Misallocation of Quota Licenses: Evidence from Chinese Textile and Clothing Exporters*

Amit Khandelwal†
Columbia Business School

Peter K. Schott‡
Yale School of Management & NBER

Shang-Jin Wei§
Columbia Business School

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Abstract

We identify misallocation of quota licenses among Chinese textile and apparel exporters under the Multifiber Arrangement. When the quotas were removed, a large fraction of aggregate exports were driven by the extensive margin. Entrants had lower prices than incumbent firms and entered at the expense of state-owned enterprises. These outcomes are inconsistent with a model in which quotas were allocated efficiently prior to their removal. Our findings indicate that the misallocation of quota licenses along this extensive margin had sizable impact on aggregate TFP.

JEL classification: F1

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†Uris Hall, 3022 Broadway, New York, NY 10027, *tel*: (212) 854-7506, *fax*: (212) 316-9219, *email*: ak2796@columbia.edu

‡135 Prospect Street, New Haven, CT 06520, *tel*: (203) 436-4260, *fax*: (203) 432-6974, *email*: peter.schott@yale.edu

§Uris Hall, 3022 Broadway, New York, NY 10027, *tel*: (212) 854-7506, *fax*: (212) 316-9219, *email*: shangjin.wei@columbia.edu

1. Introduction

Public policy or market imperfections that distort the economic allocation of resources across firms can contribute to substantial under-development. Research in this area often focuses on the "intensive" margin, i.e., whether resources are allocated efficiently across existing firms. A recent study by Hseih and Klenow (2009), for example, estimates that aggregate productivity in China would increase 30 to 50 percent if the country's capital and labor were distributed optimally among current manufacturers. Distortions may also affect aggregate productivity by favoring incumbents at the expense of entrants.[1] Though the impact of censoring this "extensive-margin" can be substantial, it has received relatively little empirical attention.[2]

This paper analyzes a particular institution – export licensing – to quantify potential misallocation of resources along the extensive margin. Our focus is China's textile and clothing industry before and after the 2005 expiration of the global Agreement on Textiles and Clothing (ATC), previously known as the Multifiber Arrangement (MFA).[3] Under the MFA, exports of textile and clothing products by China and other developing economies to the United States, the European Union and Canada were subject to quotas. In China's case, the licenses permitting firms to export a portion of the country's overall quota were distributed by the government according to a complex (and, by us, unobserved) set of rules. We use firm-level Chinese trade data to examine how the distribution of textile and clothing exports across firms changes as quotas are removed, and to gauge whether these changes are consistent with efficient allocation of quotas prior to their removal.

Our assessment of the efficiency of China's quota allocation mechanism is guided by Irarrazabal et al. (2010), who introduce specific (i.e., per-unit) tariffs into the heterogeneous-exporter models of Melitz (2003) and Chaney (2008). We interpret the specific tariff as a quota license fee which firms must pay in order to access restricted foreign markets. Our assumption is that the government can efficiently allocate the export licenses by charging a (common) license fee. This fee causes firms to select into the export market based on their efficiency as only the most productive exporters receive a license as they are the only firms whose exports remain profitable net of the fee. Inefficient allocation, on the other hand, permits "favored" but less efficient firms to export by paying a below-market license fee or no fee at all.

One implication of this model is that the removal of quotas causes entry by less-productive firms: once obtaining a costly license is no longer necessary, less-efficient firms find it profitable to export the previously constrained goods and enter the export market. As a result, exporters' productivity distribution shifts to the left, and, because export prices vary inversely with productivity, the export price distribution (net of removal of the license fee) shifts to the right.[4] Though entrants

[1] Banerjee and Duflo (2005), for example, provide a broad discussion of the effect of credit constraints on the extensive margin.

[2] A recent exception is Chari (2010), which analyzes the aggregate productivity effects of firm entry and size restrictions under India's industrial licensing policy.

[3] China's textile and clothing industry accounts for a substantial share of its overall economy. In 2005, it employed 9.4 million workers, representing 15 percent of manufacturing employment. Its exports account for 15 percent of the country's overall exports, and 23 percent of world-wide exports (which equalled $487 billion dollars in 2005).

[4] Note our emphasis on exporters; any changes to the productivity distribution of firms that supply only the domestic market are irrelevant for this prediction.

are predicted to contribute to export growth following quota removal, a second implication of the model is that high-productivity incumbents account for a substantial fraction of post-quota export growth. This asymmetry is due to the fact that per-unit license fees under the quota regime impose a greater distortion on high-productivity firms' low-priced exports than low-productivity firms' high-priced exports.[5] Once quotas are removed, both types of exports jump, but low-priced exports increase relatively more.

A useful feature of the micro-data used in our analysis is that it covers textile and clothing products subject to quotas as well as very similar textile and clothing products that are exported quota free.[6] We can use the latter to construct difference-in-difference estimates that isolate the potential effects of inefficient quota allocation from other factors affecting Chinese textile and clothing exports more broadly. For example, exports of "silk shawls and scarves" to the United States were subject to quotas in 2004, but exports of "wool shawls and scarves", were not.[7] Comparing their export outcomes in the years before and after quotas are removed allows us to control for shocks to supply or demand, such as privatization, that are common to both goods.

We find that the reallocation of exports following quota removal is inconsistent with the implications of the efficent-allocation model. As expected, China's exports of previously constrained textile and clothing products jump in 2005, while the relative prices of these exports decline.[8] In sharp contrast to the model, however, we find that net entry is the dominant source of both export growth and relative price declines. Furthermore, entrants appear to be more productive than incumbents along several dimensions. First, entrants' prices in the year following quota removal are on average 23 percent lower than incumbents, with the result that net entry accounts for three-quarters of the overall 18 percentage point decline in relative prices. Second, incumbents with the highest market share under quotas experience the largest decline in market share when quotas are removed; according to the model, these incumbents should possess the highest productivity and therefore benefit disproportionately from the removal of license fees. Finally, entrants are drawn almost exclusively from the private sector and gain their market share at the expense of state-owned enterprises (SOEs), which are well-known for their relatively low productivity (Brandt, Tombe and Zhu 2010). All three of these criteria suggest that the distribution of export licenses under the quota regime was biased toward low-productivity state-owned enterprises.

Using total factor productivity estimates from production data, we estimate that aggregate productivity among exporters increased by 5.3 percent in the year quotas were removed. We decompose

[5] This effect is similar to Alchian and Allen's (1964) "Washington apples" story, where higher-priced/higher-quality goods are shipped to the furthest destinations to lower the per unit transport cost. Hummels and Skiba (2004) provide evidence of this phenomenon in international trade patterns.

[6] Under the ATC agreement signed by WTO members in 1995, industrialized countries agreed to remove quotas on textile and clothing markets in four phases over ten years. Each developed country produced a schedule of products that were to be released from quotas at the signing of the agreement in 1995. As a result, this schedule was fully anticipated. The four phases of quotas removals occurred on January 1st, 1995, 1998, 2002 and finally on 2005. Since China became a WTO member in November 2001, the Phase I to III products were released at that time. Not surprisingly, the industrialized countries kept the most sensitive products subject to quotas until the final stage. See Brambilla et al. (2010) for more details.

[7] These products correspond to HS codes 62141000 and 62142000, respectively.

[8] Brambilla et al. (2010) and Harrigan and Barrows (2009) document the surge in Chinese textile and clothing exports as well as the reallocation of textile and clothing exports across countries following quota removal in 2005.

this gain into two components: productivity change due to the removal of an inefficient licensing system and productivity change accounted for by the removal of quotas. We find that productivity rose XXX percent relative to a counter-factual in which licenses are allocated efficiently, thereby contributing XXX percent of the overal change in productivity between 2004 and 2005.

An alternate explanation of our results is that the price declines following quota removal evince quality downgrading. Because quotas exert a relatively large per-unit penalty on low-price/low-quality goods, firms may have an incentive to raise the quality of their exports when quotas are imposed and to reduce export quality when those quotas are removed.[9] As a result, the relative price decline associated with the extensive margin could reflect the entry of low-quality exporters. On the other hand, the fact that entrants' are drawn from the private sector and are more productive than the state-owned enterprises they supplant is inconsistent with most models of quality in the international trade literature, which assume a positive relationship between productivity and quality.[10] A more general model of quality might have high-productivity firms choosing optimally to export low-quality goods. While such a model would explain a connection between entry by high-productivity firms and quality downgrading, it would still imply inefficient allocation of licenses under quotas.

The research in this paper contributes to the growing set of papers that use micro-data to estimate the effects of market distortions on existing firms.[11] Our results contribute to this literature by focusing on the extensive margin and by relying on weaker assumptions to identify misallocation. Hseih and Klenow (2009), for example, assume identcial production functions across time and countries in their comparison of the United States, India and China. Cross-country comparisons in Alfaro et al. (2008) and Restuccia and Rogerson (2010), on the other hand, assume both that the U.S. allocation of factors is distortion free and that entrepreneurial ability is drawn from the same distribution across countries. However, if entrepreneurial ability is shaped by the economic environment (such as quality of educational institutions), the distribution need not be identical across countries.[12] In the difference-in-difference strategy used here, by contrast, we assume identical technology only across similar types of textile and clothing products, e.g., silk versus wool scarves.

The impact of distortions on the extensive margin is studied most widely in the context of developing-country credit constraints (Banerjee and Duflo 2005). Banerjee and Dulfo (2004), for example, use an exogenous change in the supply of credit to specific firms to identify constraints on obtaining credit among Indian firms. Their results suggest the existence of talented entrepreneurs

[9] See Falvey (1979), Krishna (1988) and Feenstra (1988) for early theoretical research on this issue, and Aw and Roberts (1985), Feenstra (1988) and Feenstra and Boorstein (1991) for early empirical investigations of quality upgrading in footwear, autos and steel, respectively. More recently, Harrigan and Barrows (2009) find evidence of quality downgrading in U.S. textile and clothing imports following the removal of MFA/ATC quotas.

[10] See Baldwin and Harrigan (2009), Johnson (2009), Hallak and Sivadasan (2009), Mandel (2010), and Kuger and Verhoogen (2008).

[11] See, for example, Hseih and Klenow (2009), Dollar and Wei (2007), Restuccia and Rogerson (2010), Alfaro, Charlton, and Kanczuk (2008), Midrigan and Xu (2010), and Petrin and Sivadasan (2010).

[12] For example, Bloom and Van Reenan (2007) find that many entrepreneurs in developing countries do not adopt best practices, such as lean manufacturing. One potential explanation is that this entrepreneurial characteristic is itself a technology that is slow to diffuse across countries.

who are unable to borrow from the formal banking sector. Recent theoretical contributions to this literature have shown that the potential affect of this extensive-margin misallocation on aggregate productivity could be quite large.[13] We find empirical evidence for these large effects in the context of a precisely defined government institution.

Our findings also contribute to recent evaluations of the MFA/ATC regime using more aggregate data by Brambilla et al. (2010) and Harrigan and Barrows (2009). Harrigan and Barrows (2009), for example, estimate that the annual cost of the quota constraints on consumers in the United States is approximately 90 dollars per household. Here, we concentrate on how quotas affect the exporting country, thus distinguishing between losses caused by a policy versus how that policy is implemented (Krishna and Tan 1998).

The rest of the paper proceeds as follows. Section 2 presents a model of efficient quota allocation that is used to guide the empirical analysis in Sections 3, 4 and 5. Section 6 discusses alternate interpretations of our findings, including whether the price movements we observed are consistent with quality downgrading. Section 7 concludes.

2. Theory

In this section we outline a simple, "efficient-allocation" model of exporting under quotas. Our goal is to derive firm-level implications for how China's exports respond to the removal of developed-country import quotas assuming China's quotas are allocated to the most productive exporters prior to their removal. We use these implications to guide our empirical analysis.

The model delivers two key results. The first is that the removal of quotas induces *less* productive firms to enter the export market. The second is that even with this entry, the preponderance of export growth and price declines following quota removal is accounted for by incumbents. The intuition for these results is straightforward. With the elimination of quotas, potential exporters whose costs inclusive of the license fees were previously too high to attract enough foreign consumers to overcome the fixed costs of exporting can now enter the export market. However, the removal of license fees exerts a disproportionately large effect on low-price (high-efficiency) firms than high-price (low-efficiency) firms because they represent a larger fraction of high-efficiency firms' prices. In demonstrating these implications, we use numerical solutions where analytic results are not possible.

2.1. Exporting Under Quotas

Our model is a re-interpretation of Irarrazabal et al. (2010), which analyzes exporting by heterogeneous firms in a trading system where importing countries make use of both specific (i.e., per unit) and *ad valorem* tariffs. We assume that quota license fees are equivalent to per-unit increases in the cost of exporting.[14]

[13] Banerjee and Moll (2010), for example, model misallocation due to financial frictions that prevent entrepreneurs from entering markets, while Buera and Shin (2008) and Buera, Kaboski and Shin (2010) quantify the role of financial constraints on productivity and growth in a related calibration exercise.

[14] Demidova, Kee and Krishna (2009) also model quota licenses as a specific tariff in their analysis of Bangladeshi garment exporters.

Irarrazabal et al. (2010) is an N-country version of Melitz (2003) that collapses to Chaney (2008) when specific tariffs are set to zero. We assume that in order to export a quota-bound good from origin country o to destination country d, firms must pay $a_{od} > 0$ per unit exported as well as an *ad valorem* tariff $\tau_{od} > 1$ of the value of the product exported. The price of variety φ in export market d is given by[15]

$$p_{od}(\varphi, a_{od}) = \frac{\sigma}{\sigma - 1}\left(\frac{\omega_d \tau_{od}}{\varphi} + a_{od}\right), \tag{1}$$

where $\sigma > 1$ is the constant elasticity of substitution across varieties and ω_d is the wage in the home country.[16] The corresponding export quantities are given by

$$q_{od}(\varphi, a_{od}) = \left(\frac{\sigma}{\sigma - 1}\omega_d\right)^{-\sigma}\left(\frac{\tau_{od}}{\varphi} + a_{od}\right)^{-\sigma}(P_d)^{\sigma-1}\, Y_d \tag{2}$$

where P_d and Y_d are the price index and expenditure in the destination market, respectively.

We assume governments do not know the productivity of firms and therefore allocate quotas based upon an auction that charges a common price to any firm who wishes to export. The license price is found by equating the quota size Q_{od}, determined through bilateral negotiations between the producer and destination countries, and the sum of exports from o to d: $\int_{\varphi^*} q_{od}(\varphi, a_{od}) g(\varphi) d\varphi = Q_{od}$. Lower license prices connote less restrictive quotas, and *vice versa*.

A productivity cutoff,

$$\varphi^*_{od} = \left[\lambda\left(\frac{f_{od}}{Y_d}\right)^{\frac{1}{1-\sigma}} \frac{P_d}{\omega_o \tau_{od}} - \frac{a_{od}}{\tau_{od}}\right]^{-1}, \tag{3}$$

determines the marginal exporter, who is indifferent between paying the fixed costs of exporting and remaining a purely domestic firm; $\lambda = \left(\frac{\sigma-1}{\sigma}\right)\sigma^{\frac{1}{1-\sigma}}$ is a constant and f_{od} is the fixed costs of exporting from country o to country d.

For $a_{od} > 0$, there is no closed-form solution for the price index $P_d = P_d(\varphi^*_{od})$ in equation 3 (Irarrazabal et al. 2010). To fix ideas, for the remainder of this subsection we assume the price index is insensitive to changes in the license fee, i.e., that the exporting country is "small" relative to the foreign country.[17] With P_d fixed, it is easy to verify that a lower license price implies a lower cutoff for exporting, $\frac{d\varphi^*_{od}}{da_{od}} > 0$.

When license fees are zero, the ratio of output quantities between any two firms with productivities $\varphi > \varphi'$ is independent of *ad valorem* trade costs (Melitz 2003). The existence of such fees, however, breaks this independence because per-unit costs disproportionately raise the price of low-price (high-productivity) firms compared to high-price (low-productivity) firms. As a result,

[15] Productivities are drawn from the distribution $G(\varphi)$ with density $g(\varphi)$.

[16] Wages are pinned down by a perfectly competitive, freely traded transport sector operating under constant returns to scale.

[17] Berman, Martin and Mayer (2009) adopt a similar, small-country assumption in their model with per-unit costs, which are interpreted as distribution costs.

reductions in the license fee induce relatively greater growth in export quantities among higher-productivity incumbents,

$$\frac{\partial\left[\frac{q_{od}(\varphi,a_{od})}{q_{od}(\varphi',a_{od})}\right]}{\partial a_{od}} = -\sigma\left[\frac{\frac{\tau_{od}}{\varphi}+a_{od}}{\frac{\tau_{od}}{\varphi'}+a_{od}}\right]^{-\sigma-1}\frac{\tau_{od}\left(\frac{1}{\varphi'}-\frac{1}{\varphi}\right)}{\left(\frac{\tau_{od}}{\varphi'}+a_{od}\right)^2} < 0. \tag{4}$$

Thus, while the entry of low-productivity firms causes the overall share of incumbents to fall with a_{od}, among incumbent firms the market shares of the largest and most productive firms rises.

The average productivity of exporters, $\overline{\varphi}(\varphi^*)$, is given by

$$\overline{\varphi}(\varphi^*) = \frac{1}{1-G(\varphi^*)}\int_{\varphi^*}\varphi g(\varphi)d\varphi. \tag{5}$$

With P_d fixed, the average productivity of exporters falls in response to quota liberalization,

$$\frac{\partial\overline{\varphi}}{\partial a} = \frac{g(\varphi^*)}{1-G(\varphi^*)}\frac{\partial\varphi^*}{\partial a}\left[\overline{\varphi}(\varphi^*)-\varphi^*\right] > 0. \tag{6}$$

The intuition for this relationship is straightforward. As the license price falls and φ^* declines, less-productive firms enter the export market, driving down the average productivity of all exporters. As an individual firm's productivity is fixed by assumption, there is no change in the average productivity of incumbents.

The response of *quantity-weighted* average productivity to quota reduction is more complex because it depends upon the redistribution of activity among incumbents,

$$\frac{\partial\widetilde{\varphi}}{\partial a} = \underbrace{\frac{1}{1-G(\varphi^*)}\int_{\varphi^*}\frac{\partial\left[q(\varphi)/Q\right]}{\partial a}\varphi g(\varphi)d\varphi}_{\text{Intensive}} + \underbrace{\frac{g(\varphi^*)}{1-G(\varphi^*)}\frac{\partial\varphi^*}{\partial a}\left[\widetilde{\varphi}(\varphi^*)-\varphi^*\frac{q(\varphi^*)}{Q}\right]}_{\text{Extensive}} \tag{7}$$

The first term in equation (7) is the change in weighted-average productivity due to the intensive margin. The sign of this term is negative as reductions in the quota license fee increase the relative market share of high-productivity incumbents at the expense of low-productivity incumbents. The sign of the extensive-margin contribution, on the other hand, is positive: a reduction in the license price enables less efficient firms to commence exporting, which drives down the weighted average. The overall effect of a change in the license price on weighted average productivity is ambiguous. It is negative if the right tail of the distribution of firm productivity is relatively thin as low-productivity entrants will account for a larger fraction of growth. It is positive if incumbents account for a larger fraction of growth.

The model's one-to-one correspondence between productivity and price yields similar relationships with respect to export prices.[18] The average price of exports is given by

$$\overline{p}(\varphi^*) = \frac{1}{1-G(\varphi^*)}\int_{\varphi^*}p(\varphi)g(\varphi)d\varphi. \tag{8}$$

[18] In a more general setting in which firms choose the quality as well as level of their output, this one-to-one mapping might break down. We examine this issue in greater detail below.

Here, the removal of quotas implies an *increase* in the average price of exports, net of the impact of removing the license fee

$$\frac{\partial \overline{p}}{\partial a} = \underbrace{\frac{\sigma}{\sigma - 1}}_{\text{Intensive}} + \underbrace{\frac{g(\varphi^*)}{1 - G(\varphi^*)} \frac{\partial \varphi^*}{\partial a} \left[\overline{p} - p(\varphi^*)\right]}_{\text{Extensive}}. \tag{9}$$

The sign of the first term is positive and represents the change in average price among incumbents due to the reduction of the license fee (see also equation 1). The second term represents the change in the average price due to the extensive margin. This term is negative: as license prices fall, less efficient firms enter the market pushing up the average price. The key insight here is that only incumbents contribute to lower prices following quota reductions.

The response of quantity-weighted average export prices to reductions in the quota is given by

$$\frac{\partial \widetilde{p}}{\partial a} = \underbrace{\frac{1}{1 - G(\varphi^*)} \int_{\varphi^*} \frac{\partial \left[p(\varphi) q(\varphi) / Q\right]}{\partial a} \varphi g(\varphi) d\varphi}_{\text{Intensive}} + \tag{10}$$

$$\underbrace{\frac{g(\varphi^*)}{1 - G(\varphi^*)} \frac{\partial \varphi^*}{\partial a} \left[\widetilde{p}(\varphi^*) - \frac{q(\varphi^*) p(\varphi^*)}{Q}\right]}_{\text{Extensive}} \tag{11}$$

The first term represents the intensive margin and its sign is positive: when license prices fall, the prices of all incumbent firms will fall. The extensive-margin term is negative, as less-productive entrants enter the market with relatively high prices. The overall change in the weighted-average export price is ambiguous: if the most productive incumbents' market share rises enough, it falls, else it rises.

2.2. Numerical Solutions

As noted above, closed form solutions for the model are not possible when the license price is positive, i.e., $a_{od} > 0$. As a result, we use numerical solutions to derive implications that do not rely upon a "small-economy" assumption.[19]

We consider two countries and one industry. For our baseline results, we assume the importing country is four times the size of the exporter, i.e., that the labor forces of the United States and China are $L_{US} = 400$ and $L_{China} = 100$, respectively. We follow the literature in assuming firm productivity is Pareto distributed, $G(\varphi) = 1 - \varphi^{-\gamma}$ with shape parameter γ. This shape parameter and the fixed cost of exporting are chosen to match the observed average size ratio of exporters to non-exporters (1.4) and the share of firms that export (43 percent), respectively.[20] Iceberg trade costs are chosen so that the share of Chinese textile and clothing exports in U.S. imports and *vice*

[19] We are grateful to Andreas Moxnes for providing the Matlab code they use to derive the numerical solutions in Irarrazabal et al. (2010). We modify their code by adding the quota constraint. The modified code solves for an equilibrium license fee given this constraint.

[20] Our data are described in the next section.

versa match the observed shares in 2005 (23 percent and 5 percent, respectively). The iceberg cost within the home countries are set to one. Finally, we assume an elasticity of substitution, $\sigma = 4$.

Using these parameters, we solve for productivity cutoffs and price indexes in a "quota-free" equilibrium. We then re-solve the model and recover the implied license fee after imposing steadily more restrictive quotas. We measure quota restrictiveness in terms of the percent of the exporting country's exports in the quota-free equilibrium, so that lower shares imply greater restrictiveness. We note that in the model imposing a quota restrictiveness of 56 percent yields export growth following quota removal of 80 percent; this restrictiveness matches the observed growth in China's textile and clothing exports in 2005, the year quotas are removed.

Figure 1 plots the home country's change in average productivity after liberalization against the restrictiveness of the quota. Consistent with the comparative static in equation 6, the average change in productivity when quotas of the noted restrictiveness are removed is negative throughout the range of quota restrictiveness, indicating that entrants have lower productivity than incumbents. The upward slope of the relationship implies greater entry by low-productivity firms following the removal of more restrictive quotas.

Figure 2 plots the change in weighted-average productivity against quota restrictiveness. As noted in the previous section, this relationship is ambiguous and depends upon the extent to which the highest-productivity incumbents gain market share following quota removal. The negatively sloped curves in the figure indicate that at the chosen parameters, more restrictive quotas imply greater increases in weighted average productivity when quotas are removed.

3. Reallocation Following Quota Removal

The model developed in the previous section serves as our null hypothesis and guides our empirical analysis. With efficient allocation of quotas under the MFA/ATC, we expect quota liberalization to coincide with three outcomes. First, the entrance of less-productive exporters. Second, an increase in the market share of the largest incumbents. Finally, a reduction in export prices accounted for by incumbents.

An alternative to this null hypothesis is an allocation of quotas based on criteria other than firm efficiency. These criteria could include granting licenses as a reward for prior performance or to maximize political support or employment among a particular group of workers. Krishna and Tan (1998), for example, document that awarding MFA/ATC quotas on the basis of firms' ability to fill export orders in previous years was quite common. Firms generally were not permitted to sell these their licenses on a secondary market, and they would continue to receive them as long as they continued to satisfy their allocation.

In the remainder of this section, we describe the data used in our analysis and use these data to document how Chinese exporters, exports and export prices responded to the removal of quotas between 2004 and 2005.

3.1. Data

Our empirical analysis relies on data from several sources. The first is Chinese export data by firm, eight-digit Harmonized System (HS) category and destination country.[21] For each firm-product-country observation, we observe the total nominal value and quantity traded as well as the information about the ownership of the firm. We use this information to classify firms into three ownership categories: state-owned enterprises ("SOEs"), domestically owned private firms ("domestic") and foreign-owned private firms ("foreign").

Quantity units vary across products and are available for more than 99 percent of observations, representing more than 99 percent of export value across years. The availability of both value and quantity permits construction of nominal unit values or "prices" (p). As documented in previous research, e.g., Schott (2004), unit values can be noisy and we therefore follow the literature in trimming outliers for some of our results as noted below.

We split China's eight-digit HS export categories into three mutually exclusive and time-invariant classes of products using a mapping of these categories to U.S., EU and Canadian quota categories available from the Embassy of China's Economic and Commerical Affairs office.[22] The three classes are of products are: textile and clothing goods subject to U.S., European or Canadian quotas as of 2004 (referred to as "MFA" goods); other textile and clothing goods ("OTC") not subject to quotas in 2004; and non-textile and clothing ("NTC") goods such as steel or electronics.[23] We think of OTC goods as a comparator group for MFA goods and make use of them in our "difference-in-difference" estimates below. Of the 7017 eight-digit Harmonized System (HS) categories used by China in 2004, 552 are MFA, 554 are OTC and 5911 are NTC.[24] We note that an MFA good is not necessarily subject to a quota simultaneously by all three of the United States, EU and Canada. Among the 554 MFA goods in 2004, 163 are subject to quotas by all three destinations, while 160, 50, and 6 are subject to quotas solely in the United States, solely in the EU and solely in Canada, respectively.

Though all MFA products are covered by a quota for at least one country, there is variation in the extent to which these quotas are binding. Following USITC (2002), we define a quota as "binding" in a given year for a particular country if its fill rate, i.e., exports divided by the respective quota, exceeds 90 percent. Fill rates are computed using data on the level of U.S., EU

[21] These data are from *XXX* and are used by Ahn et al. (2010) and Manova and Zhang (2009). They appear consistent with aggregate Chinese export totals available elsewhere from public sources. Total exports in our data in 2005, for example, are 777 billion dollars versus 762 billion dollars in Comtrade. The match with Comtrade at lower levels of aggregation, e.g., two-digit HS categories, is also consistent. Chinese trade data are collected using eight-digit HS codes, i.e., they are the most detailed available.

[22] We treat the EU as a single block of countries throughout our analysis given that quotas are set for the union as a whole.

[23] As discussed in Brambilla et al. (2010), quotas were relaxed on some of China's textile and clothing goods in 2002 as part of its entry into the WTO in 2001. As our focus is on the reallocation of exports that occurs after any remaining quotas are removed in 2004, those eight-digit HS categories are not classified as MFA goods in our analysis. We note that changes to China's export classification scheme each year results in small changes to the number of products in each class between 2000 and 2005.

[24] The set of MFA and OTC products are: two-digit HS chapters 50-63; four-digit HS chapter 6406; five-digit HS chapters 30059 and 65059; six-digit HS chapters 701919 and 94049. We identify the MFA products among these based on the concordance described above.

and Canadian quotas available from websites maintained by each country.[25] We find that 282 of the MFA products, representing 62 percent of MFA value, are binding in 2004. As noted below, some of our results are broken out according to whether or not the quotas on MFA goods are binding.

3.2. Export Growth Following Quota Removal

Chinese export growth in 2005 is disproportionately large for textile and clothing goods released from quotas, and generally occurs at the expense of state-owned enterprises.

Table 1 provides a breakdown of China's export value and number of exporting firms from 2000 to 2005 according to the class of product exported (i.e., MFA, OTC or NTC) and its destination. For the purposes of this subsection, countries are grouped into two blocks: the first encompasses the United States (US), the members of the European Union (EU) and Canada and is referred to as "UEC"; the second block contains all other countries and is referred as "rest of the world" or "ROW". To ease exposition, we refer to the six possible pairs of product-class and aggregate destination as "groups", e.g., the OTC-ROW group. Our group of main interest is MFA-UEC. Its two closest comparators focus either on textile and clothing goods without quotas exported to the same destinations, i.e., OTC-UEC, or on the same MFA goods sent to non-quota countries, i.e., MFA-ROW.

As indicated in the top panel of the Table 1, the MFA-UEC group's 287 percent increase in export value between 2000 and 2005 is the largest among all six groups over this period. By comparison, export growth is 179 and 113 percent for OTC-UEC and MFA-ROW, respectively, and 236 percent for Chinese exports as a whole. The MFA-UEC group's differentially large 2000 to 2005 growth is due primarily to the 82 percent jump in export value that occurs in the final year of the sample, when quotas are removed. MFA-UEC growth in prior years, by contrast, averages just 21 percent per year.[26] Likewise, the MFA-UEC group's 2005 growth is more than twice as large as that exhibited by OTC-UEC and MFA-ROW, which increase 34 and 4 percent in 2005, respectively.

Data in the lower panel of Table 1 indicates that the surge in MFA-UEC export value is accompanied by a similarly large increase in the number of MFA-UEC exporting firms. Between 2004 and 2005, the number of MFA-UEC exporters jumps 63 percent, from 13,646 to 22,232. Here too, this jump is disproportionately large compared to prior years, and to both the 19 percent increase in Chinese exporters overall as well as the 36 and 16 percent increases exhibited by OTC-UEC and MFA-UEC, respectively. The relatively large increase in firms exporting MFA-UEC in 2005 is the first indication of the importance of the extensive margin in China's response to quota removal.[27]

[25] Data on U.S., EU and Canadian quotas are obtained from *[note sources]*.

[26] As discussed in Brambilla et al. (2009), U.S., EU and Canadian quotas on China's MFA exports grew an average of 2-3 percent per year *in terms of quantity* once China was admitted to the WTO in December 2001. The relatively high value growth rates displayed before 2004 in Table 1 reflect a combination of this growth in quantity as well as sizeable increases in prices, as discussed further in Section 3.4.

[27] We note that a firm may appear in more than one group in Table 1 if it exports in multiple product classes or if it exports to both ROW and UEC. We find that less than 5 percent of MFA-UEC exporters representing an even smaller fraction of MFA-UEC exports are active only in that group. Indeed, depending on the year, 82 to 88 percent of MFA-UEC exporters also export in MFA-ROW. Overlap with other groups, e.g., OTC-UEC is lower, on the order of 50 to 60 percent of firms. In our model, we treat multiple-product firms as single-product firms that manufacture

Table 2 reports export value market shares by firm ownership type and product-destination group in 2004 (top panel) and 2005 (middle panel), as well as the change in market share between these two years (bottom panel). SOEs have a substantially greater presence in MFA-UEC than in the other five product-destination groups prior to quota removal, but that gap drops markedly once quotas are removed. As indicated in the table, SOEs possess 51 percent of the MFA-UEC market in 2004 versus 26 percent for overall exports and 42 and 32 percent for OTC-UEC and MFA-ROW, respectively. Once quotas are removed, SOEs' MFA-UEC market share falls 13 percentage points, to 38 percent, bringing it closer to the 34 and 27 percent for OTC-UEC and MFA-ROW in that year, respectively. Although the decline of SOEs MFA-UEC market share is consistent with the overall decline of SOEs across all groups, it is far more pronounced in MFA-UEC.

The results in Tables 1 and 2 highlight three important facts about MFA-UEC exports following quota removal. First, post-quota export growth in MFA-UEC is large relative to other groups, particularly its closet comparator, OTC-UEC. Second, MFA-UEC export growth is accompanied by a similarly large relative increase in the number of MFA-UEC exporters. Third, the disproportionately high market share held by SOEs under quotas disappears quickly once quotas are removed.

The first fact indicates that the quotas imposed on Chinese exports by the United States, EU and Canada were binding. The second and third facts suggest that export growth following quota removal is at odds with the efficient-licensing model discussed above. According to the model, export growth following quota removal is concentrated among relatively efficient incumbents versus relatively inefficient new entrants.

In fact, SOEs, among the largest incumbent exporters under the quota regime, experienced relatively large declines in market share following liberalization, suggesting their allocations were not awarded on the basis of productivity.[28] This relatively large decline among large incumbent SOEs in MFA-UEC can be seen in Figure 3. The top panel of the figure plots incumbent firms' change in market share between 2004 and 2005 against their market share in 2004, by type of firm.[29] The bottom panel uses lowess smoothing highlight the variation in this relationship across groups. As indicated in the figure, large SOEs lost relatively more market share than large privately owned firms, foreign or domestic, which is inconsistent with the efficient allocation model.

We now turn to a more detailed examination of the margins of adjustment.

3.3. Margins of Adjustment

While the exports of MFA-UEC incumbents increase when quotas are removed, overall MFA-UEC export growth is disproportionately driven by net entry. This relative contribution of net entry

different varieties.

[28] Average MFA-UEC export value per firm for SOEs and privately owned domestic and foreign firms is 1.1, 0.9 and 1.1 million dollars, respectively. Exports are moderately more concentrated among the largest privately owned firms than among SOEs. The top ten percent of firms account for 72, 75 and 77 percent of SOE, domestic and foreign firms; exports, respectively.

[29] As discussed further in the next section, we use quantity-based market share in Figure 3 to remove the impact of price changes. Firms market share in the figure are with respect to their eight-digit HS product and country of destination rather than group because quantities cannot be aggregated across products.

can be seen in Figure 4, which provides a breakdown of the 2005 export value growth reported in Table 1 by margin of adjustment.

Here, and for the remainder of the paper, we compute margins of adjustment with respect to eight-digit HS product and country pairs. That is, we define an incumbent as a firm that exports the same eight-digit HS product to the same country in consecutive years, while an entrant is a country that exports a product-country pair in year t after not having exported it in year $t-1$.[30] The only exception to this definition is the EU, which we continue to treat as a single "country" given that EU quotas were set for the union as a whole.[31] As illustrated in the figure, net entry accounts for a greater share – 73 percent – of MFA-UEC export growth in 2005 than is exhibited by other groups, which average 47 percent after excluding MFA-ROW, where the contribution of incumbents is negative. This relative importance of entry in MFA-UEC following quota removal suggests inefficient allocation of licenses under the MFA/ATC: had licenses been allocated on the basis of firm productivity, the model above implies incumbents would account for the majority of export value growth.

Net entry can be decomposed into three extensive margins: "exit", "new exporting" and "switching". Exiters are firms that stop exporting a product-country pair in year t after having exported it in year $t-1$. New exporters are firms that begin exporting a product-country pair in year t after not having exported at all in year $t-1$. Switchers are also new to a product-country pair in year t, but were observed exporting one or more other product-country pairs in year $t-1$. As defined here, switchers may or may not remain in the product-country combination exported in year $t-1$.

The relative contribution of these groups of firms can be assessed using either value- or quantity-based market shares. Given the sharp changes in relative MFA prices discussed in the next section, we use the latter, but note that a qualitatively similar story regarding the relative contributions of intensive and extensive margins emerges using either approach.[32] One complication with using quantity-based market shares is that quantities cannot be aggregated across eight-digit HS categories.[33] As a result, we first sum firms' quantity-based market shares within each product-country pair by ownership type and margin of adjustment, and then take the mean of these sums across product-country pairs.[34]

Table 3 reports the average changes in quantity-based market share for MFA-UEC between 2004 and 2005 by type of firm ownership and margin of adjustment. The first column summarizes the overall shift in market share from incumbents to net entrants. As indicated in the first row of

[30] As a result, a given firm may be counted in more than one margin of adjustment depending upon the mix of product-country pairs in which it participates over time. For example, an incumbent with respect to one MFA-UEC product-country may be an entrant (or, below, a switcher) with respect to another if it adds an MFA-UEC country pair between years t and $t-1$.

[31] Treating the EU as a single country, China exports NTC, OTC and MFA products to an average of 203, 186 and 193 countries over the sample period, respectively.

[32] Given the general decline in prices, results using value- rather than quantity-based market share, though broadly similar to those presented in the main text, overstate the decline in incumbents' market share and understate the magnitude of entrant's market share.

[33] While it is possible to measure the quantity of many MFA products in "square meter [of fabric] equivalents", that is not true for textile and clothing goods more generally. Likewise, a variety of non-compatible units are used to track the quantities of non-textile-and-clothing products.

[34] There are 1,538 and 41,212 product-country pairs in MFA-UEC and MFA-ROW, respectively.

that column, incumbents' quantity-based market share declines an average of 19 percentage points across MFA-UEC product-destination pairs in the year quotas are removed. The largest gain among net entrants, noted in the remaining rows of that column, is registered by switchers, who claim an average of 60 percent of the market in 2005, while new exporters on average account for an additional 7 percentage points. Firms that exit MFA-UEC between 2004 and 2005, by contrast, held an average of 48 percent of the market in 2004.

The remaining columns of Table 3 break down the MFA-UEC group's intensive- and extensive-margin adjustments by ownership, so that the sum of the final three columns equals the value in the first column. Three trends stand out. The first, contained in the final row of the table, is a *net* reallocation of export activity away from SOEs: their quantity-based market share declines an average of 18 percentage points between 2004 and 2005, with 11 percentage points of this market share going to privately owned domestic firms and 7 percentage points to privately owned foreign firms.[35] Second, there is substantial *gross* reallocation of market share within firm types. This gross reallocation is highest among SOEs, where exiters and switchers contribute -29 and 25 percent market share. There, the overall negative contribution of net entry reinforces the loss of market share by incumbents. Among privately owned domestic and foreign firms, by contrast, the positive contribution of net entry more than offsets the negative contribution of incumbents. Third, while net entry by new exporters is negligible among SOEs, it accounts for 5 and 2 percentage points of the overall 11 and 7 percentage point gains of privately owned domestic and foreign firms.

Comparison of MFA-UEC to the other textile and clothing groups – OTC-UEC in particular – aids our assessment of whether the margin adjustments observed above are related to quota removal versus other factors common to textile and clothing products, e.g., the removal of entry barriers or the ongoing privatization of SOEs. Figure 5 provides a visual analogue to the decomposition in the first column of Table 3 for all four textile and clothing groups. It demonstrates that incumbents and switchers play a more important role in MFA-UEC reallocation than in the contemporaneous reallocation of OTC-UEC. Indeed, incumbents' 14 percentage point loss of market share in MFA-UEC is three times larger than in OTC-UEC, while its switchers' 60 percentage point gain in market share is one quarter larger than in OTC-UEC. The loss of market share by incumbents in MFA-UEC is also substantially larger than that observed in two other comparator groups which export textile and clothing goods to rest-or-world, OTC-ROW and MFA-ROW. Figure 6, which compares the margin adjustments of MFA-UEC and OTC-UEC by ownership type, reveals that the relatively large reallocations associated with incumbents and switchers is concentrated among SOEs and privately owned domestic firms.

Together, the data in Figures 5 and 6 and Table 3 show that even though incumbents' exports grew (Figure 4) following quota removal, they lost market share to entrants, and that this loss of market share is concentrated among SOEs. These results provide further support for the idea that quota licenses were allocated inefficiently both across and within firm ownership types prior to their removal in 2005.

[35] Price changes explain the difference between the 18 percent decline in SOEs' average quantity-based market shares in Table 3 and their 13 percent decline in value-based market share in Table 2.

3.4. Prices

Chinese MFA-UEC export prices fall relative to the export prices of all other groups the year that quotas are removed. These relative price declines are disproportionately due to the extensive margin, i.e., entrants with lower prices replacing exiters with higher prices. The concentration of price declines among the extensive margin is inconsistent with the efficient allocation developed above, which implies that quota removal causes the entry of relatively low-productivity, high-price firms.

Figure 7 displays the mean percent change in (quantity-weighted) average product-country export prices between 2004 and 2005, by group. These changes are computed in two steps. First, for each product-country pair in each year, we calculate a weighted-average export price ($\overline{P}_{hct}$) across all exporting firms using their quantity market shares as weights, i.e., $\overline{P}_{hct} = \sum_f \theta_{fhct} p_{fhct}$, where θ represents the market share of firm f in product-country hc at time t. We then compute the difference in these weighted-average prices between years t and $t-1$ for each product-country pair, and divide them by the weighted average price in year $t-1$, i.e., $\Delta P_{hct} = \left(\overline{P}_{hct} - \overline{P}_{hct-1}\right)/\overline{P}_{hct-1}$. Each bar in Figure 7 displays the mean ΔP_{hct} across product-country pairs in 2005 by group, excluding outliers.[36] As indicated in the figure, export prices in OTC-ROW, MFA-ROW and OTC-UEC grew 38, 20 and 15 percent, on average, between 2004 and 2005. In MFA-UEC, by contrast, export prices *fell* 2 percent on average, yielding relative MFA-UEC price declines of 41, 22 and 18 percent *vis a vis* these groups, respectively.[37]

The importance of net entry plays in these declines is illustrated in Figure 8, which compares firm-level incumbent, entrant and exiter normalized price distributions for MFA-UEC in the year following quota removal. For incumbents and entrants, normalized prices are defined as the (base 2) log difference between these firms' export prices in 2005 and $\overline{P}_{hc}$,the mean of the quantity-weighted average prices across all firms in the respective product-country in 2004 and 2005 from above, i.e., $\log_2(p_{fhc2005}/\overline{P}_{hc})$, where $\overline{P}_{hc} = \left(\overline{P}_{hc2004} + \overline{P}_{hc2005}\right)/2$.[38] For exiters, which are not present in 2005, normalized prices represent the (base 2) log difference between their price in 2004 and the same average, i.e., $\log_2(p_{fhc2004}/\overline{P}_{hc})$. As in Figure 7, Figure 8 excludes outliers, here defined to be firms whose relative prices are below and above the first and ninety-ninth percentiles of each distribution, respectively.

The incumbent, entrant and exiter distributions displayed in Figure 8 convey two messages. The first is that the price distribution for exiters lies to the right of that for entrants, indicating that firms that exit MFA-UEC in 2004 have relatively high prices compared with firms that enter

[36] Extreme price changes are found for some product-country combinations, e.g., HS 62101030, "garments of felt or nonwovens, of man-made fibres", to Suriname, which grew 70,000 percent between 2004 to 2005. In Figure 7 we drop product-country pairs whose price changes are either below or above the first and ninety-ninth percentile, respectively. Though excluding these product-country pairs lowers average export price growth in all groups, it does not undermine any of the substantive patterns discussed in this section. Results including these outliers are presented in our electronic appendix.

[37] The MFA-UEC price decline in 2005 is also sharp relative to that group's average price *growth* of 16 percent between 2003 and 2004.

[38] As in the previous section, we compute margins of adjustment with respect to eight-digit HS product and country pairs.

the group in 2005. We find that the mean price of entrants is 6 percent below $\overline{P}_{hc}$, while the mean price of exiters is 6 percent above $\overline{P}_{hc}$.[39] A similar pattern is hard to find among other groups in either 2005 or earlier years. Figure 9, for example, plots analogous export price distributions for MFA-UEC in 2004 as well as OTC-UEC in 2005. In the former, exiters' prices are *lower* than entrants' prices; in the latter they are almost indistinguishable.

The second message of Figure 8 is that MFA-UEC incumbents' prices exhibit a relatively thin left tail compared to MFA-UEC exiters and entrants, as well as to OTC-UEC incumbents (Figure 9). Indeed, the mean price of incumbents in Figure 8 is 16 percent above $\overline{P}_{hc}$ $(0.24 * ln(2))$. The relatively low concentration of low export prices among MFA-UEC incumbents provides intuition for their loss of market share, discussed in the previous section. Indeed, long-term contracts, greater knowledge of the market and other potential asymmetries may explain why incumbents do not lose even more market share in 2005 given their relatively high prices. To the extent these advantages decay over time, MFA-UEC incumbents' market share may have eroded further in subsequent years.[40]

The contributions of the intensive and extensive margins to overall price changes depend on changes in exporters' market shares as well as changes in prices. We assess the relative importance of these factors by adopting and modifying a decomposition method proposed by Foster et al. (2008) and Griliches and Regev (1995). This decomposition breaks the overall change in export prices for a particular product-country pair between periods $t-1$ and t, ΔP_{hct}, into three terms – for incumbents, entrants and exiters – each of which has a "within" and an "across" component[41]:

$$\begin{aligned}\Delta P_{hct} = &\frac{1}{\overline{P}_{hct-1}}\left[\underbrace{\sum_{f\in I}\overline{\theta}_{fhc}\left(p_{fhct}-p_{fcht-1}\right)}_{\text{Incumbent: Within}}+\underbrace{\sum_{f\in I}\left(\theta_{fhct}-\theta_{fhct-1}\right)\left(\overline{p}_{fhc}-\overline{P}_{hc}\right)}_{\text{Incumbent: Across}}\right] \\ &+\frac{1}{\overline{P}_{hct-1}}\left[\underbrace{\sum_{f\in N}\overline{\theta}_{hct-1}\left(p_{fhct}-\overline{P}_{hc}\right)}_{\text{Entrant: Within}}+\underbrace{\sum_{f\in N}\left(\theta_{fhct}-\overline{\theta}_{hct-1}\right)\left(p_{fhct}-\overline{P}_{hc}\right)}_{\text{Entrant: Across}}\right] \\ &-\frac{1}{\overline{P}_{hct-1}}\left[\underbrace{\sum_{f\in X}\overline{\theta}_{hct-1}\left(p_{fhct-1}-\overline{P}_{hc}\right)}_{\text{Exiter: Within}}+\underbrace{\sum_{f\in X}\left(\theta_{fhct-1}-\overline{\theta}_{hct-1}\right)\left(p_{fhct-1}-\overline{P}_{hc}\right)}_{\text{Exiter: Across}}\right].\end{aligned} \tag{12}$$

As above, θ and p represent quantity-based market share and export unit values, while f, h and c index exporters, eight-digit HS categories and countries. I, N and X correspond to incumbent,

[39] These figures convert the means noted on the figure into natural log differences, $0.09 * ln(2)$.

[40] It is also possible that incumbents' exports are of higher quality. We discuss evidence for and against this explanation below.

[41] As entry is predominantly due to switching, we do not break this margin down any further.

entering (new exporters plus switchers) and exiting firms.[42] Bars over a variable indicate averages, with $\overline{P}_{hc}$ and $\overline{P}_{hct}$ as defined above. $\overline{\theta}_{hct-1}$ is the mean quantity-based market share across firms in product-country pair hc in year $t-1$, while $\overline{\theta}_{fhc}$ is the average market share of firm f in hc across both years, i.e., $\overline{\theta}_{fhc} = \left(\overline{\theta}_{fhct} + \overline{\theta}_{fhct-1}\right)/2$. $\overline{p}_{fhc}$ is the average price of firm f in product-country hc across years t and $t-1$. Like $\overline{\theta}_{fhc}$, it can be computed only for incumbents.

The first term in square brackets captures the intensive margin. Its "within" component measures the price change of incumbent exporters holding their market share fixed. The second, "across" component accounts for changes in incumbents' market shares, weighting those changes by the difference between the firm's average across-year price and the overall average across-year price. If incumbents' prices fall, the within component is negative. If incumbents' average price across years t and $t-1$ is higher than the overall average price, while at the same time their market shares fall, the across component is also negative. A negative across component indicates that market shares are reallocated away from high-priced incumbents, or, alternatively, that market shares are reallocated towards low-priced incumbents. In this case, the price decline $(p_{fhct} - p_{fcht-1})$ and the market share decline $(\theta_{fhct} - \theta_{fhct-1})$ both contribute to a steeper decline in ΔP_{hct}.

The second term in square brackets captures the entry margin. Its within component compares entrants' prices to the across-year average price $\overline{P}_{hc}$ holding their market share fixed at the previous period's average market share across all firms. The second, across component weights these same price differences according to entrants' relative size upon entry. If entrants have relatively low prices, the first term is negative. If entrants are also relatively small, the second component is positive, so that the effect of entrant's low prices on ΔP_{hct} is mitigated by the fact that they are relatively small. If instead entrants are relatively large, the across component is negative, and the effect of their low prices is amplified by their size. It is important to note that even though the overall market share of entrants may be high because of a large number of entrants, each individual entrant may have a relatively low market share $\left(\theta_{fhct} - \overline{\theta}_{hct-1}\right) < 0$.

The third term in square brackets captures the exit margin and can be interpreted analogously to the entry term. The within component compares exiters' prices to the across-year average holding their market share fixed, while the second component weights these same price differences according to exiter's size relative to the prior year's average. If exiters have relatively high prices, the first term in square brackets is positive. If exiters are relatively small upon exit, the second component is negative, i.e., the influence of the loss of exiters' high prices on ΔP_{hct} is muted. Note that the entire exiter term is *subtracted* from the others: all else equal, if exiters have high prices, they contribute to a decline in ΔP_{hct} , but if their market share upon exit is small, this decline is mitigated.

Table 4 displays a decomposition of MFA-UEC export prices changes between 2004 and 2005 by each component. This table is constructed in two steps. First, we compute each term in equation **??** for each product-country pair. We then take the mean of each of these terms across all product-country pairs in MFA-UEC. The first column reports these average constituents of the overall price change, while the second column reports each average as a percent of the total change listed in the

[42] We do not break entrants into switchers versus new exporters given the relatively small market share of new entrants (see Table **??**).

final row of the first column. That total change, -0.022, corresponds to the 2.2 percent price decline illustrated in the final bar of Figure 7. Here, we drop the same product-country pair outliers as in that figure.

The principal message of Table 4 is that entrants account for the overwhelming majority – 123 percent – of the overall decline in MFA-UEC export prices after the removal of quotas. Incumbents also contribute to this decline, though their contribution, 32 percent, is smaller. Exiters, in contrast, push prices *up*; their contribution is -55 percent. (Recall that the contribution of exiters is *subtracted* from the sum of the contributions of incumbents and entrants, so the negative sign in the penultimate row of the table implies an increase in prices.)

Intuition for these adjustments is found by examining the within and across components of each margin. For the intensive margin, the positive but small within component indicates that incumbents' nominal prices in 2005 are slightly higher than their nominal prices in 2004 when these price changes are given constant weights. The negative across component, however, reveals, intuitively, that incumbents with relatively large price increases lose market share disproportionately. Combined, the within and across components lead to a reduction in overall prices of -0.7 percent.

Changes in market share play a similarly influential role in entry and exit margins. For entrants, we first note that the positive within component reveals that these firms have relatively high prices *vis a vis* the across-year average ($\overline{P}_{hc}$). Though that outcome may appear counter-intuitive, it is an artifact of using nominal price data: with positive inflation, the nominal prices of entrants in 2005 easily may exceed the average price across 2004 and 2005.[43] Given entrants' positive within term, their negative across term must be due to entering firms having on average relatively low market share compared with the 2004 average. As noted in the table, the across term dominates. This dominance reveals, intuitively, that among entrants, those with the lowest prices have disproportionately greater market share.

The exit margin is interpreted analogously. Exiters' relatively high price compared with the across-year mean implies that their negative across term is due to relatively low market share compared with the 2004 average. Here, too, the across term dominates, indicating that among exiters, firms with the lowest prices have the highest market shares. In contrast with the entry margin, however, this pattern contributes to an increase in ΔP_{hc2005} because the exiter components are subtracted from the sum of the incumbent and entrant terms.

One drawback of the decomposition in Table 4 is its use of nominal prices. We overcome this hurdle in Table 5 by presenting a decomposition of MFA-UEC price changes relative to the price changes in OTC-UEC. This "difference-in-difference" comparison helps control for price inflation as well as other factors such as changes in technology, factor input prices and exchange rates that affect the prices of all Chinese textile and clothing products equally. Table 5 is constructed by performing separate decompositions for each group, and then taking the difference between the MFA-UEC and OTC-UEC components term by term.[44] Table 5 further decomposes each margin

[43] The relative ordering of the entrants' and exiters' within terms in Table 4 is the opposite of what is found in Figure 8. This discrepancy between product-country (Table 4) and firm-level (Figure 8) averages is due to entrants with relatively low prices being spread unevenly across product-country groups.

[44] Results for each term separately are reported in the electronic appendix.

by firm ownership; here, too, the sum of the final three columns of the table equals the value in the first column. The top panel reports changes in price, while the bottom panel expresses them as a percent of the overall difference in the two groups' average price changes. As with Table 4, that difference, -0.176, corresponds to the 17.6 percent gap between the 2004 to 2005 MFA-UEC and OTC-UEC price changes displayed in Figure 7. Results in Table 5 drop the same product-country outliers as Table 4.

In contrast with the results in Table 4, all three margins contribute to MFA-UEC *relative* price declines. Two key results stand out in Table 5. First, as above, we find that the extensive margin accounts for a large majority – 76 percent – of the overall decline in MFA-UEC relative prices after quota removal, with 43 due to entrants and 33 percent accounted for by exiters. Incumbents represent the remaining 24 percent. For the incumbent margin, the relative price decline is driven by MFA-UEC incumbents having smaller price increases than OTC-UEC incumbents and the fact that MFA-UEC firms exhibiting the lowest price increases earn relatively more market share than the smaller-price-increase OTC-UEC incumbents.

With respect to the entry margin, Table 5 reveals that MFA-UEC entrants have lower relative prices than their OTC-UEC counterparts. Furthermore, the lower-priced firms among them gain relative more market share than the lower-priced OTC-UEC entrants. Likewise, on the exit margin, the relatively low prices of MFA-UEC versus OTC-UEC exiters is more than offset by the fact that they exit with relatively higher market shares. In both cases, the large negative contribution of the entry and exit margins is indicative of inefficient license allocation.

The second result that stands out in Table 5 relates to firm ownership. We find that just under half (49 percent) of the overall relative price decline is due to SOEs, versus 33 and 18 percent for privately-owned domestic and foreign firms, respectively. Moreover, within ownership types there is substantial variation in the contribution of each margin. For privately owned firms, particularly foreign firms, entrants account for the largest share of price declines. For SOEs, by contrast, exiters play the largest role. This simultaneous entry of low-price private-sector firms and displacement of high-price SOEs are important for understanding the relative price declines.

The statistical significance of the above intensive and extensive margin contributions can be assessed in a series of product-country-level "difference-in-difference" regressions of the form:

$$Z_{hc} = \alpha + \sum_{g} \beta_g 1\{hc \in g\} + \varepsilon_{hc}, \tag{13}$$

where Z represents ΔP_{hct} or one of the incumbent, entrant or exiter terms from equation **??**, and $1\{hc \in g\}$ is a dummy variable indicating whether a particular product-country pair belongs to textile and clothing group $g \in \{\text{MFA-ROW, OTC-UEC, MFA-UEC}\}$. This regression allows us to compare changes in MFA-UEC prices controlling for market and product shocks. For example, the MFA-ROW dummy controls for technology shocks specific to MFA products but neutral with respect to destination. The OTC-UEC dummy, on the other hand, controls for market-specific demand shocks that are common to all textile and clothing products.

Table 6 reports the results of comparing MFA-UEC to the three other textile and clothing groups margin by margin. Each cell of the table contains a p-value from a different comparison

of $\beta_{MFA-UEC}$ to the coefficient for another group, by ownership type and margin. As with the results reported in Table 5, we find that $\beta_{MFA-UEC} < \beta_g$ for all g. As indicated in Table 6, these differences are statistically significant at conventional levels in all but two cases.

The concentration of price declines in the extensive margin demonstrated in this section provides further evidence against efficient allocation of quota prior to 2005. When quotas were removed, MFA-UEC export prices fell 17.6 percent relative to OTC-UEC. According to the model presented in Section 2., any price declines that occur should be due to incumbents, who no longer need to purchase quota licenses and pass these cost savings on to consumers. These declines should manifest in incumbents' "within" components and possibly their "across" components if trade costs are additive (Irrazzabal et al., 2010). While we do find price declines among incumbents, particularly SOEs, price declines due to entry and exit are larger. In contrast with the implications of the model, entrants' lower prices suggests that they are relatively efficient compared to incumbents.

3.5. Productivity

Estimates of Chinese firms' productivity indicate that state-owned enterprises are substantially less efficient than privately owned domestic or foreign firms operating in China. Dollar and Wei (2007) examine Chinese firms from 2002 to 2004 and find that value-added per capital is 50 percent higher for private firms compared to SOEs.

Analysis of the Annual Survey of Industrial Production collected by China's National Bureau of Statistics yields similar estimates. These data combine a census of a non-state-owned firms with more than 5 million yuan in revenue with a census of all state-owned enterprises. Hseih and Klenow (2009) report that revenue-based total factor productivity (TFP) is 41 percent lower for SOEs compared to private firms. Brandt and Zhu (2010) estimate even starker gaps – roughly twice the difference in TFP – between the state and non-state sectors.

While both studies demonstrate that SOEs are substantially less productive than private firms, these studies compute combine productivity estimates across exporting and non-exporting firms. In order to understand aggregate productivity gains in our context, we need to compare exporters to firms solely supplying the domestic market. We use the Annual Survey of Industrial Production to compute labor productivity and TFP for the set of exporting firms that are classified within the textile and clothing industries (industry codes 17 and 18) in 2005. Following Brandt, Van Biesebroeck and Zhang (2009), we estimate TFP using a Tornqvist index number approach:[45]

$$\ln TFP_f = (q_f - \overline{q}) - \widetilde{s}_i(l_f - \overline{l}) - (1 - \widetilde{s}_i)(k_f - \overline{k}), \tag{14}$$

where q, l, and k are in logs and denote value added, wages and fixed assets (net of depreciation) for each firm. The bars denote averages across all firms for each variable. The weight on wages is $\widetilde{s}_i = (s_i + \overline{s})/2$, where s_i is the share of wages in total value added by each firm and $\overline{s}$ is the average across firms. The TFP measure for a given firm is relative to a hypothetical firm with the average output and inputs.

[45] See Van Biesebroeck (2007) for an extensive discussion of various approaches for estimating TFP.

Figure 10 plots the TFP distribution by ownership for these exporting T&C firms. The figure illustrates the large difference in productivity between SOEs and their private-sector counterparts. The average SOE is 0.42 log base two points below the industry mean while privately owned foreign and domestic firms are 24 and 50 points above the mean, respectively.

Table 8 provides a back-of-envelope calculations of the productivity gain following liberalization using the TFP estimates. The first column of the table reports the log TFP estimates. The second column reports the 2004 to 2005 change in market share within MFA-UEC by ownership; these numbers are taken from Table 2. The overall change in aggregate productivity in the bottom of the fourth column is the product of the change in market share and average productivity summed across the three firm types in the rows above. Aggregate TFP increased 14.7 percentage points, with the decline in market share of SOEs accounting for 51 percent (7.5/14.7) of this increase.

To control for other changes that might have occurred in the textile and clothing industry more broadly over this period, we perform a similar exercise for OTC-UEC in the third panel of the table and find that aggregate TFP increases 9.4 percentage points. The difference-in-difference estimate of the productivity gain caused by quota liberalization is therefore 5.3 percentage points $(14.7 - 9.4)$.[46]

These productivity estimates re-inforce the evidence from the price analysis that productivity rose after liberalization. The estimates indicate that SOEs are substantially less efficient than firms in the private sector, and so large reallocation away from SOEs towards the private sector contributed to large aggregate productivity gains.

4. Alternative Explanation: Quality

An alternative interpretation of the decline in export prices following quota removal is quality downgrading. Here, we argue that while quality downgrading may be consistent with our results, it does not overturn the inference of inefficient allocation of quotas prior to their removal.

Recent research has sought to interpret productivity in the Melitz (2003) framework as quality, based on evidence that more productive firms export products at higher, rather than lower, unit values.[47] Under this interpretation, entrants following trade liberalization export lower-quality products. To the extent that the low prices of entrants observed in our data reflect low-quality exports, these entrants maybe be of lower productivity than incumbents and therefore be consistent with the extensive margin adjustment noted in the efficient allocation model. Furthermore, quality downgrading following quota removal receives both theoretical and empirical support in the international trade literature.[48]

[46] We obtain slightly lower difference-in-difference estimates, 3.1 percentage points, using labor productivity (value added per worker), and again, this gain is driven predominantly by the disproportionate decline in market share of the SOEs. However, as noted by Brandt, Van Biesebroeck and Zhang (2009), labor productivity is not a very good estimate of firm productivity in the Chinese context.

[47] See Baldwin and Harrigan (2009), Johnson (2009), Hallak and Sivadasan (2009), Mandel (2010), and Kuger and Verhoogen (2008).

[48] See Falvey (1979), Krishna (1988) and Feenstra (1988) for early theoretical research on this issue, and Aw and Roberts (1985), Feenstra (1988) and Feenstra and Boorstein (1991) for early empirical investigations of quality upgrading in footwear, autos and steel, respectively. Harrigan and Barrows (2009) find evidence of quality downgrading

One piece of evidence against this interpretation is the fact that entrants are predominantly private-sector firms, and that they enter at the expense of SOEs. As we demonstrated earlier, careful estimates of the productivity of firms within China, however, conclude that SOEs are 40 to 80 percent less productive than their private-sector counterparts.

More general models of quality might have high-productivity firms choosing optimally to export low-quality products when quality upgrading is either not very costly and/or has high returns.[49] Existing empirical evidence by Johnson (2010), Khandelwal (2010) and Verhoogen and Kugler (2008) suggests that such an outcome might be prevalent in the apparel industry. The important point here, however, is that if the lower export prices of entrants are driven by high-productivity firms choosing to export low-quality goods, their entrance still implies inefficient allocation of quotas under the MFA/ATC.

We note that while within–product price declines may or may not be consistent with quality downgrading, our results are consistent with an alternative definition of quality downgrading developed by Aw and Roberts (1986) that defines quality upgrading as a shift in consumption from low- to high-priced product categories. The method used to infer such across-product downgrading compares a unit-value index, which uses quantity weights, to an exact price index, which uses value weights. If the unit-value index of a countries' exports increases by more than the exact price index, exports have shifted towards more expensive categories and average quality is said to have risen.[50] This "across-product" evidence of quality downgrading is complementary to any within product quality downgrading that may be occurring if more productive firms choose to export low quality products, or if there is no quality heterogeneity at all.

5. Conclusion

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in the textile and clothing sectors after the end of the MFA/ATC.

[49] See, for example, Baldwin and Harrigan (2009), Johnson (2009) and Kugler and Verhoogen (2008).

[50] Harrigan and Barrows (2009) estimate that the quality of the most restricted of China's textile and clothing exports to the U.S. fell after quotas were removed because U.S. consumers shifted their expenditure to relatively low-priced products.

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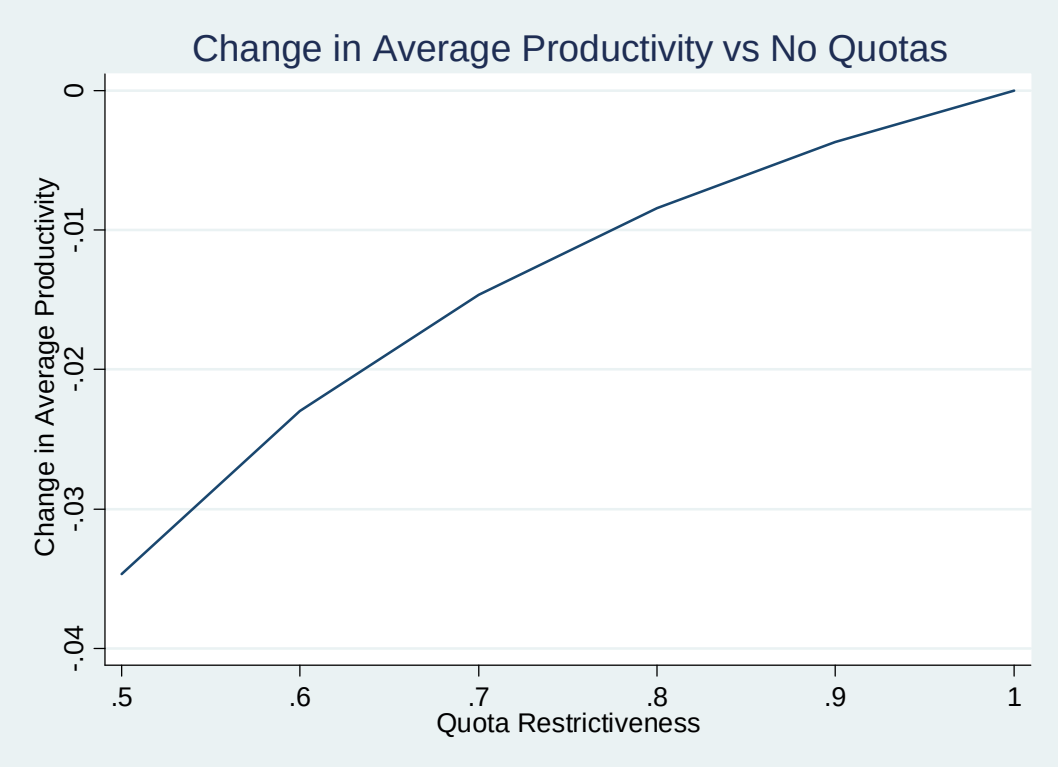

Figure 1: Numerical Solution: Change in Exporters' Average Productivity

	Export Value ($Billion)						
	ROW			US/EU/Can			
	NTC	OTC	MFA	NTC	OTC	MFA	Total
2000	104.8	8.8	27.3	79.5	3.8	7.2	231.4
2001	132.7	8.9	34.3	97.1	3.4	9.4	285.8
2002	153.0	8.9	37.0	112.4	4.1	10.3	325.6
2003	204.7	11.2	46.1	157.3	5.9	13.2	438.5
2004	283.6	13.9	55.8	217.1	7.9	15.3	593.6
2005	383.6	16.6	58.2	279.8	10.6	27.8	776.6
%Growth 2000-5	266	88	113	252	179	287	236
%Growth 2000-4	171	57	104	173	108	113	157
%Growth 2004-5	35	19	4	29	34	82	31
	Number of Firms						
	ROW			US/EU/Can			
	NTC	OTC	MFA	NTC	OTC	MFA	Total
2000	37,500	10,225	11,973	24,044	4,076	4,704	92,522
2001	47,093	11,778	14,878	30,274	4,665	5,763	114,451
2002	61,583	14,447	19,169	39,309	7,239	8,203	149,950
2003	74,926	17,608	23,097	49,049	9,621	10,774	185,075
2004	94,919	22,548	29,216	63,085	12,772	13,646	236,186
2005	112,488	26,287	33,848	77,028	17,397	22,232	289,280
%Growth 2000-5	200	157	183	220	327	373	213
%Growth 2000-4	153	121	144	162	213	190	155
%Growth 2004-5	19	17	16	22	36	63	22

Notes: Panels report annual export value and number of exporters by type of product and destination. NTC, OTC and MFA represent non-textile-and-clothing, other textile and clothing, and quota-constrained textile and clothing goods, respectively (see text). ROW refers to rest of world, while US/EU/Canada refers to exports to one of these three countries. Final rows of each panel report percent growth from 2000 to 2004 and from 2004 to 2005, respectively.

Table 1: Export Value and Number of Exporters, by Product and Destination

	Value Market Share, 2004						
	ROW			US/EU/Can			
	NTC	OTC	MFA	NTC	OTC	MFA	Total
SOE	0.26	0.28	0.32	0.21	0.42	0.51	0.26
Domestic	0.15	0.28	0.32	0.13	0.28	0.27	0.17
Foreign	0.58	0.44	0.35	0.65	0.30	0.22	0.57
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Value Market Share, 2005						
	ROW			US/EU/Can			
	NTC	OTC	MFA	NTC	OTC	MFA	Total
SOE	0.23	0.24	0.27	0.18	0.34	0.38	0.22
Domestic	0.18	0.32	0.38	0.15	0.33	0.33	0.19
Foreign	0.60	0.44	0.35	0.67	0.33	0.29	0.59
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Difference in Value Market Share, 2005						
	ROW			US/EU/Can			
	NTC	OTC	MFA	NTC	OTC	MFA	MFA
SOE	-0.04	-0.04	-0.05	-0.03	-0.09	-0.13	-0.04
Domestic	0.02	0.04	0.06	0.02	0.05	0.07	0.02
Foreign	0.01	0.00	-0.01	0.02	0.04	0.06	0.02

Note: Table reports export-value market share by type of firm, product and destination market in 2004 and 2005, as well as the change in market share between 2004 and 2005.

Table 2: 2004 versus 2005 Export Value Market Shares, by Type of Firm, Product and Destination

Margin of Adjustment	All	SOE	Domestic	Foreign
Incumbents	-0.19	-0.14	-0.03	-0.02
Net Entry				
Exiters	-0.48	-0.29	-0.14	-0.05
Switchers	0.60	0.25	0.23	0.12
New Exporters	0.07	0.00	0.05	0.02
Total Net Entry	0.19	-0.04	0.15	0.08
Total	0.00	-0.18	0.11	0.07

Notes: Table decomposes 2004 to 2005 changes in MFA-UEC export quantity market share by margin of adjustment (see text). Rows 3 to 5 sum to row 6. Final row is sum of rows 1 and 6. First column is sum of remaining columns.

Table 3: Decomposition of 2004 to 2005 Changes in MFA-UEC Market Share

Sources of 2004 to 2005 Price Decline		
Margin	Change	Percent of Total
Incumbent (I)		
Within	0.000	0
Across	-0.007	32
Total	-0.007	32
Entrant (N)		
Within	0.955	-4341
Across	-0.982	4464
Total	-0.027	123
Exiter (X)		
Within	0.305	-1386
Across	-0.317	1441
Total	-0.012	55
Total (I+N-X)	-0.022	100

Notes: Firt column decomposes average 2004 to 2005 change in MFA-UEC export prices by margin of adjustment. Second column reports each change as a percent of the overall change. Overall change is incumbent plus entrant *less* exiter. Results exclude product-country pairs with total price changes below and above the first and ninety-ninth percentiles, respectively.

Table 4: Decomposition of MFA-UEC 2004 to 2005 Export Price Decline

Sources of MFA-UEC Relative Price Declines				
Margin	All	SOE	Domestic	Foreign
Incumbent (I)				
Within	-0.021	-0.011	-0.005	-0.005
Across	-0.021	-0.016	-0.004	-0.001
Total	-0.042	-0.027	-0.009	-0.006
Entrant (N)				
Within	-0.508	-0.040	-0.212	-0.256
Across	0.432	0.016	0.183	0.233
Total	-0.076	-0.024	-0.029	-0.023
Exiter (X)				
Within	-0.271	-0.134	-0.087	-0.050
Across	0.329	0.169	0.107	0.053
Total	0.058	0.035	0.020	0.003
Total (I+N-X)	-0.176	-0.086	-0.058	-0.032
Percent of Total Price Decline				
Margin	All	SOE	Domestic	Foreign
Incumbent (I)				
Within	12	6	3	3
Across	12	9	2	1
Total	24	15	5	3
Entrant (N)				
Within	289	23	120	145
Across	-245	-9	-104	-132
Total	43	14	16	13
Exiter (X)				
Within	154	76	49	28
Across	-187	-96	-61	-30
Total	-33	-20	-11	-2
Total (I+N-X)	100	49	33	18

Notes: Top panel decomposes 2004 to 2005 relative MFA-UEC versus OTC-UEC price changes by margin of adjustment and ownership. Bottom panel reports the contribution of each change as a percent of the overall change, i.e., incumbents plus entrants *less* exiters. Results exclude product-country pairs with total price changes below and above the first and ninety-ninth percentiles, respectively.

Table 5: Decomposition of MFA-UEC vs OTC-UEC Export Price Declines Between 2004 and 2005

	MFA-UEC verus:		
Margin	OTC-ROW	MFA-ROW	OTC-UEC
All Firms			
Total	0.000	0.000	0.000
Incumbent	0.000	0.000	0.000
Entry	0.000	0.000	0.000
Exit	0.000	0.000	0.000
SOEs			
Total	0.000	0.000	0.000
Incumbent	0.000	0.000	0.000
Entry	0.000	0.000	0.001
Exit	0.000	0.000	0.000
Domestic			
Total	0.000	0.000	0.000
Incumbent	0.000	0.000	0.002
Entry	0.000	0.000	0.000
Exit	0.000	0.000	0.000
Foreign			
Total	0.000	0.000	0.000
Incumbent	0.000	0.020	0.092
Entry	0.000	0.000	0.000
Exit	0.000	0.177	0.361

Notes: Table reports p-values indicating whether or not the decompostion term for MFA-UEC is less than the decomposition term for the noted group.

Table 6: Statistical Significance of MFA-UEC Relative Decomposition Terms, By Comparator Group and Margin

2004 to 2005 Change in MFA-ROW Export Value				
Channel	SOE	Domestic	Foreign	Total
Within-Firm	-2.3	0.0	-0.6	-2.9
Across-Firm	-0.1	4.2	1.2	5.2
Total	-2.4	4.2	0.5	2.4
2004 to 2005 Change in MFA-ROW Export Value				
Firm Status	SOE	Domestic	Foreign	Total
Within-Firm	1.9	1.6	1.5	5.1
Across-Firm	0.9	3.5	3.0	7.4
Total	2.8	5.2	4.5	12.5

Notes: Table decomposes 2004 to 2005 MFA-ROW (top panel) and MFA-UEC (bottom panel) export growth from Table 3 according to ownership type and whether or not the growth occurs within firms that export both groups in both years. There are 735, 1191 and 976 firms present in both MFA-UEC and MFA-ROW during both 2004 and 2005 among SOEs and privately owned domestic and foreign firms, respecively.

Table 7: 2005 Export Growth Among Exporters of MFA to Both Destinations in 2004 and 2005

		MFA-UEC		OTC-UEC	
Ownership	TFP	2004-05 Market Share Change	TFP Change	2004-05 Market Share Change	TFP Change
State-Owned Enterprises	-0.42	-18%	0.075	-11%	0.044
Private Enterprises	0.50	11%	0.056	9%	0.046
Foreign Enterprises	0.24	7%	0.016	1%	0.003
Overall			0.147		0.094

Notes: Table decomposes aggregate productivity by ownership for MFA-UEC (panel 2) and OTC-UEC (panel 3). See text for a description of how productivity measures are calculated. The first panel reports average (log) labor productivity and (log) TFP relative to the industry mean. These averages correspond to the averages reported in Figure 10. The 2004-05 changes in market share in the first column of panels 2 and 3 are taken from from Table 2. The second and third columns in panels 2 and 3 multiply the change in market share with the average productivity measure. The final row is the sum of first three rows.

Table 8: Aggregate TFP Gain Following Quota Removal

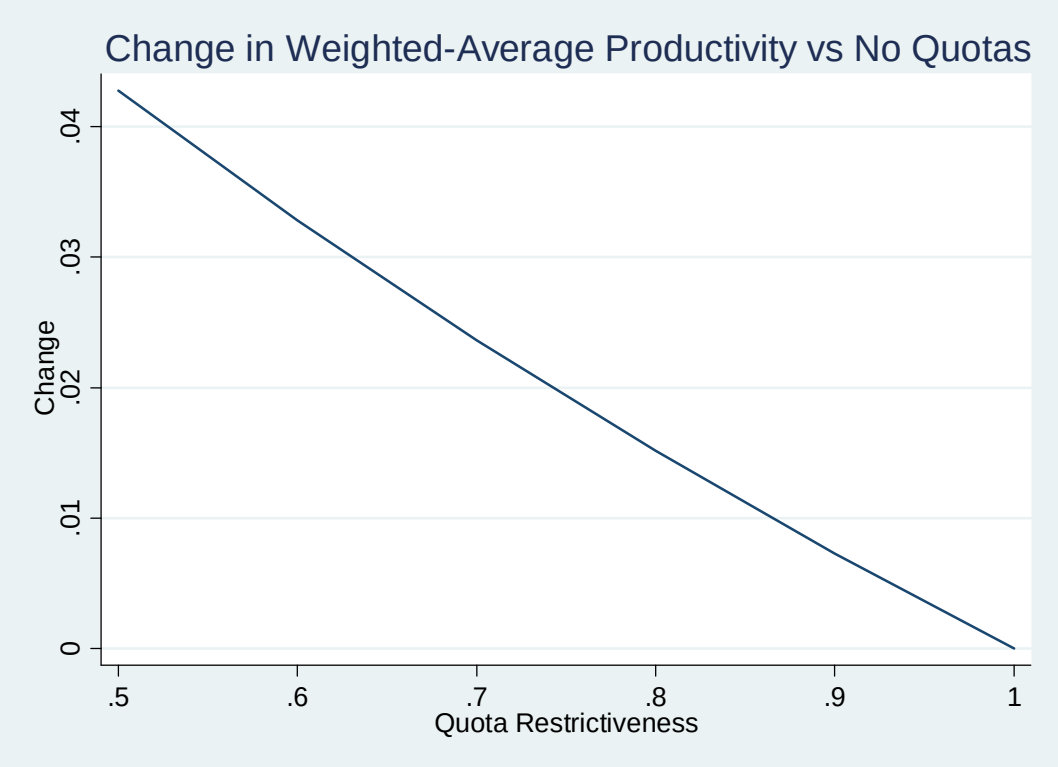

Figure 2: Numerical Solution: Change in Exporters' Quantity-Weighted Average Productivity

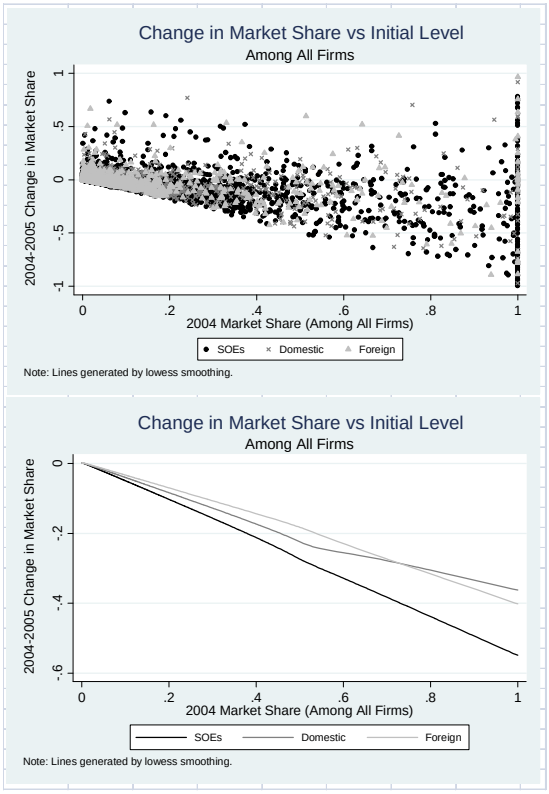

Figure 3: MFA-UEC Incumbents's 2004-5 Change in Market Share vs Initial 2004 Level

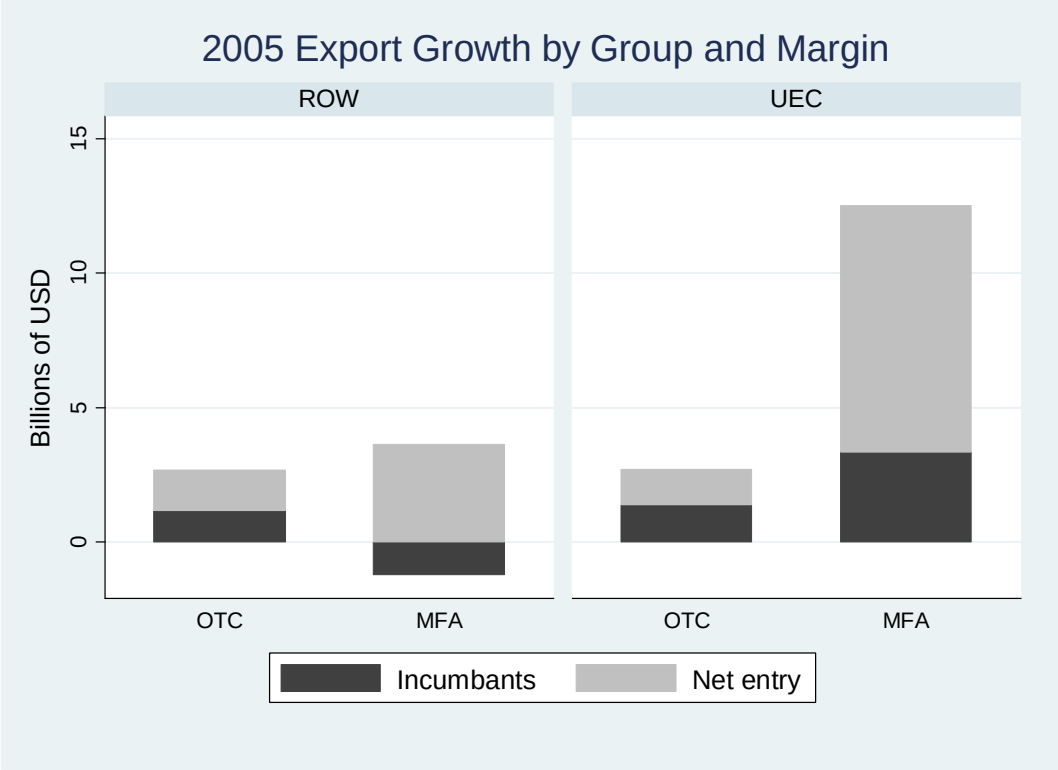

Figure 4: Export Growth by Year, Group and Margin

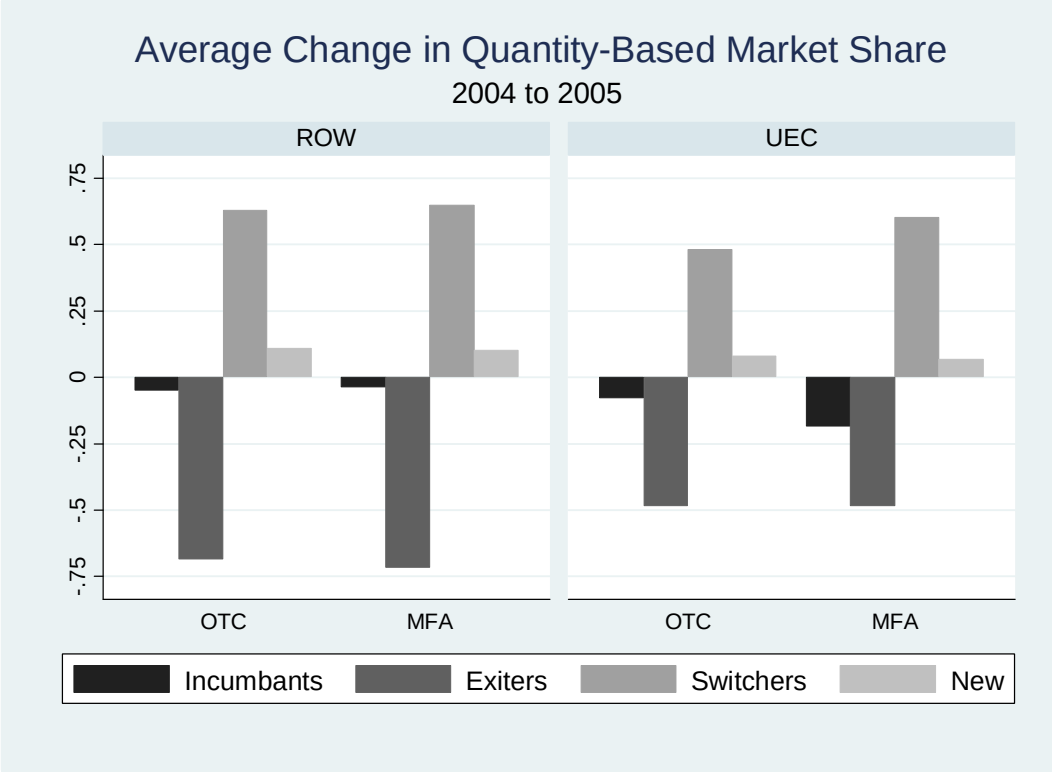

Figure 5: Average 2004 to 2005 Change in Quantity-Based Market Share, by Group and Margin of Adjustment

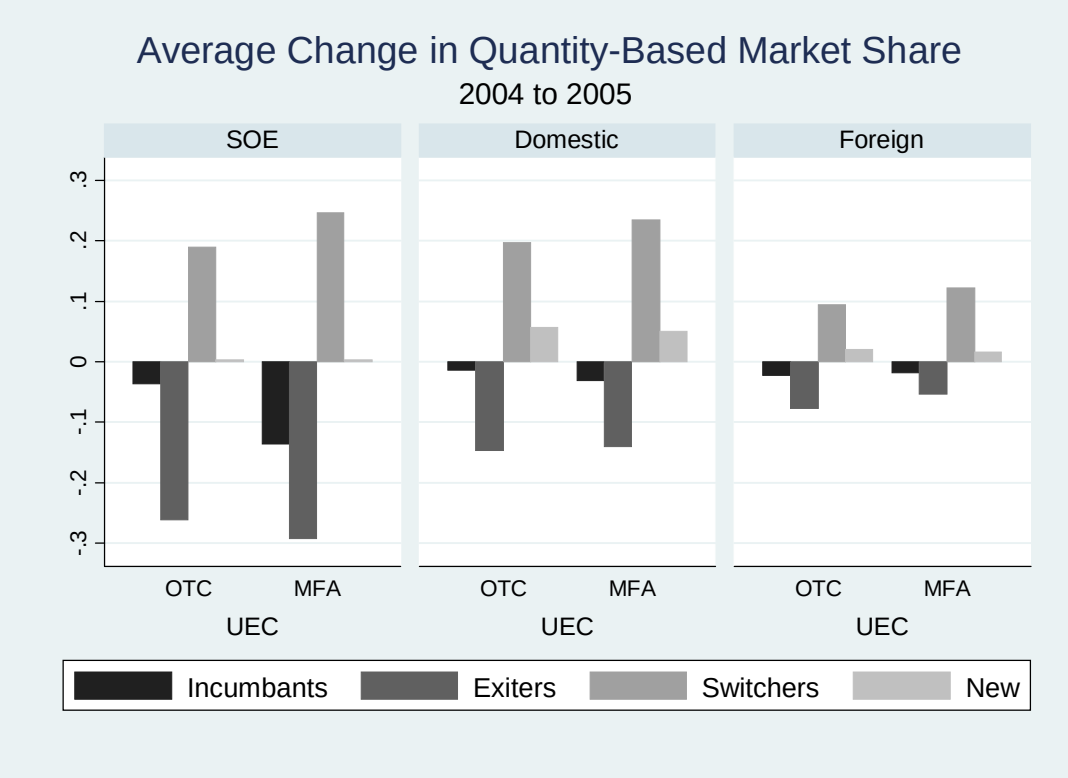

Figure 6: Average 2004 to 2005 Change in Quantity-Based Market Share, by Ownership, Group and Margin of Adjustment

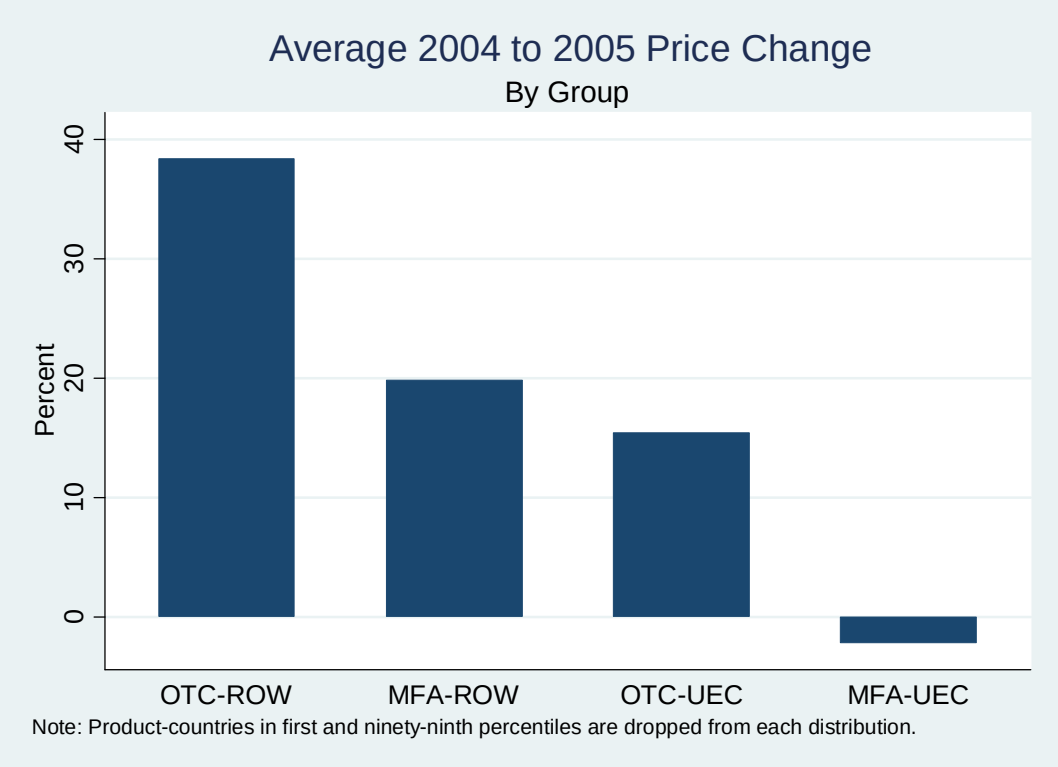

Figure 7: Average Export Price Growth Across Product-Country Pairs, by Group

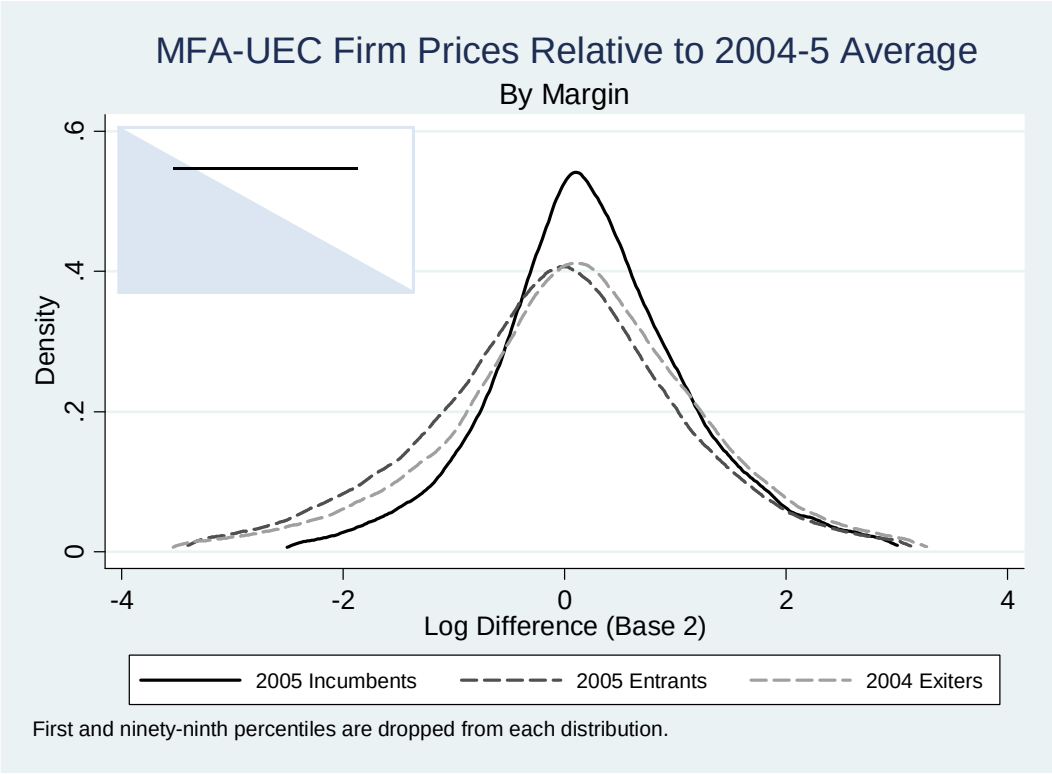

Figure 8: MFA-UEC Export Prices Relative to the Average Export Price Across All Firms in 2004 and 2005 ($\overline{P}_{hc}$), by Margin

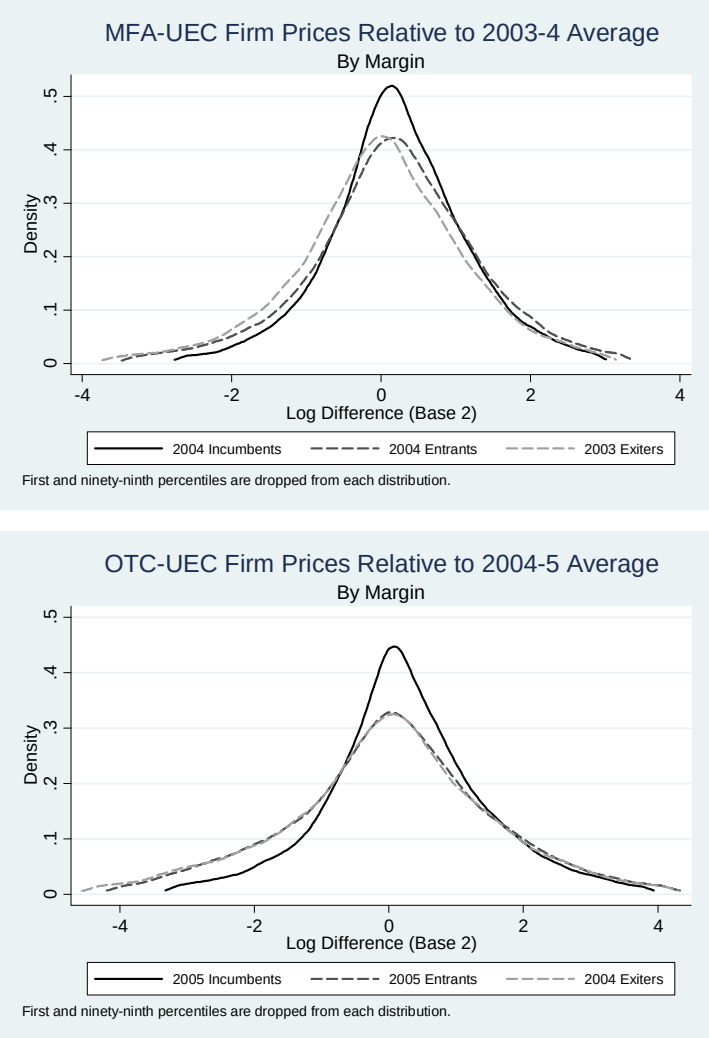

Figure 9: Exiters versus Entrants in 2005 OTC-UEC and 2004 MFA-UEC

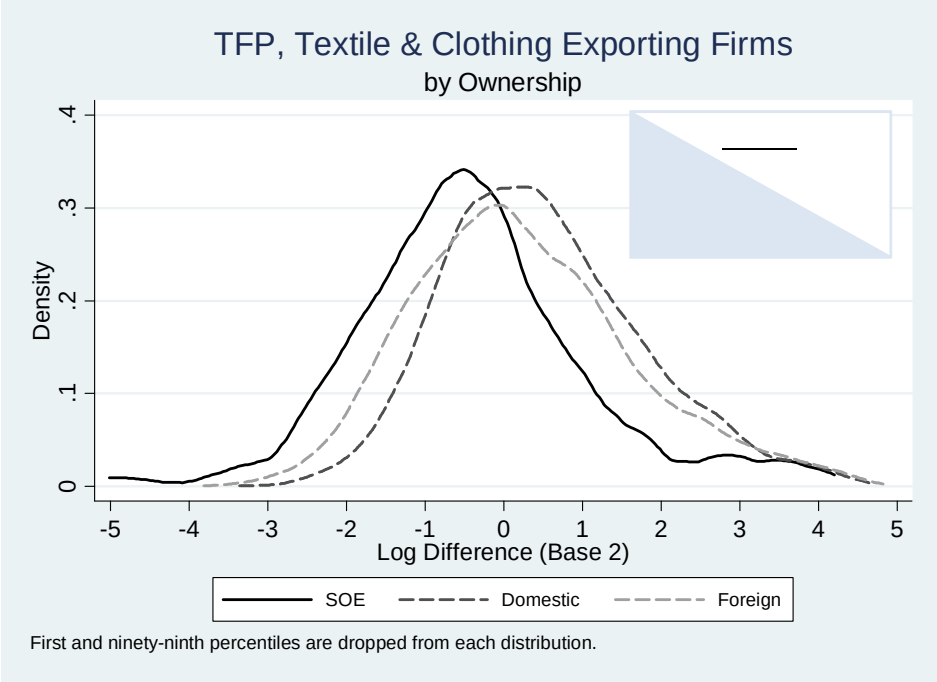

Figure 10: Figure plots total factor productivity across ownership type for textile and apparel firms that export in 2005. See text for details of how TFP is measured.