheses are standard errors of coefficients estimated. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively.

Table B9. Estimates of changes in export product concentration (quota vs. non-quota firms)

	Dependent variable: sales share of top product							
	All products				Continued products exported in 2004 and 2005			
	All firms (1)	Private firms (2)	State firms (3)	Foreign firms (4)	All firms (5)	Private firms (6)	State firms (7)	Foreign firms (8)
YR2002	−0.009	−0.001	−0.145	−0.007	0.010	0.007	−0.012	0.021
	(0.024)	(0.030)	(0.110)	(0.043)	(0.021)	(0.026)	(0.100)	(0.039)
YR2003	−0.016	−0.016	−0.110	0.001	0.010	0.010	0.027	0.006
	(0.019)	(0.023)	(0.088)	(0.038)	(0.017)	(0.020)	(0.076)	(0.033)
YR2005	−0.010	−0.010	−0.020	−0.008	0.002	0.002	−0.001	0.001
	(0.016)	(0.019)	(0.067)	(0.032)	(0.013)	(0.016)	(0.055)	(0.028)
YR2006	−0.011	−0.012	0.011	−0.014	0.001	−0.001	0.039	−0.001
	(0.017)	(0.021)	(0.073)	(0.036)	(0.015)	(0.018)	(0.063)	(0.033)
Mixed	−0.156***	−0.151***	−0.244***	−0.156***	−0.130***	−0.130***	−0.145***	−0.127***
	(0.013)	(0.016)	(0.061)	(0.027)	(0.012)	(0.014)	(0.053)	(0.024)
Quota	−0.077***	−0.074***	−0.184***	−0.055*	−0.043***	−0.046***	−0.084	−0.021
	(0.016)	(0.019)	(0.062)	(0.032)	(0.014)	(0.018)	(0.054)	(0.029)
YR2002*Mixed	−0.011	−0.034	0.285**	−0.004	0.008	0.002	0.148	−0.006
	(0.028)	(0.035)	(0.126)	(0.051)	(0.026)	(0.031)	(0.117)	(0.049)
YR2002*Quota	−0.046	−0.079*	0.249*	−0.082	−0.043	−0.057	0.076	−0.073
	(0.036)	(0.046)	(0.128)	(0.072)	(0.036)	(0.047)	(0.122)	(0.066)
YR2003*Mixed	−0.025	−0.033	0.094	−0.021	0.002	−0.014	0.083	0.023
	(0.023)	(0.028)	(0.106)	(0.044)	(0.021)	(0.025)	(0.094)	(0.040)
YR2003*Quota	−0.023	−0.032	0.074	−0.007	−0.021	−0.023	−0.028	−0.016
	(0.029)	(0.036)	(0.109)	(0.057)	(0.027)	(0.035)	(0.098)	(0.052)
YR2005*Mixed	−0.111***	−0.115***	−0.032	−0.112***	0.002	−0.005	−0.013	0.022
	(0.019)	(0.022)	(0.086)	(0.038)	(0.017)	(0.020)	(0.075)	(0.034)
YR2005*Quota	−0.091***	−0.088***	−0.024	−0.120***	0.001	−0.003	−0.008	0.014
	(0.022)	(0.027)	(0.088)	(0.046)	(0.020)	(0.025)	(0.077)	(0.041)
YR2006*Mixed	−0.099***	−0.093***	−0.055	−0.116***	0.027	0.029	−0.029	0.034
	(0.021)	(0.024)	(0.094)	(0.042)	(0.019)	(0.022)	(0.085)	(0.039)
YR2006*Quota	−0.098***	−0.082***	0.023	−0.182***	0.020	0.018	−0.009	0.028
	(0.025)	(0.030)	(0.096)	(0.051)	(0.024)	(0.029)	(0.087)	(0.047)
Constant	0.927***	0.925***	0.950***	0.928***	0.958***	0.960***	0.956***	0.949***
	(0.011)	(0.013)	(0.047)	(0.023)	(0.010)	(0.011)	(0.039)	(0.020)
R^2	0.155	0.152	0.176	0.175	0.080	0.086	0.110	0.075
No. of obs.	6,318	4,355	331	1,632	4,797	3,268	260	1,269

Notes. The sample here only contains pure textile firms, i.e., firms only exported textile products. Columns 1-4 present results for the sample of all products exported by pure textile firms, while columns 5-8 present results for the sample of continued products exported by pure textile firms in both 2004 and 2005. "YR" refers to years, with the omitted year being 2004. "Mixed" are those pure textile firms who ever exported quota and and non-quota products, and "Quota" are those pure textile firms who exported only quota products, with the omitted firms being those pure textile firms who only exported non-quota textile products. Textile products are those products included in the HS chapters 50-63. State firms are those reported as state-owned enterprises, foreign firms are those reported as either wholly foreign-owned enterprises or Sino-foreign joint ventures, while the rest are all roughly classified as (domestic) private firms. Numbers in parentheses are standard errors of coefficients estimated. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively.

Table B10. Estimates of changes in the export product scopes of pure textile firms (U.S. market vs. Japanese market)

	Dependent variable: number of products							
	All products				Products exported to Japan in 2004			
	All firms (1)	Private firms (2)	State firms (3)	Foreign firms (4)	All firms (5)	Private firms (6)	State firms (7)	Foreign firms (8)
YR2002	0.038	0.554	−1.996*	−0.537	−2.660***	−2.381***	−4.364***	−2.740***
	(0.372)	(0.483)	(1.127)	(0.695)	(0.272)	(0.306)	(1.217)	(0.587)
YR2003	−0.062	−0.137	−1.288	0.426	−2.184***	−2.011***	−3.588***	−2.153***
	(0.303)	(0.343)	(1.228)	(0.655)	(0.222)	(0.227)	(1.148)	(0.496)
YR2005	0.234	0.217	−0.400	0.500	−2.057***	−2.024***	−2.714***	−1.910***
	(0.216)	(0.292)	(0.720)	(0.312)	(0.186)	(0.233)	(0.771)	(0.322)
YR2006	0.079	0.437	−3.033**	0.349	−2.501***	−2.301***	−4.242***	−2.367***
	(0.300)	(0.390)	(1.150)	(0.454)	(0.234)	(0.287)	(1.155)	(0.368)
US	−1.419***	−1.124**	−3.886*	−1.290*	−3.805***	−3.651***	−5.943***	−3.440***
	(0.434)	(0.536)	(2.102)	(0.679)	(0.355)	(0.418)	(1.939)	(0.568)
YR2002*US	−1.262**	−1.616*	0.347	−0.652	1.923***	1.769***	3.453**	1.983***
	(0.641)	(0.952)	(1.399)	(0.964)	(0.373)	(0.510)	(1.280)	(0.695)
YR2003*US	−0.182	−0.096	1.068	−0.667	2.005***	1.900***	3.420**	1.828***
	(0.382)	(0.447)	(1.709)	(0.726)	(0.251)	(0.262)	(1.428)	(0.486)
YR2005*US	1.971***	1.667***	1.629	2.850***	2.552***	2.506***	3.029***	2.500***
	(0.335)	(0.401)	(1.187)	(0.704)	(0.242)	(0.296)	(1.108)	(0.430)
YR2006*US	1.853***	1.291**	3.440**	2.568***	2.822***	2.645***	4.289***	2.712***
	(0.430)	(0.551)	(1.482)	(0.764)	(0.297)	(0.373)	(1.364)	(0.464)
Constant	5.369***	5.197***	7.533***	5.034***	5.343***	5.123***	7.600***	5.073***
	(0.253)	(0.303)	(1.212)	(0.428)	(0.232)	(0.271)	(1.245)	(0.389)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.574	0.590	0.540	0.562	0.681	0.708	0.608	0.661
No. of obs.	2,970	1,899	295	776	2,970	1,899	295	776

Notes. Columns 1-4 present results for the sample of all products exported by pure textile firms, while columns 5-8 present results for the sample of products exported by pure textile firms, which had been previously exported to Japan by each firm in 2004. "YR" refers to years, with the omitted year being 2004. "US" refers to the U.S., with the omitted destination market being Japan. Textile products are those products included in the HS chapters 50-63. State firms are those reported as state-owned enterprises, foreign firms are those reported as either wholly foreign-owned enterprises or Sino-foreign joint ventures, while the rest are all roughly classified as (domestic) private firms. Numbers in parentheses are standard errors of coefficients estimated, clustered within each firm. *,** ,*** indicate significance at 10%, 5%, and 1% levels respectively.

Table B11. Estimates of proportional changes in the export product scopes of pure textile firms (U.S. market vs. Japanese market)

	Dependent variable: log number of products							
	All products				Products exported to Japan in 2004			
	All firms (1)	Private firms (2)	State firms (3)	Foreign firms (4)	All firms (5)	Private firms (6)	State firms (7)	Foreign firms (8)
YR2002	0.019	0.055	−0.239	0.021	−0.510***	−0.469***	−0.656***	−0.551***
	(0.056)	(0.072)	(0.166)	(0.108)	(0.047)	(0.057)	(0.149)	(0.100)
YR2003	−0.002	−0.035	−0.156	0.116	−0.414***	−0.418***	−0.460***	−0.404***
	(0.047)	(0.058)	(0.146)	(0.098)	(0.037)	(0.047)	(0.099)	(0.078)
YR2005	0.086**	0.078*	−0.070	0.160**	−0.361***	−0.373***	−0.316***	−0.351***
	(0.035)	(0.045)	(0.086)	(0.065)	(0.027)	(0.034)	(0.071)	(0.053)
YR2006	0.105**	0.140**	−0.306*	0.165*	−0.463***	−0.443***	−0.583***	−0.469***
	(0.045)	(0.055)	(0.163)	(0.087)	(0.036)	(0.043)	(0.147)	(0.072)
US	−0.214***	−0.177**	−0.518**	−0.199*	−0.797***	−0.775***	−1.118***	−0.727***
	(0.063)	(0.080)	(0.236)	(0.114)	(0.055)	(0.064)	(0.241)	(0.103)
YR2002*US	−0.207**	−0.122	−0.092	−0.384**	0.393***	0.375***	0.513**	0.417***
	(0.085)	(0.110)	(0.208)	(0.178)	(0.079)	(0.100)	(0.233)	(0.150)
YR2003*US	−0.019	0.042	0.179	−0.214*	0.422***	0.450***	0.504**	0.334***
	(0.066)	(0.081)	(0.255)	(0.127)	(0.055)	(0.066)	(0.190)	(0.122)
YR2005*US	0.315***	0.307***	0.334*	0.328***	0.521***	0.490***	0.501***	0.591***
	(0.055)	(0.068)	(0.182)	(0.107)	(0.044)	(0.051)	(0.158)	(0.097)
YR2006*US	0.266***	0.184**	0.407*	0.407***	0.555***	0.517***	0.673***	0.573***
	(0.064)	(0.080)	(0.235)	(0.119)	(0.055)	(0.064)	(0.200)	(0.118)
Constant	1.093***	1.070***	1.337***	1.068***	1.178***	1.152***	1.438***	1.147***
	(0.036)	(0.045)	(0.122)	(0.068)	(0.027)	(0.034)	(0.108)	(0.051)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.558	0.551	0.554	0.594	0.760	0.768	0.705	0.781
No. of obs.	2,970	1,899	295	776	2,440	1,551	244	645

Notes. Columns 1-4 present results for the sample of all products exported by pure textile firms, while columns 5-8 present results for the sample of products exported by pure textile firms, which had been previously exported to Japan by each firm in 2004. "YR" refers to years, with the omitted year being 2004. "US" refers to the U.S., with the omitted destination market being Japan. Textile products are those products included in the HS chapters 50-63. State firms are those reported as state-owned enterprises, foreign firms are those reported as either wholly foreign-owned enterprises or Sino-foreign joint ventures, while the rest are all roughly classified as (domestic) private firms. Numbers in parentheses are standard errors of coefficients estimated, clustered within each firm. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively.

Table B12. Estimates of changes in the export product concentration of pure textile firms (U.S. market vs. Japanese market)

	Dependent variable: share of top product							
	All products				Products exported in both 2004 and 2005			
	All firms (1)	Private firms (2)	State firms (3)	Foreign firms (4)	All firms (5)	Private firms (6)	State firms (7)	Foreign firms (8)
YR2002	0.002	−0.003	0.042	0.002	0.050***	0.041**	0.102**	0.050*
	(0.016)	(0.021)	(0.049)	(0.030)	(0.014)	(0.018)	(0.044)	(0.030)
YR2003	0.002	0.011	0.008	−0.018	0.041***	0.044***	0.059*	0.032
	(0.014)	(0.018)	(0.044)	(0.027)	(0.012)	(0.015)	(0.034)	(0.025)
YR2005	−0.030***	−0.037***	0.022	−0.029	−0.008	−0.011	0.014	−0.007
	(0.011)	(0.014)	(0.029)	(0.022)	(0.007)	(0.010)	(0.026)	(0.011)
YR2006	−0.041***	−0.060***	0.029	−0.022	0.021*	0.016	0.042	0.028
	(0.014)	(0.018)	(0.043)	(0.027)	(0.011)	(0.013)	(0.042)	(0.021)
US	0.027	0.013	0.034	0.060**	0.042**	0.024	0.108*	0.062*
	(0.017)	(0.022)	(0.052)	(0.029)	(0.018)	(0.022)	(0.055)	(0.036)
YR2002*US	0.046*	0.019	0.100	0.069	0.038	0.017	0.026	0.086**
	(0.025)	(0.032)	(0.069)	(0.050)	(0.024)	(0.030)	(0.070)	(0.043)
YR2003*US	0.016	0.003	0.054	0.031	0.012	−0.018	0.081	0.053
	(0.021)	(0.027)	(0.073)	(0.037)	(0.018)	(0.023)	(0.061)	(0.033)
YR2005*US	−0.036**	−0.026	−0.067	−0.049	0.014	0.019	−0.032	0.018
	(0.018)	(0.023)	(0.054)	(0.031)	(0.010)	(0.014)	(0.026)	(0.017)
YR2006*US	−0.017	0.016	0.012	−0.103***	0.021	0.027	0.004	0.013
	(0.020)	(0.027)	(0.063)	(0.036)	(0.016)	(0.020)	(0.052)	(0.030)
Constant	0.744***	0.753***	0.706***	0.737***	0.790***	0.802***	0.725***	0.788***
	(0.010)	(0.012)	(0.028)	(0.018)	(0.009)	(0.011)	(0.029)	(0.020)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.491	0.480	0.492	0.537	0.593	0.609	0.575	0.580
No. of obs.	2,970	1,899	295	776	2,424	1,539	244	641

Notes. Columns 1-4 present results for the sample of all products exported by pure textile firms, while columns 5-8 present results for the sample of products exported by pure textile firms, which were exported by each firm in both 2004 and 2005. "YR" refers to years, with the omitted year being 2004. "US" refers to the U.S., with the omitted destination market being Japan. Textile products are those products included in the HS chapters 50-63. State firms are those reported as state-owned enterprises, foreign firms are those reported as either wholly foreign-owned enterprises or Sino-foreign joint ventures, while the rest are all roughly classified as (domestic) private firms. Numbers in parentheses are standard errors of coefficients estimated, clustered within each firm. *,**,*** indicate significance at 10%, 5%, and 1% levels respectively.

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