Assortative Matching of Exporters and Importers*

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Abstract

This paper studies the matching mechanism of exporters and importers in Mexican textile/apparel exports to the US. A surge in Chinese exports to the US after the end of the Multifibre Arrangement in 2005 caused re-matching of incumbent US importers and Mexican exporters according to their pre-liberalization trade volume. We show the re-matching pattern is consistent with a model combining Becker-type positive assortative matching of exporters and importers by their capability with the standard Melitz-type model. The model suggests the observed re-matching brings new gains from trade: trade liberalization improves buyer-supplier matching within industries.

Keywords: Firm heterogeneity, assortative matching, two-sided heterogeneity, trade liberalization

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1 Introduction

Over the past decade, a growing body of research has focused on firms and trade. A robust finding that only firms with high capability (productivity/quality) engage in exporting and importing (e.g. Bernard and Jensen, 1995) has spurred new theories emphasizing new gains from trade (Melitz, 2003; Bernard, Eaton, Jensen, and Kortum, 2003). Trade liberalization shifts resources to more capable firms within industries (e.g., Pavcnik, 2002; Trefler, 2004).[1]

In contrast to our knowledge regarding who exports and imports, we have little known who trades with whom, i.e. how exporters and importers match in a product market. Do exporters and importers match based on their respective capabilities? Does trade liberalization change matching in any systematic way? Does matching matter for the aggregate gains from trade liberalization? This paper is one of the first attempts to answer these questions empirically.

We study matching of Mexican exporters and US importers in textile/apparel product markets. Mexico-US textile/apparel trade is particularly suitable for our purpose. First, Mexico and the US are well integrated in textile/apparel trade. In 2004, the US is the largest market for Mexico, while Mexico is the second largest source for the US.[2] Second, at the disaggregate product (HS 6 digit) level, matching of Mexican exporters and US importers in a given year is approximately one-to-one. "Main-to-main" matches, in which both the exporter and the importer are the main partner of each other, account for 80% of the aggregate trade volume. This allows us to analyze firm's choice of their main partners in a simple one-to-one matching model. Finally, Mexico-US textile/apparel trade experienced a large trade liberalization, the end of the Multifibre Arrangement (MFA). In 2005, the

[1] See survey papers e.g., Bernard, Jensen, Redding, and Schott (2007; 2012) and Redding (2011) for additional papers in the literature.

[2] 91.9 % of Mexican exports are shipped to the US and 9.5% of US imports are from Mexico.

US removed import quota against non-NAFTA countries for some textile/apparel products, which induced the massive entry of Chinese exporters to the US. This arguably exogenous product-level shock to matching of Mexican exporters and US importers helps to identify the matching mechanism.

Our theoretical framework is a model combining a canonical matching model of Becker (1973) with a Melitz-type model of heterogeneous firms. The model has final producers (importers) in the US and suppliers (exporters) in Mexico and China, all of whom are heterogeneous in capability. A final producer and a supplier form a team under perfect information. These teams compete in the US final good market in a monopolistically competitive way. Team members' capabilities exhibit complementarity within teams, so stable matching becomes positively assortative matching (PAM) by capability: high capability exporters match with high capability importers, while low capability exporters match with low capability importers.

Using this model, we analyze the end of the MFA that experienced the entry of Chinese suppliers at various capability levels. This new entry induces existing firms to change partners so that the resulting new matching becomes PAM under the new environment. Final producers switch to partners with higher capability, while suppliers switch to partners with lower capability. Suppliers with the lowest capability exit. This rematching toward PAM leads to an efficient use of technology exhibiting complementarity and lowers the consumer price index. This is a new mechanism of gains from trade: trade liberalization improves buyer-supplier matching within industries.

Then, we empirically analyze the end of the MFA and test the model's predictions on rematching toward PAM. Using firms' pre-MFA trade volumes in 2004 as a proxy for capability, we find three results. First, US importers switched their Mexican main partners to those with higher capability, whereas Mexican suppliers switched their US main partners to those with lower capability. Partner change in the other directions did not occur. Second, Mexican exporters with low capability stop exporting. We identify these results by comparing firms in products subject to US binding quotas on imports from China in 2004 (the treatment group) and those in other textile/apparel products (the control group) within HS 2 digit industries. The treatment group exhibits the above rematching and exit patterns more frequently than the control group. Finally, among firms who switched their main partners, the capability ranks of the new partners are positively correlated with those of the old partners. These three findings support Becker-type PAM. In addition, we present numerous additional analyses supporting the robustness of our results and rejecting alternative explanations.

Our finding supports the matching approach to modeling international trade pioneered by James Rauch and his coauthors. Workhorse trade models such as Ricardian, Heckscher-Ohlin and the love of variety models consider types of trade wherein exporter-importer matching does not play an important role.[3] Rauch (1996), Casella and Rauch (2002), and Rauch and Trindade (2003) develop Becker-type matching models of exporters and importers to emphasize the importance of having right partners for firms and frictions that complicate matching in non-anonymous markets.[4] Our finding provides the first evidence for this approach from actual data on exporter-importer matching.[5]

Our paper is also related to the recent empirical literature on exporter-importer matching. As pioneering studies, Blum, Claro, and Horstmann (2010, 2011) and

[3]In perfectly competitive models such as the Ricardian and Heckscher-Ohlin models, the market is anonymous in the sense that exporters and importers are indifferent regarding who they trade with. The "love of variety" model also avoids positing any specific matching mechanism, instead predicting that all exporters will trade with all importers.

[4]Chaney (2014) and Eaton, Jinkins, Tybout and Xu (2015) present buyer-supplier matching models emphasizing informational frictions.

[5]While in these models firms match based on horizontally differentiated characteristics, we find firms match based on vertically differentiated capability (e.g., Antras, Garicano and Rossi-Hansberg, 2006; Sugita 2015). That is, every exporter prefers to trade with high capability importers, but only high capability exporters can in fact trade with them.

Eaton, Eslava, Jinkins, Krizan, and Tybout (2012) document characteristics of matching in Chile–Colombia trade, Argentina–Chile trade, and Colombia–US trade, respectively. Bernard, Moxnes, and Ulltveit-Moe (2016), Carballo, Ottaviano, and Volpe Martincus (2013), Eaton, Kortum and Kramatz (2016) analyze the Norwegian customs data, the customs data of Costa Rica, Ecuador, and Uruguay, and the French customs data to examine exports from one country to multiple destinations. Benguria (2014) and Dragusanu (2014) find positive correlations for firm-level variables (employment, revenue, etc.) of exporters and importers for France–Colombia trade and India–US trade, respectively. Eaton et al. (2012) and Machiavello (2010) conduct pioneering studies about exporter's partner change in Colombian exports to the US and in Chilean wine exports to the UK, respectively. Monarch (2015) analyzes partner changes in Chinese exports to the US. While these studies consider partner changes in steady state dynamics, we study partner changes caused by trade liberalization. The above-mentioned studies propose different theories to explain their findings, but none of them proposes Becker-type PAM.[6]

The rest of the paper is organized as follows. Section 2 discusses our data and Mexico-US textile/apparel trade. Section 3 presents our model and derives predictions that will be confirmed in later sections. Section 4 explains our empirical strategies. Section 5 presents the main empirical results and robustness checks. Section 6 reports results using alternative capability measures and additional results to reject alternative explanations for our main results. Section 7 concludes the paper. There is an online Appendix that document calculations, proofs, data construction, summary statistics, and additional analyses.

[6]Note that our treatment–control group comparison is silent about whether other mechanisms exist or not. Thus, our finding should be regarded as complement to these studies.

2 Mexico-US Textile Apparel Trade

2.1 Matched Exporter Importer Data

We construct matched exporter–importer data from June 2004 to December 2011 on Mexican textile/apparel exports (from HS50 to HS63) to the US from the Mexican customs data. For each match of a Mexican exporter and a US importer, the dataset contains: (1) exporter-ID; (2) importer-ID; (3) year; (4) the 6 digit HS product code; (5) value of annual shipment (in US dollars); (6) quantity and unit; and (7) an indicator of a duty free processing reexport program (the Maquiladora/IMMEX program); and other information. Appendix explains the construction of the dataset.

Data cleaning drops some information. First, since the dataset covers only from June to December for 2004, we drop observations from January to May for other years to make each year's information comparable. Similar results are obtained with January-to-May data. Second, we drop exporters who do not report importer information for most transactions. These exporters use the Maquiladora/IMMEX program where exporters do not have to report an importer for each shipment.[7] Luckily, a substantial number of Maquiladora/IMMEX exporters do report importer information. To address a potential selection issue, we compare these Maquiladora/IMMEX exporters and other normal exporters in almost all empirical analyses below.

2.2 Approximately One-to-one Matching at Product Level

Table 1 reports mean and median statistics about product-level matching. While Rows (1) and (2) show that an average product has 11–15 exporters and 15–20

[7] The Maquiladoras program started in 1986 and was replaced by the IMMEX (Industria Manufacturera, Maquiladora y de Servicios de Exportation) program in 2006. In the Maquiladoras/IMMEX program, firms in Mexico can import materials and equipments duty free if the firms export products assembled using them. To be eligible for the program, exporters must register the foreign buyers' information in advance but do not need to report it for each shipment.

importers, Rows (3) and (4) show that the majority of firms trade with only one partner.[8] Rows (5) and (6) show that even firms who trade with multiple partner concentrates more than 70% of trade volume with their single main partners, with whom the firms trade most. In sum, most firms conduct most of their trade with only one partner in a given year.

Furthermore, product-level matching of Mexican exporters and US importers is approximately one-to-one. To show this, we develop a new measure "main-to-main share", which expresses the extent to which overall transactions in one product market are quantitatively close to one-to-one matching. We define a "main-to-main match" as a match in which the exporter is the main partner of the importer and simultaneously the importer is the main partner of the exporter. Then, we define "main-to-main share" as the share of trade volume by main-to-main matches out of the total aggregate trade volume. If matching is exactly one-to-one in each product market, this share takes the maximum value, which is one. We call matching is approximately one-to-one if the main-to-main share is close to one.

Column (1) in Table 2 reports that the main-to-main share for Mexico's textile/apparel exports to the US is approximately 80 percent, which is stable across years.[9] This means that a one-to-one matching model is a fair approximation of product-level matching.

Columns (2) to (5) in Table 2 examine whether high main-to-main share is due to unique features of Mexico-US textile/apparel trade. First, the Maquiladora/IMMEX

[8] Numbers in Rows (1) to (4) in Table 1 appear smaller than those in other studies such as Blum et al. (2010, 2011), Bernard et al. (2013), and Carballo et al. (2013). This is probably because they report matches at the country level in their main tables, while we report matches at the product–country level, which identifies fewer partners for firms trading multiple products. When a match is defined at the country level, the numbers in Rows (1) to (4) in Table 1 increase and become similar to other studies.

[9] In Appendix, we investigate the distribution of main-to-main shares across product-year combinations. The median main-to-main share is 0.97 and the 25 percentile is 0.86. Furthermore, we find high main-to-main share is not related with the number of firms in each product.

program for processing reexports requires the registration of importers in advance and these registration costs might lead firms to trade with only a small number of partners. However, the main-to-main shares are very similar between Maquiladora/IMMEX trade in Column (2) and other normal trade in Column (3), respectively.[10] Second, in 2005 the US removed import quota on textile/apparel imports from countries outside the NAFTA, notably China. Main-to-main shares for products for which quota on Chinese products was binding in 2004 in Column (4) is very similar to those of other textile/apparel products in Column (5). Thus, neither high trade barriers nor their removal is likely to cause high main-to-main shares.[11]

2.3 End of the Multifibre Arrangement

The Mexico-US textile/apparel trade experienced a large scale trade liberalization in 2005, the end of the Multifibre Arrangement (MFA). The MFA and its successor, the Agreement on Textile and Clothing, are agreements on quota restrictions regarding textile/apparel imports among GATT/WTO member countries. At the GATT Uruguay round, the US (together with Canada, the EU, and Norway) promised to abolish their quotas in four steps (1995, 1998, 2002, and 2005). At each removal, liberalized products constituted 16, 17, 18, and 49% of imports in 1990, respectively. The end of the MFA in 2005 is the largest liberalization.

There are several studies on the impact of the 2005 quota removal. We highlight three facts from previous studies.

[10] To calculate columns (2) and (3), we treat Maquiladora/IMMEX trade and other normal trade in a given HS 6 digit product as two different products. This means that numbers in column (1) does not necessarily fall between numbers in columns (2) and (3).

[11] One potential reason for one-to-one matching might be exclusive dealing. A firm might not allow the partner to trade with other rivals to prevent information leakage or to raise rival's costs through vertical foreclosure.

Surge in Chinese Exports to the US According to Brambilla, Khandelwal, and Schott (2010), US imports from China disproportionally increased by 271% in 2005, whereas imports from almost all other countries decreased. Following Brambilla et al. (2010), we classify each HS-10 digit textile/apparel product in two groups. The first "treatment group" consists of products for which Chinese exports to the US are subject to binding quota in 2004, while the second "control group" consists of other textile/apparel products. The left panel in Figure 1 displays Chinese exports to the US from 2000 to 2010 for the treatment group with a dashed line and the control group with a solid line. After the 2005 quota removal, Chinese exports of the treatment group increased much faster than the control group.[12]

Exports by New Chinese Entrants with Various Capability Levels Using Chinese customs transaction data, Khandelwal, Schott, and Wei (2013) decompose the increases in Chinese exports to US, Canada, and the EU after the quota removal into intensive and extensive margins. They find that increases in Chinese exports of the treatment group were mostly driven by the entry of Chinese exporters who had not previously exported these products. Furthermore, these new exporters are much more heterogeneous in capability than incumbent exporters, with many new exporters being more capable than incumbent exporters.[13]

Mexican Exports Face Competition from China Mexico already had tariff- and quota-free access to the US market through the North American Free Trade Agree-

[12]Seeing this substantial surge in import growth, the US and China had agreed to impose new quotas until 2008, but imports from China never dropped back to the pre-2005 levels. This is because (1) new quota system covered fewer product categories than the old system (Dayaranta-Banda and Whalley, 2007), and (2) the new quotas levels were substantially greater than the MFA levels (see Table 2 in Brambilla et al., 2010).

[13]Khandelwal et al. (2013) find that incumbent exporters are mainly state-owned firms and new exporters include private and foreign firms, which are typically more productive than state-owned firms. In addition, the distribution of unit prices for new entrants has a lower mean but a greater support than that of unit prices of incumbent exporters.

ment (NAFTA).[14] With the MFA's end, Mexico lost its advantage to third-country exporters, thus facing increased competition with Chinese exporters in the US market. The right panel in Figure 1 shows Mexican exports to the US from 2000 to 2010 for the treatment group (dashed line) and for the control group (solid line). The two series had moved in parallel before 2005, whereas the treatment group significantly declined after 2005. The parallel movement of the two series before 2005 suggests that the choice of products for quota removal in 2005 was exogenous to Mexican exports to the US.

3 The Model

3.1 A Matching Model of Exporters and Importers

Based on those facts presented in Section 2, we develop a matching model of importers and exporters. The model includes three types of continuum of firms, namely, US final producers, Mexican suppliers, and Chinese suppliers.[15] A US final producer matches with a supplier from either Mexico or China to form a team that produces one variety of differentiated final goods. Once teams are formed, suppliers tailor intermediate goods for their teams; therefore, firms transact intermediate goods only within their team. Each firm joins only one team.

Firms' capabilities are heterogeneous. Capability reflects either productivity or quality. Let x and y be the capability of final producers and suppliers, respectively. There exist a fixed mass M_U of final producers in the US, M_M of suppliers in Mexico, and M_C of suppliers in China. The cumulative distribution function (c.d.f.) for

[14]The NAFTA liberalized the US market to Mexican exports in 1994, 1999, and 2003.

[15]Our model is a partial equilibrium version of Sugita (2015) wherein firm entry is endogenous and international matching arises from Ricardian comparative advantage in a two-country general equilibrium model.

the capability of US final producers is $F(x)$ with continuous support $[x_{min}, x_{max}]$. The capability of Mexican and Chinese suppliers follows an identical distribution, and the c.d.f. is $G(y)$ with continuous support $[y_{min}, y_{max}]$.[16] For simplicity, a Chinese supplier is a perfect substitute for a Mexican supplier of the same capability.

Teams' capabilities are heterogeneous. Team capability $\theta(x, y)$ increases members' capability, $\theta_1 \equiv \partial\theta(x, y)/\partial x > 0$ and $\theta_2 \equiv \partial\theta(x, y)/\partial y > 0$. The model has two stages. In Stage 1, teams are formed under perfect information. Matching endogenously determines the distribution of θ. In Stage 2, teams compete in the US final good market in a monopolistically competitive fashion.

The US representative consumer maximizes the following utility function:

$$U = \frac{\delta}{\rho}\ln\left[\int_{\omega\in\Omega}\theta(\omega)^{\alpha}q(\omega)^{\rho}d\omega\right] + q_0 \text{ s.t. } \int_{\omega\in\Omega}p(\omega)q(\omega)d\omega + q_0 = I.$$

where Ω is a set of available differentiated final goods, ω is a variety of differentiated final goods, $p(\omega)$ is the price of ω, $q(\omega)$ is the consumption of ω, $\theta(\omega)$ is the capability of a team producing ω, q_0 is consumption of a numeraire good, I is an exogenously given income. $\alpha \geq 0$ and $\delta > 0$ are given parameters. Consumer demand for a variety with price p and capability θ is derived as $q(p, \theta) = \delta\theta^{\alpha\sigma}P^{\sigma-1}p^{-\sigma}$, where $\sigma \equiv 1/(1-\rho) > 1$ is the elasticity of substitution and $P \equiv \left[\int_{\omega\in\Omega}p(\omega)^{1-\sigma}\theta(\omega)^{\alpha\sigma}d\omega\right]^{1/(1-\sigma)}$ is the price index.

Production technology is of Leontief type. When a team produces q units of final goods, the team supplier produces q units of intermediate goods with costs $c_y\theta^{\beta}q + f_y$; then, using them, the final producer assembles these goods into final goods with costs $c_x\theta^{\beta}q + f_x$, where c_i and f_i are positive constant ($i = x, y$). The total costs for a team with capability θ producing q units of final goods are

[16] An identical capability distribution of Chinese and Mexican suppliers is assumed for the graphical exposition and not essential for the main predictions.

$c(\theta, q) = c\theta^{\beta}q + f$, where $c \equiv c_x + c_y$ and $f \equiv f_x + f_y$. Externality within teams makes firms' marginal costs to depend on their partner's capability and their own capability.[17] For simplicity, we assume firm's marginal costs depend on the team's capability.

Team capability θ may represent productivity and/or quality, depending on parameters α and β. For instance, when $\alpha = 0$ and $\beta < 0$, all teams face symmetric demand and high θ implies lower marginal costs. In this case, θ represents productivity (e.g. Melitz, 2003). When $\alpha > 0$ and $\beta > 0$, a team with high θ faces a large demand at a given price and simultaneously pays high marginal costs. In this case, θ may be called quality (e.g. Baldwin and Harrigan, 2011; Johnson, 2012; Verhoogen, 2008).

Backward induction obtains an equilibrium (see Appendix for calculations).

Stage 2 Team's optimal price is $p(\theta) = c\theta^{\beta}/\rho$. Hence, a team revenue $R(\theta)$, total costs $C(\theta)$, and joint profits $\Pi(\theta)$ are

$$R(\theta) = \sigma A\theta^{\gamma}, \ C(\theta) = (\sigma - 1) A\theta^{\gamma} + f, \text{ and } \Pi(\theta) = A\theta^{\gamma} - f. \quad (1)$$

where $A \equiv \frac{\delta}{\sigma}\left(\frac{\rho P}{c}\right)^{\sigma-1}$ summarizes factors that (infinitesimal) individual teams take as given. We assume $\gamma \equiv \alpha\sigma - \beta(\sigma - 1) > 0$ so that team profits increase in team capability. Furthermore, we normalize $\gamma = 1$ by choosing the unit of θ as comparative statics on α, β, and σ is not our main interest. Let M and $H(\theta)$ be the mass and capability distribution of active teams. The consumer price index $P = c/\left(\rho\Theta^{1/(\sigma-1)}\right)$ turns to be decreasing in the aggregate capability of active

[17] An example of a within-team externality is costs of quality control. Producing high quality final goods might require extra costs of quality control at each production stage because even one defective component can destroy the whole product (Kremer, 1993). Another example is productivity spillovers. Through teaching and learning (e.g. joint R&D) within a team, each member's marginal cost depends on the entire team capability.

teams $\Theta \equiv M \int \theta dH(\theta)$.

Stage 1 Firms choose their partners and decide how to split team profits, taking A as given. Profit schedules, $\pi_x(x)$ and $\pi_y(y)$, and matching functions, $m_x(x)$ and $m_y(y)$, characterize equilibrium matching. A final producer with capability x matches with a supplier having capability $m_x(x)$ and receives the residual profit $\pi_x(x)$ after paying profits $\pi_y(m_x(x))$ to the partner. Let $m_y(y)$ be the inverse function of $m_x(x)$ where $m_x(m_y(y)) = y$.

We focus on stable matching that satisfies the following two conditions: (i) *individual rationality*, wherein all firms earn non-negative profit, $\pi_x(x) \geq 0$ and $\pi_y(y) \geq 0$ for all x and y; (ii) *pair-wise stability*, wherein each firm is the optimal partner for the other team member:[18]

$$\pi_x(x) = A\theta(x, m_x(x)) - \pi_y(m_x(x)) - f = \max_y A\theta(x, y) - \pi_y(y) - f;$$
$$\pi_y(y) = A\theta(m_y(y), y) - \pi_x(m_y(y)) - f = \max_x A\theta(x, y) - \pi_x(x) - f. \tag{2}$$

The first order conditions for the maximization in (2) are

$$\pi_y'(m_x(x)) = A\theta_2(x, m_x(x)) > 0 \text{ and } \pi_x'(m_y(y)) = A\theta_1(m_y(y), y) > 0, \tag{3}$$

which proves that profit schedules are increasing in capability. Thus, capability cut-offs x_L and y_L exist such that only final producers with $x \geq x_L$ and suppliers with $y \geq y_L$ engage in international trade. These cut-offs satisfy

$$\pi_x(x_L) = \pi_y(y_L) = 0 \text{ and } M_U[1 - F(x_L)] = (M_M + M_C)[1 - G(y_L)]. \tag{4}$$

The second condition in (4) indicates that the number of suppliers in the matching

[18]Roth and Sotomayor (1990) is an excellent textbook of matching models.

market is equal to the number of final producers.

Differentiating the first order condition (3) by x, we obtain

$$m_x'(x) = \frac{A\theta_{12}}{\pi_y'' - A\theta_{22}}, \text{ where } \theta_{12} \equiv \frac{\partial^2\theta}{\partial x \partial y} \text{ and } \theta_{22} \equiv \frac{\partial^2\theta}{\partial y^2}.$$

Since the denominator is positive from the second order condition, the sign of cross derivatives θ_{12} is the same as the sign of $m_x'(x)$, i.e. the sign of sorting in stable matching (e.g. Becker, 1973). For simplicity, we consider three cases where the sign of θ_{12} is constant for all x and y: (1) Case C (Complement) $\theta_{12} > 0$; (2) Case I (Independent) $\theta_{12} = 0$; (3) Case S (Substitute) $\theta_{12} < 0$.[19] In Case C, we have positive assortative matching (PAM) ($m_x'(x) > 0$): high capability firms match with high capability firms whereas low capability firms match low capability firms. In Case S, we have negative assortative matching (NAM) ($m_x'(x) < 0$): high capability firms match low capability firms. In Case I, we cannot determine a matching pattern (i.e. $m_x(x)$ cannot be defined as a function) because each firm is indifferent about partner's capability. Therefore, we assume matching is random in Case I. Case I is a useful benchmark because it nests traditional models where firm heterogeneity exists only in one side of the market, i.e. either among exporters ($\theta_1 = \theta_{12} = 0$) or among importers ($\theta_2 = \theta_{12} = 0$). We focus on Case C and Case I in the main text of the paper and discuss Case S in Section 6 and Appendix.

In Case C, the matching function $m_x(x)$ satisfies the "matching market clear-

[19] In Case C and Case S, θ is also called strict supermodular and strict submodular, respectively. An example for Case C is the complementarity of quality of tasks in a production process (e.g. Kremer, 1993). For instance, a high-quality car part is more useful when combined with other high-quality car parts. An example for Case S is technological spillovers through learning and teaching. Gains from learning from high capable partners might be greater for low capability firms. See e.g. Grossman and Maggi (2000) for further examples on Case C and Case S.

ing" condition:

$$M_U\left[1-F(x)\right]=\left(M_M+M_C\right)\left[1-G\left(m_x(x)\right)\right] \text{ for all } x\geq x_L. \tag{5}$$

The left hand side of (5) is the mass of final producers with higher capability than x and the right hand side is the mass of suppliers who match with them, i.e. suppliers with higher capability than $m_x\left(x\right)$. Figure 2 describes how matching function $m_x(x)$ is determined for a given $x\geq x_L$. The width of the left rectangle equals the mass of US final producers, whereas the width of the right rectangle equals the mass of Mexican and Chinese suppliers. The left vertical axis expresses the value of $F(x)$ and the right vertical axis does the value of $G(y)$. The left gray area is the mass of final producers with higher capability than x and the right gray area is the mass of suppliers with higher capability than $m_x(x)$. Matching function $m_x(x)$ is determined so that the two areas have the same size for all $x\geq x_L$.

An equilibrium is obtained as follows. In both Case C and Case I, the team with the lowest capability θ_L consists of a final producer with x_L and a supplier with y_L. From (1), (4) and $A=\delta/\sigma\Theta$, the team earns zero profits:

$$A\theta_L=\frac{\delta\theta_L}{\sigma\Theta}=f. \tag{6}$$

In Case C, matching function $m_x(x)$ determines $\Theta\left(x_L\right)=M_U\int_{x_L}^{\infty}\theta\left(x,m_x(x)\right)dF(x)$ and $\theta_L\left(x_L\right)=\theta\left(x,m_x(x_L)\right)$ as functions of x_L. In Case I, Condition (4) determines $y_L(x_L)$ as a function of x_L. Let $\theta(x,y)\equiv\theta^x(x)+\theta^y(y)$. Then, $\Theta\left(x_L\right)=M_U\int_{x_L}^{\infty}\theta^x\left(x\right)dF(x)+\left(M_M+M_C\right)\int_{y_L(x_L)}^{\infty}\theta^y(y)dG(y)$ and $\theta_L(x_L)=\theta^x\left(x_L\right)+\theta^y\left(y_L(x_L)\right)$ become functions of x_L. Finally, equation (6) determines a unique x_L since $\Theta\left(x_L\right)$ is decreasing and $\theta_L(x_L)$ is increasing in x_L.

3.2 Consequences of Chinese Entries at the end of the MFA

We analyze the impact of Chinese entries at the end of the MFA (the MFA end) on matching between US importers and Mexican exporters. As discussed in section 2.3, new entrants are heterogeneous in capability. Thus, we model this event as an exogenous increase in the mass of Chinese suppliers ($dM_C > 0$) in the US market. We assume positive but negligible costs for switching partners so that a firm changes its partner only if it strictly prefers the new match over the current match.

Case C Figure 3 shows how matching functions change from $m_x^0(x)$ to $m_x^1(x)$ for given capability x. Area A expresses US importers with capabilities higher than x. They initially match with suppliers in areas $B + C$ who have higher capability than $m_x^0(x)$. When new Chinese exporters enter, the original matches become unstable because they are not PAM under the new environment. Some US importers are willing to switch their partners to the new entrants. In the new matching, final producers in area A match with suppliers in areas $B + D$ who have higher capability than $m_x^1(x)$. A US final producer with a capability x switches its main partner from the one with capability $m_x^0(x)$ to the one with the higher capability $m_x^1(x)$. We call this change "partner upgrading" by US final producers. This in turn implies "partner downgrading" by Mexican suppliers. Mexican suppliers with capability $m_x^1(x)$ used to match with final producer with strictly higher capability than x prior to the entry of Chinese suppliers. Finally, not all Mexican suppliers can match with new US partners. Mexican suppliers with low capability must exit from the US market, which is formally proved in Appendix.

Our data on Mexico-US trade only record rematching by firms engaging in Mexico-US trade both before and after the MFA end. We call these firms *US continuing importers* and *Mexican continuing exporters*. Then, we obtain three predictions for Case C.

C1 US continuing importers switch their Mexican partners to those with higher capability (partner upgrading), while Mexican continuing exporters switch their US partners to those with lower capability (partner downgrading).

C2 PAM hold both before and after the MFA end.

C3 Mexican exporters with low capability exit from the US market.

Case I The entry of Chinese suppliers also raises the capability cutoff y_L for suppliers and low capability suppliers exit, which is proved in Appendix. US importers who matched with these exiting suppliers switch to new Chinese suppliers. Other firms continue to match with their old partners, though they change price and quantity. In Case I, firms are indifferent about their partners as long as they have higher capability than the cutoffs. Then, we obtain three predictions for Case I.

I1 US continuing importers do not change their Mexican partners, while Mexican continuing exporters do not change their US partners.

I2 Matching is random before and after the MFA end.

I3 Mexican exporters with low capability exit from the US market.

Rematching Gain from Trade The entry of Chinese exporters causes two adjustments. First, new Chinese suppliers with high capability replace Mexican suppliers with low capability (the replacement effect). Second, in Case C, continuing firms re-match (the rematching effect). We show each of these two adjustments lowers the price index and benefits the consumer.

To see each adjustment, we consider a hypothetical "no-rematching" equilibrium where no rematching occurs among continuing firms and firms switch their partners only if their partners exit from the market. Label variables in this no-rematching equilibrium by "NR", variables before the MFA end by "B", and variables after the MFA end by "A". Then, the change in the price index $P^B - P^A$ can be decomposed into the replacement effect $P^B - P^{NR}$ and the rematching effect $P^{NR} - P^A$. The following lemma compares the price index across these three environments.

Lemma 1. *In Case C, $P^A < P^{NR} < P^B$, while in Case I, $P^A = P^{NR} < P^B$.*

The proof is given in Appendix. In Case C, the rematching effect is positive, that is, the rematching creates an additional consumer gain. From $P = c/\left(\rho\Theta^{1/(\sigma-1)}\right)$, these falls in the price index reflect increases in the aggregate capability, i.e. $\Theta^A > \Theta^{NR} > \Theta^B$. The reason for the aggregate capability gains is from a classic theorem in the matching theory that a stable matching (i.e. PAM) maximizes the aggregate payoffs of the participants (i.e. $A\Theta - Mf$ for given A) (Koopmans and Beckmann, 1957; Shapley and Shubik, 1972; Gretsky, Ostroy and Zame, 1992). In Case I, the rematching effect is zero because matching is irrelevant in Case I. The rest of the paper identifies this rematching in data.

4 Empirical Strategies

4.1 Proxy for Capability Rankings

To test predictions C1-C3 and I1-I3 need data on firm capability. Estimating capability measures such as total factor productivity (TFP) at the firm-product level is one strategy, but it is extremely difficult. Instead, we use firm's trade volume as a proxy for firm capability, using a property of the model in Case C and Case I.

Trade volume within a match $T(x, y)$ is equal to supplier's costs plus supplier's profit: $T(x, y) = \left[\frac{c_y}{c}\{C(\theta(x, y)) - f\} + f_y\right] + \pi_y(y)$. From $C'(\theta) > 0$ from (1), both $\partial T(x,y)/\partial x$ and $\partial T(x,y)/\partial y$ are positive. In Case C, from $m'_x(x) > 0$ and $m'_y(y) > 0$, both import volumes by US importers $I(x) = T(x, m_x(x))$ and export volumes by Mexican suppliers $X(y) = T(m_y(y), y)$ increase in their own capabilities, respectively. In Case I, expected import volumes by US importers, $\bar{I}(x) = [1 - G(y_L)]^{-1} \int_{y_L}^{y_{max}} T(x,y)dG(y)$, and expected export volumes by Mexican exporters, $\bar{X}(y) = [1 - G(x_L)]^{-1} \int_{x_L}^{x_{max}} T(x,y)\, dF(x)$, both increase in their own capabilities.

For each product we create a ranking of US continuing importers by their imports from their main partner in 2004 before the MFA end. From the monotonicity of import volumes and capability ($I'(x) > 0$), this ranking should agree with the true capability ranking in Case C and on average so in Case I. Similarly, for each product we rank Mexican continuing exporters by their exports to their main partner in 2004, which should also agree with the true capability ranking in Case C and on average in Case I. We use the rank measured from 2004 data for the same firm throughout our sample period, assuming that the capability ranking is stable in a short run.

Using these rankings, we create three variables: firm i's own rank in product g in country c, $OwnRank_{ig}^c$; the rank of the firm's main partner of product g in 2004 before the MFA, $OldPartnerRank_{ig}^c$; and the rank of the firm's main partner of product g in 2007 after the MFA end, $NewPartnerRank_{ig}^c$.[20] Note that $OldPartnerRank_{ig}^c$ differs from $NewPartnerRank_{ig}^c$ if and only if the firm switches the main partner during 2004-07. These ranks are standardized using the number of firms so as to fall in [0,1]. Smaller ranks indicate higher capability.

Then, we create variables of partner changes as follows. Partner upgrading dummy Up_{igs}^c equals one if $NewPartnerRank_{igs} < OldPartnerRank_{igs}$, i.e. the

[20] We choose the period of 2004-07 because the 2008 Lehman crisis, which greatly reduced Mexican exports to the US, potentially confounds the impact of the MFA end.

firm switched to a partner with higher capability. Partner downgrading dummy $Down^c_{igs}$ equals one if $NewPartnerRank_{igs} > OldPartnerRank_{igs}$.

4.2 Specifications

Partner Changes (C1 and I1) We estimate the following regressions to test predictions C1 and I1 on partner changes:

$$\begin{aligned} Up^c_{igs} &= \beta^c_U Binding_{gs} + \lambda_s + \varepsilon^c_{Uigs} \\ Down^c_{igs} &= \beta^c_D Binding_{gs} + \lambda_s + \varepsilon^c_{Digs}, \end{aligned} \tag{7}$$

where c, i, g, and s index a country (US and Mexico), a firm, a HS6 digit product, and a sector (HS2 digit level), respectively. Dummy variable $Binding_{gs}$ equals one if Chinese exports of product g to the US faced a binding quota in 2004, which is constructed from Brambilla et al. (2010). λ_s represents HS-2 digit-level sector fixed effects.[21] u^c_{igs} and ε^c_{ijs} are error terms. Appendix explains the construction of the binding dummy and other variables.

The coefficients of interest in (7) are β^c_U and β^c_D. With HS-2 digit product fixed effects, these coefficients are identified by comparing the treatment and control groups within the same HS-2 digit sectors. The treatment is the removal of binding quotas on Chinese exports to the US ($Binding_{gs} = 1$). The coefficients β^c_U and β^c_D estimate its impact on the probability that firms will switch their main partner to ones with higher and lower capabilities, respectively.

Prediction I1 for random matching states that in response to the MFA end, continuing US importers and Mexican exporters would not change their partners. In reality, other shocks inducing partner changes may exist. A virtue of our treatment-

[21]We drop HS 2 sectors (HS 50, 51, 53, 56, 57, and 59) in which there is no variation of the binding dummy at HS 2 digit level.

control group comparison is that we can distinguish the effect of the MFA end from the effects of these other shocks if the latter symmetrically affected both groups. Considering this point, we reformulate prediction I1: no difference should exist in the probability of partner changes in any direction between treatment and control groups. This prediction corresponds to $\beta_U^{US} = \beta_D^{US} = \beta_U^{Mex} = \beta_D^{Mex} = 0$ in (7).

Prediction C1 for PAM states that in response to the MFA end, all continuing US importers upgrade whereas all continuing Mexican exporters downgrade their main partners. Though the frictionless matching model predicts all firms will change their partners, in reality, other factors such as transaction costs are likely to prevent some firms from changing partners, at least in the short run. Again, our treatment-control group comparison can control for these other factors as long as they symmetrically affect both groups. Accordingly, we reformulate prediction C1: US importers' partner upgrading and Mexican exporters' partner downgrading will occur more frequently in the treatment group than in the control group. This prediction corresponds to $\beta_U^{US} > 0$, $\beta_D^{US} = \beta_U^{Mex} = 0$, and $\beta_D^{Mex} > 0$ in (7).

Old and New Partner Ranks (C2 and I2) To test predictions C2 and I2, we estimate the following regression for firms who switched partners during 2004-07:

$$NewPartnerRank_{ig}^c = \alpha^c + \gamma^c OldPartnerRank_{ig}^c + \varepsilon_{ig}^c \quad (8)$$

$$\text{for firms with } NewPartnerRank_{ig}^c \neq OldPartnerRank_{ig}^c.$$

Prediction C2 states that PAM holds both before and after the MFA end. New partner ranks should be positively correlated with old partner ranks, i.e. $\gamma^c > 0$. Predictions I2 states that matching is random before and after the MFA end. Thus, there should be no correlation among them, i.e. $\gamma^c = 0$.

There are two remarks. First, if we run (8) only for firms not changing partners, then γ^c equals to one by construction. To avoid this mechanical correlation, we estimate (8) only for firms who change partners. Second, regression (8) combines both the treatment and control groups since PAM should hold for both groups in Case C. For instance, if there exists any industry-wide shock that induces Mexican exporter's partner downgrading in both treatment and control groups, the model with PAM should predict $\gamma^c > 0$ for both groups.

Small Exporter's Exit (C3 and I3) Finally, we test predictions C3 and I3 about Mexican exporters' exit. While the MFA end is the only shock in the model, there might exist other shocks inducing exit. To address them, we consider a simple threshold model of exit. In each period r, Mexican supplier i receives a random i.i.d. shock ε_{ir} to its profits, which captures idiosyncratic factors inducing firm exit. The firm chooses to exit if ε_{ir} is below a threshold $\bar{\varepsilon}_{ir}(y)$, that is, firm i's exit probability is $\Pr(\varepsilon < \bar{\varepsilon}_{ir}(y))$. Case C and Case I have two predictions: (i) threshold $\bar{\varepsilon}_{ir}(y)$ is a decreasing function in the firm's capability y; (ii) the MFA end increases threshold $\bar{\varepsilon}_{ir}(y)$ for a given capability.

To control for intrinsic differences between treatment and control groups, we conduct a difference-in-difference comparison of firm exit rates between groups for two periods of pre-liberalization (2001-04) and post-liberalization (2004-07). Since Mexican customs data before 2004 have no (digitized) record on importers, we use Mexican exporter's total product export volume as proxy for capability, which is highly correlated with exports with the main partners in 2004-07 data. Then, we estimate the following regression for Mexican firm i who exports product g to the US in the initial year of period r :

$$\begin{aligned} Exit_{igsr} &= \delta_1 Binding_g + \delta_2 Binding_g * After_r + \delta_3 After_r + \delta_4 \ln Exports_{igr} \\ &\quad + \delta_5 After_r * \ln Exports_{igr} + \lambda_s + u_{igsr}. \end{aligned} \tag{9}$$

Dummy variable $Exit_{igsr}$ equals one if the firm stops exporting during period r. Dummy variable $After_r$ equals one if period r is 2004-07 (after the end of the MFA). $\ln Exports_{igr}$ is the log of the firm's total export volume of product g in the initial year of period r, which proxies for the firm's capability.[22] λ_s represents HS-2 digit-level sector fixed effects. u^c_{igs} are error terms.

Based on positive correlations between firm's capability and trade volume, the above mentioned predictions (i) and (ii) are expressed as: (i) $\delta_4 < 0$ and $\delta_4 + \delta_5 < 0$, i.e. small low capability firms are more likely to exit; (ii) $\delta_2 > 0$, i.e. the end of the MFA increase exit probability for a given capability level.

5 Results

5.1 Partner Changes

Table 3 report regressions for partner changes during 2004–07 using linear probability models.[23] Columns with odd numbers reports estimates of β^c_d ($c = US, Mex$ and $d = U, D$) from baseline regressions (7). We find that β^{US}_U in Column (1) and β^{Mex}_D in Column (7) are positive and statistically significant, while β^{US}_D in Column (3) and β^{Mex}_U in Column (5) are close to and not statistically different from zero. These signs of β^c_d support Case C and reject Case I. The removal of binding quotas from Chinese exports increased the probability of US importers upgrading partners by 5.2 percentage points and the probability of Mexican exporters downgrading partners by 12.7 to 15 percentage points. These effects are quantitatively large when compared with the sample averages of Up^{US}_{igs} and $Down^{Mex}_{igs}$, 3 percentage

[22] Regression (9) includes (the log of) export volumes instead of the rank of export volumes used in regressions (7) and (8). This is because in the model the rank of capability determines matching, while the level of capability determines firm's exit.

[23] Probit regressions provide very similar results for all regressions.

points and 15 percentage points, respectively.[24]

Columns with even numbers in Table 3 report regressions adding the firm's own rank and its interaction with the Binding dummy. The coefficients of interaction terms are estimated small and statistically insignificant, while the coefficients of the binding dummy remain similar to the baseline estimates. This means that both large and small switch their partners as in the model.

Panel A in Table 4 reports estimates of β_U^{US} and β_D^{Mex} by changing the end year to 2006, 2007, or 2008. First, β_D^{US} and β_U^{Mex} remain positive and statistically significant, showing that our findings are not sensitive to the choice of end year. Second, estimates of β_U^{US} and β_D^{Mex} in later periods such as 2004-07 and 2004-08 are larger than those in an early period 2004-06. This suggests partner changes occur gradually over time, probably due to certain partner switching costs.

Panel B in Table 4 examines partner changes in later periods, 2007-11 and 2009-11, to check our assumption that the treatment and control groups would exhibit similar patterns in partner changes if the treatment were absent.[25] For each period, we re-construct capability rankings based on trade volume in the new initial years and re-create the upgrading/downgrading dummies. If the transition from an old to new equilibrium largely completed by 2007, we should not observe any difference in partner changes between the two groups. Panel B in Table 4 report very small and insignificant estimates of β_U^{US} and β_D^{Mex} for 2007–11 [Columns (7) and (10)] and 2009–11 [Columns (9) and (12)]. These results support our assumption.[26]

[24]Note that the sample averages of Up_{igs}^{US} and $Down_{igs}^{Mex}$ are likely to underestimate the true probabilities of partner changes in population. In our data partner upgrading/downgrading are observed only if the firm, the new partner, and the old partner are all continuing firms. Partner switching to firms in other countries and to firms that did not exist in 2004 are not included.

[25]To compare partner changes between the two groups before 2004 is one way to check this assumption, but not feasible since our data contain information only from June 2004. At the aggregate level, Figure 1 demonstrates the absence of differential time trends in the aggregate export volumes before the MFA quota removal in 2005.

[26]The period 2008–2011 [Columns (8) and (11)] shows a very different pattern from other two periods. One possible reason is the effect of the Lehman crisis and the Great Trade Collapse of 2008-

Finally, Table 5 controls for product and firm characteristics in 2004 before the MFA end In Appendix, we pick up several product and firm characteristics that might affect partner changes and examine whether they significantly differ between the treatment and control groups. Table 5 includes characteristics that are statistically different between the two groups within HS two digit products.[27] Even with additional controls, estimates of β_U^{US} and β_D^{Mex} remain statistically significant and similar in magnitude.

5.2 New and Old Partners Ranks

Figure 4 reports regressions (8) testimg predctions C2 and I2 with corresponding scatter plots. The left panel draws the normalized ranks of old partners in the horizontal axis and those of new partners in the vertical axis for those US importers who change their main partners between 2004 and 2007. The right panel draw a similar plot for Mexican exporters. The lines represent OLS regressions (8). Figure 4 and regressions show significant positive relationships. This means that firms who match with relatively high capable partners in 2004 switch to relatively high capable partners in 2007. This result again supports Case C PAM and rejects Case I random matching.

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09. As exports from other countries, Mexican exports declined by a huge amount in the second half of 2008. This shock might introduce noise into the rankings.

[27]Panel A includes product-level characteristics: the number of exporters and importers ($\#Exporters$ and $\#Importers$, respectively), the log of product level trade volume ($lnTotalTrade$), and product type dummies on whether products are for men, women, or not specific to gender and those on whether products are made of cotton, wool, or man-made (chemical) textiles. Panel B includes firm-product level characteristics: a log of firm's product trade volume with the main partner($lnTrade$), the share of Maquladora/IMMEX trade in firm's product trade ($Maquiladora$), the number of partners ($\#Partners$), and a dummy on whether a US importer is an intermediary firm such as wholesalers and retailers ($US\,Intermediary$). The results are also robust when controlling for main-to-main share, the ratio of the numbers of exporters and importers, and the location of Mexican exporters, all of which do not statistically differ between the two groups within HS two digit products (see Appendix).

5.3 Small Exporter Exit

Table 6 reports regressions (9) testing predictions C3 and I3. Columns (1), (3), and (5) report baseline regressions using three different lengths of the two periods, respectively. Columns (2), (4), and (6) include additional control variables of product and firm characteristics in the initial year of each period and their interactions with the After dummy. We choose the same control variables as we used in Table 5.[28]

Estimated coefficients from all specifications confirm C3 and I3. First, estimates of δ_4 and $\delta_4 + \delta_5$ are both negative and statistically significant, which means that small exporters are more likely to exit. Second, estimates of δ_2 are positive and statistically significant. Thus, the MFA end increased Mexican exporter's exit probability for a given capability level. These patterns are stable across different periods and robust to inclusions of control variables.

6 Discussion

6.1 Alternative Capability Rankings

We create two alternative rankings using firm's total product trade volume in 2004 and firm's unit price of the product's trade with the main partners in 2004, respectively. Then, we estimate partner change regressions (7) and regressions of new and old partner ranks (8) using these two rankings.[29] We use the total trade ranking for a robustness check and the price ranking for investigating the source of exporter's capability. If exporter's capability mainly reflects quality rather than productivity, the unit price ranking may agree with the true capability ranking. On the other

[28] Variables requiring importer information such as $\#Importers$, $\#Partners$ and $US\,Intermediary$ are not included.

[29] The exit regression uses firm's total product trade volume. Since price data before 2004 are very noisy, we do not estimate the exit regression using price data.

hand, if capability mainly reflects productivity, the unit price ranking may become the exact reversal of the true capability ranking.

Table 7 report partner change regressions in Panel A and regressions of new and old partner ranks in Panel B. Columns labeled “Baseline”, “Total Trade”, and “Price” report estimates using our baseline rankings, total volume rankings, and price rankings, respectively. All three rankings support the main results. The results from price rankings also implies that exporter’s capability mainly reflects its quality. Previous studies on export data find that quality is an important determinant of firm’s exporting.[30] Table 7 shows one step further: quality also determines firm’s export partner.[31]

6.2 Alternative Explanations

This section discusses alternative hypotheses for our findings and presents additional evidence to show that they do not fully explain our results.

Negative Assortative Matching (NAM) Appendix shows Case S is different from Case C and Case I in two points. First, firm’s trade volume may not be monotonically increasing in its capability. The import volume of US importers with capability x, $I(x)$, and the export volume of Mexican exporters with capability y, $X(y)$, satisfy $X(m_x(x)) = I(x)$. Since $X'(m_x(x))m'_x(x) = I'(x)$ and $m'_x(x) < 0$, $I'(x)$ and $X'(y = m_x(x))$ must have the opposite signs. Thus, it is impossible that trade ranking agrees with true capability ranking both for exporters and for importers. Second, if the MFA end increases the mass of suppliers in the

[30] See e.g., Kugler and Verhoogen (2012) and Manova and Zhang (2012) for studies using firm-level data and Baldwin and Harrigan (2011), Bernard et al. (2007), and Johnson (2012) for studies using product-level data.

[31] Regressions using price rankings report smaller coefficients than those using baseline rankings. This difference might reflect that exporters being differentiated by productivity or quality is heterogeneous across products (e.g., Baldwin and Ito, 2011; Mandel, 2009).

US, then the direction of partner change depends on the firm's capability. There exists a threshold capability $\tilde{x}$ such that US importers with $x > \tilde{x}$ upgrade their partners, while those with $x < \tilde{x}$ downgrade their partners. With these two complications, it is theoretically possible but unlikely that NAM explains the observed systematic relationships between rematching and trade ranking.

Segment Switching Another explanation for partner changes is "product segment switching" inspired by Holmes and Stevens (2014). Even one HS-6 digit product category may have two different segments. One "standardized" segment is produced on a large scale and sold with low markups, while the other "custom" segment is produced on a small scale but sold with high markups. Suppose that large US importers produce "standardized" products, while small US importers produce "custom" products. Suppose that Chinese exporters enter mainly in "standardized" products and that Mexican exporters switched from "standardized" to "custom" products to escape from competition. This change might be observed as Mexican exporters' partner downgrading and US importers' partner upgrading.

If this hypothesis mainly explains our findings, small firms and large firms should respond to the end of the MFA in heterogeneous ways. As small "custom" US importers should become more attractive to Mexican exporters and able to match more capable Mexican exporters, small US importers should upgrade partners more frequently than large US importers. However, Table 3 shows that both small and large US importer upgrade partners in a similar way.[32]

[32] In Appendix A.7, we also examine whether imports by initially small "custom" US importers show higher growth rates than those by large "standardized" US importers. We actually find the import growth by small US importers, but this pattern holds more strongly in the control group rather than in the treatment group, which is inconsistent with the hypothesis.

Production Capacity Another hypothesis is that firm's trade volume mainly reflects the size of Mexican supplier's production capacity instead of its productivity and quality. Since production capacity can be regarded as an element of firm's capability, this hypothesis is still consistent with PAM by capability. However, the mere demand for production capacity is unlikely to be the main reason for the observed partner upgrading. If this is the case, US importers in the treatment group who upgrade partners should increase import more than other firms. However, in Appendix A.7, we report that the import growth rate of US importers during 2004-07 is not correlated with either whether the firms belong to the treatment group or whether the firms upgrade Mexican partners.

7 Conclusion

This paper have empirically identified a simple mechanism determining exporter and importer matching at the product level: Becker-type positive assortative matching by capability. When the end of the MFA enables Chinese suppliers to enter the US market, existing US importers and Mexican exporters change partners so that the resulting matching becomes positively assortative under the new environment. Our model combining Becker (1973) and Melitz (2003) shows that this rematching brings additional gains from trade: trade liberalization improves buyer-supplier matching within industries.

We believe the assortative matching model will provide new insights on firms and trade. For instance, policy discussions often encourage domestic suppliers to export, particularly to highly capable foreign buyers. However, the implication of importer's capability for exporters cannot be analyzed in conventional anonymous market models where exporters are indifferent about importer's capability in equilibrium. In contrast, the assortative matching model explains why exporters prefer to trade with highly capable importers but often fail to do so. Suppliers must develop high capability to trade with highly capable foreign buyers.

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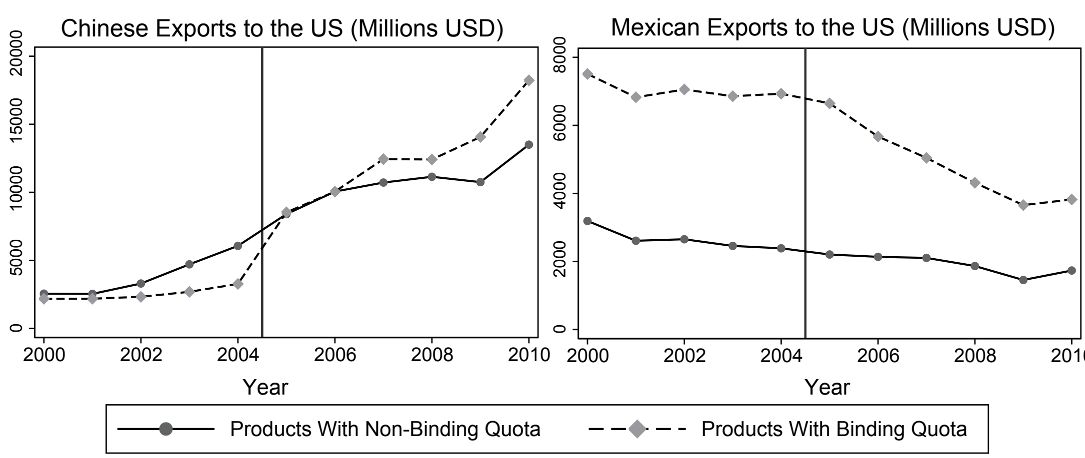
Figure 1: Chinese and Mexican Textile/apparel Exports to the US



Note: The left panel shows export values in millions of US dollars from China to the US for the two groups of textile/apparel products from 2000 to 2010. The dashed line represents the sum of export values of all products upon which US had imposed binding quotas against China in 2004 (treatment group), and the solid line represents that of the products with non-binding quotas (control group). The right panel expresses the same information for exports from Mexico to the US.

Figure 2: Case C: Positive Assortative Matching (PAM)

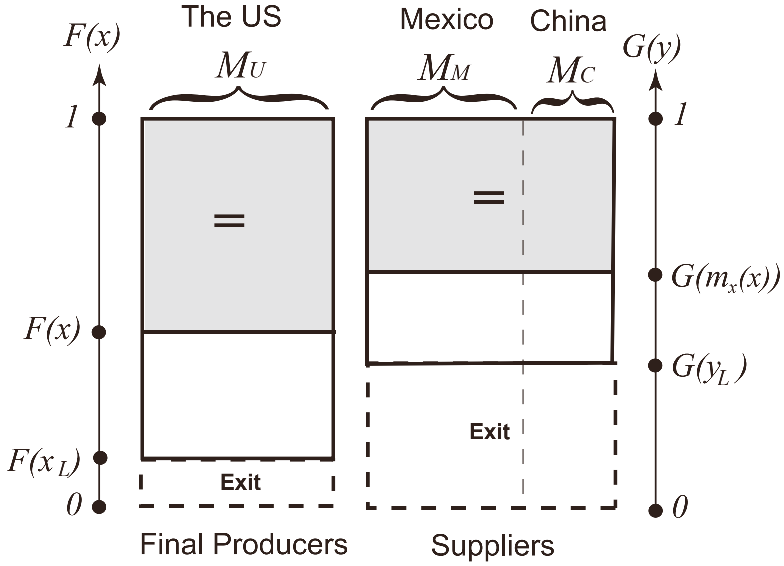


Figure 3: Case C: the Response of Matching to the MFA End

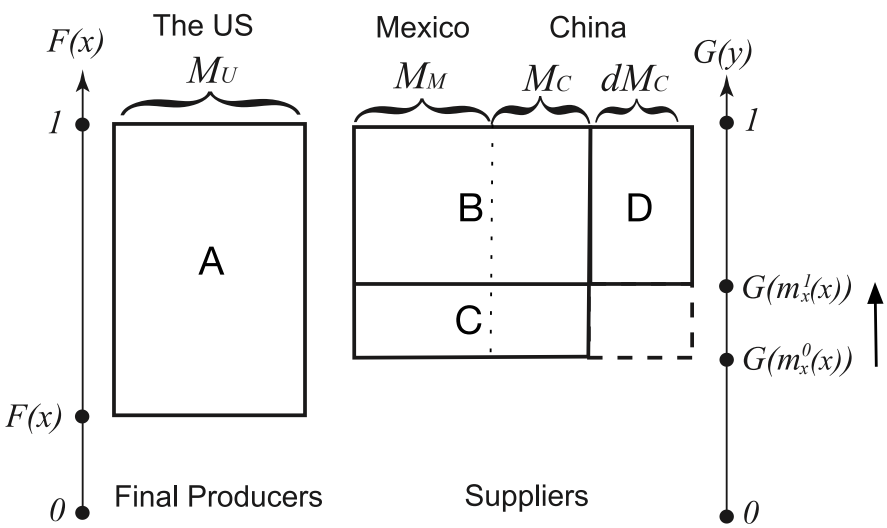
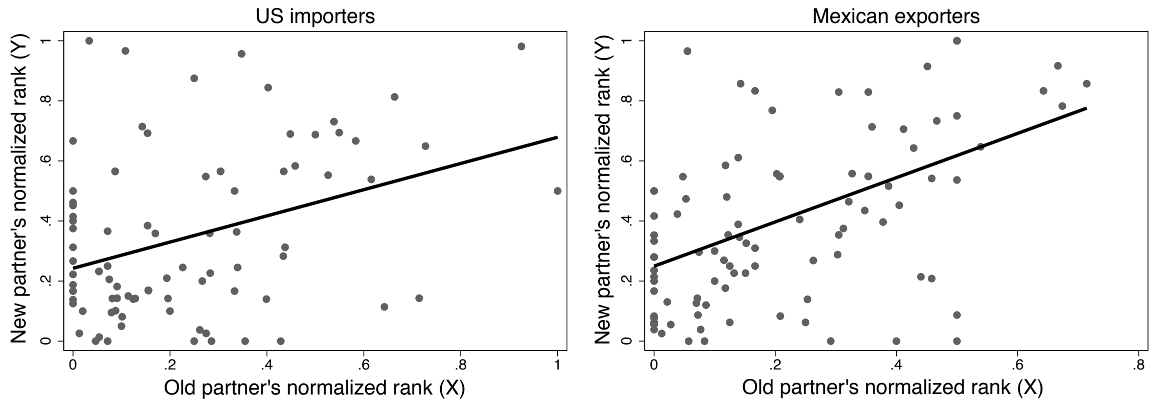


Figure 4: Old and New Partner Ranks



$Y = 0.24 + 0.44\,X,\ R^2{=}0.13,\ Obs.{=}88.$
(s.e. 0.048) (0.12)

$Y = 0.25 + 0.74\,X,\ R^2{=}0.24,\ Obs.{=}104$
(s.e. 0.036) (0.13)

Note: The left panel plots the rank of the new main partners in 2007 against the rank of the old main partners in 2004 for those US importers who change their main partners between 2004 and 2007. The right panel draws similar partner ranks for Mexican exporters. The lines represent OLS fits.

Table 1: Summary Statics for Product-Level Matching

HS6 digit level statistics, mean (median)	2004	2005	2006	2007
(1) N of Exporters	14.7 (8)	14.1(7)	11.7 (6)	11.3 (6)
(2) N of Importers	19.6 (11.5)	18.7 (10)	15.5 (9)	14.9 (9)
(3) N of Exporters Selling to an Importer	1.1 (1)	1.1 (1)	1.1 (1)	1.1 (1)
(4) N of Importers Buying from an Exporter	1.5 (1)	1.5 (1)	1.5 (1)	1.4 (1)
(5) Value Share of the Main Exporter (N of Exporters>1)	0.77	0.77	0.76	0.77
(6) Value Share of the Main Importer (N of Importers>1)	0.74	0.75	0.77	0.76

Note: Each row reports mean of indicated variables with median in parenthesis. Rows (1) and (2): the numbers of Mexican exporters and US importers of a given product, respectively. Row (3): the number of Mexican exporters selling a given product to a given US importer. Row (4): the number of US importers buying a given product from a given Mexican exporter. Statistics in Rows (5) and (6) are calculated only for firms with multiple partners. Row (5): the share of imports from the main Mexican exporters in terms of the importer's product import volume. Row (6): the share of exports to the main US importers in terms of the exporter's product export volume.

Table 2: Main-to-Main Shares in Mexico's Textile/Apparel Exports to the US

Year	Main-to-Main Share: All	Maquila	Non-Maquila	Quota-bound	Quota-free
	(1)	(2)	(3)	(4)	(5)
2004	0.79	0.79	0.80	0.78	0.80
2005	0.81	0.82	0.81	0.82	0.79
2006	0.81	0.83	0.83	0.81	0.82
2007	0.84	0.85	0.84	0.84	0.85

Note: Each column reports main-to-main shares in Mexico's textile/apparel exports to the US for types of transactions. All: all textile/apparel products. Maquila: Maquiladora/IMMEX transactions. Non-Maquila: the other normal transactions. Quota-bound: products for which Chinese exports to the US were subject to binding quotas; Quota-free: the other textile/apparel products.

Table 3: Partner Change during 2004-07

	Liner Probability Models: Up^{US}		$Down^{US}$		Up^{Mex}		$Down^{Mex}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Binding	0.052**	0.041*	-0.017	0.004	-0.003	-0.000	0.127***	0.130***
	(0.021)	(0.023)	(0.027)	(0.042)	(0.020)	(0.018)	(0.035)	(0.049)
OwnRank		-0.001		-0.074*		0.004		-0.087
		(0.024)		(0.042)		(0.014)		(0.054)
Binding*		0.034		-0.070		-0.007		-0.018
OwnRank		(0.049)		(0.074)		(0.026)		(0.087)
HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	718	718	718	718	601	601	601	601

Note: The dependent variables Up^c_{igs} and $Down^c_{igs}$ are dummy variables indicating whether during 2004-07 firm i in country c switched the main partner of HS-6 digit product g in country c' to the one with a higher capability rank and to the one with a lower capability rank, respectively. $Binding_{gs}$ is a dummy variable indicating whether product g from China faced a binding US import quota in 2004. $OwnRank_{igs}$ is the normalized rank of firm i in 2004. All regressions include HS-2 digit (sector) fixed effects. Standard errors are in parentheses and clustered at the HS-6 digit product level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 4: Partner Change in Different Periods

A: Gradual Partner Changes

	Partner Change in Different Periods: Linear Probability Models					
	Up^{US}			$Down^{Mex}$		
	2004-06	2004-07	2004-08	2004-06	2004-07	2004-08
	(1)	(2)	(3)	(4)	(5)	(6)
Binding	0.036**	0.052**	0.066**	0.056*	0.127***	0.121***
	(0.015)	(0.021)	(0.027)	(0.031)	(0.035)	(0.032)
HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	964	718	515	767	601	442

B: Placebo Checks

	Partner Change in Different Periods: Linear Probability Models					
	Up^{US}			$Down^{Mex}$		
	2007-11	2008-11	2009-11	2007-11	2008-11	2009-11
	(7)	(8)	(9)	(10)	(11)	(12)
Binding	-0.001	0.027**	-0.000	-0.008	0.047	0.005
	(0.018)	(0.011)	(0.006)	(0.036)	(0.031)	(0.020)
HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	449	575	747	393	499	655

Note: The dependent variables Up^c_{igs} and $Down^c_{igs}$ are dummy variables indicating whether during the period indicated by each column, firm i in country c switched the main partner of HS-6 digit product g in country c' to the one with a higher capability rank and to the one with a lower capability rank, respectively. $Binding_{gs}$ is a dummy variable indicating whether product g from China faced a binding US import quota in 2004. All regressions include HS-2 digit (sector) fixed effects. Standard errors are shown in parentheses and clustered at the HS-6 digit product level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 5: Partner Change during 2004-07 with Additional Controls

	A: HS 6 digit Product Level Controls: Linear Probability Models							
	Up^{US}				$Down^{Mex}$			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Binding	0.043**	0.44*	0.049**	0.042*	0.122***	0.125***	0.123***	0.130***
	(0.022)	(0.022)	(0.022)	(0.024)	(0.035)	(0.037)	(0.038)	(0.037)
#Exporters	0.001***				0.000			
	(0.000)				(0.000)			
#Importers		0.0003**				0.000		
		(0.0001)				(0.000)		
LnTotalTrade			0.007***				0.002	
			(0.002)				(0.007)	
Product type				Yes				Yes
HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	718	718	718	718	601	601	601	601

	B: Firm-Product Level Controls: Linear Probability Models							
	Up^{US}				$Down^{Mex}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Binding	0.049**	0.053**	0.051**	0.049**	0.123***	0.127***	0.103***	0.104***
	(0.022)	(0.022)	(0.021)	(0.019)	(0.038)	(0.035)	(0.037)	(0.034)
LnTrade	0.002				0.002			
	(0.004)				(0.007)			
Maquiladora		-0.015				-0.025		
		(0.017)				(0.024)		
#Partners			0.007***				0.036***	
			(0.002)				(0.009)	
US Intermediary				0.011				0.034
				(0.013)				(0.031)
HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	718	718	718	629	601	601	601	489

Note: The dependent variables Up^c_{igs} and $Down^c_{igs}$ are dummy variables indicating whether during 2004-07 firm i in country c switched the main partner of HS-6 digit product g in country c' to the one with a higher capability rank and to the one with a lower capability rank, respectively. $Binding_{gs}$ is a dummy variable indicating whether product g from China faced a binding US import quota in 2004. $\#Exporters_g$ and $\#Importers_g$ are the numbers of exporters and importers of product g in 2004, respectively. $LnTotalTrade_g$ is the log of trade volume of product g in 2004. Product Types are a collection of dummy variables indicating whether products are Men's, Women's, cotton, wool and man-made (chemical). $LnTrade_{ig}$ is the log of firm i's trade volume of product g in 2004. $Maquiladora_{ig}$ is the share of Maquiladora/IMMEX trade in firm i's trade of product g in 2004. $\#Partners_{ig}$ is the number of firm i's partner in product g in 2004. $US\,Intermediary_{ig}$ is a dummy variable indicating whether either US firm i or firm i's US main partner is an intermediary firm. All regressions include HS 2 digit (sector) fixed effects. Standard errors are shown in parentheses and clustered at the HS-6 digit product level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 6: Mexican Exporter's Exit from the US market

	Linear Probability Models					
	$Exit_{igsr}$					
Period 1	2001-04		2002-04		2000-04	
Period 2	2004-07		2004-06		2004-08	
	(1)	(2)	(3)	(4)	(5)	(6)
Binding	-0.040***	-0.035***	-0.037**	-0.019	-0.019	-0.017
(δ_1)	(0.014)	(0.013)	(0.015)	(0.015)	(0.013)	(0.013)
Binding	0.076***	0.099***	0.044**	0.064***	0.032**	0.054***
*After (δ_2)	(0.016)	(0.020)	(0.018)	(0.021)	(0.014)	(0.02)
After	-0.361***	-0.331***	-0.454***	-0.427***	-0.262***	-0.184***
(δ_3)	(0.042)	(0.069)	(0.049)	(0.081)	(0.030)	(0.068)
ln $Export$	-0.058***	-0.059***	-0.078***	-0.076***	-0.045***	-0.046***
(δ_4)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln $Export$*	0.020***	0.026***	0.031***	0.036***	0.012***	0.017***
After (δ_5)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.002)
Controls		Yes		Yes		Yes
HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	22625	22624	20655	20655	24474	24474

Note: The dependent variable $Exit_{igsr}$ is a dummy variables indicating whether Mexican firm i stops exporting product g to the US in period r. $Binding_{gs}$ is a dummy variable indicating whether product g from China faced a binding US import quota in 2004. $After_r$ is a dummy variable indicating whether period r is after 2004. $lnExport_{igr}$ is the log of firm i's export of product g in the initial year of period r. Columns (2), (4) and (6) include the following control variables of the initial year and their interactions with $After_r$: the share of Maquiladora/IMMEX trade in firm i's trade of product g in the initial year; the log of trade volume of product g; the number of exporters of product g; a collection of dummy variables indicating whether products are Men's, Women's, cotton, wool and man-made (chemical). All regressions include HS-2 digit (sector) fixed effects. Standard errors are shown in parentheses and clustered at the HS-6 digit product level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 7: Alternative Capability Rankings

A: Partner Changes during 2004-07: Linear Probability Models

	Up^{US}			$Down^{US}$		
	Baseline	Total Trade	Price	Baseline	Total Trade	Price
	(1)	(2)	(3)	(4)	(5)	(6)
Binding	0.052**	0.052**	0.047**	-0.017	-0.017	0.006
	(0.021)	(0.021)	(0.018)	(0.027)	(0.027)	(0.023)
HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	718	718	672	718	718	672
	Up^{Mex}			$Down^{Mex}$		
	Baseline	Total Trade	Price	Baseline	Total Trade	Price
	(7)	(8)	(9)	(10)	(11)	(12)
Binding	-0.003	0.001	0.037	0.127***	0.123***	0.069**
	(0.020)	(0.019)	(0.031)	(0.035)	(0.035)	(0.028)
HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	601	601	559	601	601	559

B: Old and New Partners 2004-07: OLS

	New Partner Rank					
	US Importers			Mexican Exporters		
	Baseline	Total Trade	Price	Baseline	Total Trade	Price
	(13)	(14)	(15)	(16)	(17)	(18)
Old Partner	0.44***	0.44***	0.17*	0.74***	0.68***	0.47***
Rank	(0.12)	(0.13)	(0.10)	(0.13)	(0.13)	(0.12)
Constant	0.24***	0.24***	-0.44***	0.25***	0.25***	0.30***
	(0.05)	(0.04)	(0.06)	(0.04)	(0.04)	(0.07)
R^2	0.13	0.15	0.04	0.24	0.21	0.14
Obs.	88	88	80	104	104	98

Note: Ranking is based on the firm's product trade with the main partner in 2004 in "Baseline", the firm's product total trade in 2004 in "Total Trade", and the firm's unit price of product in 2004 in "Price". Significance: * 10 percent, ** 5 percent, *** 1 percent. (Panel A) The dependent variables Up^c_{igs} and $Down^c_{igs}$ are dummy variables indicating whether during 2004-07 firm i in country c switched the main partner of HS-6 digit product g in country c' to the one with a higher capability rank and to the one with a lower capability rank, respectively. $Binding_{gs}$ is a dummy variable indicating whether product g from China faced a binding US import quota in 2004. All regressions include HS-2 digit (sector) fixed effects. Standard errors are shown in parentheses and clustered at the HS-6 digit product level. (Panel B) Regressions are run for firm i in country c who switch their main partners of product g during 2004-07. The dependent variable $NewPartnerRank^c_{ig}$ is the normalized rank of firm i's new main partner of product g in 2007. $OldPartnerRank^c_{ig}$ is the normalized rank of firm i's old main partner of product g in 2004.

Appendix (Not for Publication)

A1. Solving the Model

Consumer Maximization

The consumer maximization problem is equivalent with maximizing

$$U = \frac{\delta}{\rho}\ln\left[\int_{\omega\in\Omega}\theta(\omega)^{\alpha}q(\omega)^{\rho}d\omega\right] - \int_{\omega\in\Omega}p(\omega)q(\omega)d\omega + I.$$

The first order conditions are

$$\frac{\delta\theta\left(\omega\right)^{\alpha}q\left(\omega\right)^{\rho-1}}{\int_{\omega'\in\Omega}\theta(\omega')^{\alpha}q(\omega')^{\rho}d\omega'} = p\left(\omega\right) \text{ for all } \omega\in\Omega. \tag{10}$$

The first order conditions for two varieties $\omega,\omega'\in\Omega$, imply

$$\begin{aligned}
\left(\frac{\theta\left(\omega'\right)}{\theta\left(\omega\right)}\right)^{\alpha}\left(\frac{q(\omega')}{q\left(\omega\right)}\right)^{\rho-1} &= \frac{p(\omega')}{p(\omega)} \\
\left(\frac{\theta\left(\omega'\right)}{\theta\left(\omega\right)}\right)^{\alpha\frac{\rho}{\rho-1}}\left(\frac{q(\omega')}{q\left(\omega\right)}\right)^{\rho} &= \left(\frac{p(\omega')}{p(\omega)}\right)^{\frac{\rho}{\rho-1}} \\
\left(\frac{\theta\left(\omega'\right)}{\theta\left(\omega\right)}\right)^{\alpha(1-\sigma)}\left(\frac{q(\omega')}{q\left(\omega\right)}\right)^{\rho} &= \left(\frac{p(\omega')}{p(\omega)}\right)^{1-\sigma} \\
\theta(\omega')^{\alpha}q(\omega')^{\rho} &= \left(\frac{p(\omega')}{p(\omega)}\right)^{1-\sigma}\frac{\theta\left(\omega'\right)^{\alpha\sigma}}{\theta\left(\omega\right)^{\alpha(\sigma-1)}}q(\omega)^{\rho}
\end{aligned}$$

Integrating both sides with respect to $\omega'\in\Omega$, we obtain

$$\begin{aligned}
\int_{\omega'\in\Omega}\theta(\omega')^{\alpha}q(\omega')^{\rho}d\omega' &= \frac{q(\omega)^{\rho}}{\theta(\omega)^{\alpha(\sigma-1)}p\left(\omega\right)^{1-\sigma}}\int_{\omega'\in\Omega}\theta(\omega')^{\alpha\sigma}p(\omega')^{1-\sigma}d\omega'. \\
&= \frac{q(\omega)^{\rho}}{\theta(\omega)^{\alpha(\sigma-1)}p\left(\omega\right)^{1-\sigma}}P^{1-\sigma},
\end{aligned}$$

where $P \equiv \left[\int_{\omega\in\Omega} p(\omega)^{1-\sigma}\theta\left(\omega\right)^{\alpha\sigma} d\omega\right]^{1/(1-\sigma)}$ is the price index. Substituting this into (10), we obtain the demand function:

$$\frac{\delta\theta\left(\omega\right)^{\alpha} q\left(\omega\right)^{\rho-1}}{\int_{\omega'\in\Omega} \theta(\omega')^{\alpha} q(\omega')^{\rho} d\omega'} = p\left(\omega\right)$$

$$\delta\theta\left(\omega\right)^{\alpha} q\left(\omega\right)^{\rho-1}\left(\frac{\theta(\omega)^{\alpha(\sigma-1)} p\left(\omega\right)^{1-\sigma}}{q(\omega)^{\rho} P^{1-\sigma}}\right) = p\left(\omega\right)$$

$$q(\omega) = \frac{\delta\theta\left(\omega\right)^{\alpha\sigma}}{P^{1-\sigma}} p(\omega)^{-\sigma}. \qquad (11)$$

Stage 2: Team profit maximization

Facing the demand function (11), teams choose prices under monopolistic competition. Let $A \equiv \frac{\delta}{\sigma}\left(\frac{\rho P}{c}\right)^{\sigma-1}$ and $\gamma \equiv \alpha\sigma - \beta\left(\sigma - 1\right)$. Since a team with capability θ has marginal costs $c\theta^{\beta}$, it chooses the optimal price $p(\theta) = \frac{c\theta^{\beta}}{\rho}$. Team's output $q\left(\theta\right)$, revenue $R(\theta)$, costs $C(\theta)$, and profits $\Pi(\theta)$ become

$$\begin{aligned}
q\left(\theta\right) &= \delta P^{\sigma-1}\left(\frac{\rho}{c}\right)^{\sigma}\theta^{(\alpha-\beta)\sigma};\\
R(\theta) &= p(\theta) q\left(\theta\right)\\
&= \delta\left(\frac{\rho P}{c}\right)^{\sigma-1}\theta^{(\alpha-\beta)\sigma+\beta}\\
&= \sigma A\theta^{\gamma};\\
C(\theta) &= c\theta^{\beta} q\left(\theta\right) + f\\
&= \frac{\delta}{\rho}\left(\frac{\rho P}{c}\right)^{\sigma-1}\theta^{(\alpha-\beta)\sigma+\beta} + f\\
&= \left(\sigma - 1\right) A\theta^{\gamma} + f;\\
\Pi\left(\theta\right) &= R(\theta) - C(\theta) = A\theta^{\gamma} - f.
\end{aligned}$$

Normalize $\gamma = 1$. From the optimal price, the price index is

$$P = \left[\int_{\omega \in \Omega} p(\omega)^{1-\sigma} \theta\left(\omega\right)^{\alpha\sigma} d\omega \right]^{1/(1-\sigma)}$$
$$= \frac{c}{\rho} \left[\int_{\omega \in \Omega} \theta\left(\omega\right)^{\gamma} d\omega \right]^{1/(1-\sigma)}$$
$$= \frac{c}{\rho} \left[\int_{\omega \in \Omega} \theta\left(\omega\right) d\omega \right]^{1/(1-\sigma)}.$$
$$= \frac{c}{\rho} \Theta^{1/(1-\sigma)},$$

where $\Theta \equiv \int_{\omega \in \Omega} \theta\left(\omega\right) d\omega$ is the aggregate capability. Then, the index A becomes

$$A = \frac{\delta}{\sigma} \left(\frac{\rho P}{c} \right)^{\sigma - 1} = \frac{\delta}{\sigma \Theta}.$$

Stage 1

The mass of active final producers equals to that of active suppliers:

$$M_U[1 - F(x_L)] = \left(M_M + M_C\right)\left[1 - G(y_L)\right]$$

This equation determine $y_L(x_L)$ as an increasing function of x_L.

In Case C and Case I, a team with the lowest capability θ_L consists of a final producer with x_L and a supplier with y_L. This implies two properties. First, the lowest capability $\theta_L(x_L) = \theta\left(x_L, y_L(x_L)\right)$ becomes an increasing fiction of x_L. Second, the team profit is zero: $\Pi(\theta_L) = \pi_x(x_L) + \pi_y(y_L) = 0$, which implies the team cutoff condition:

$$A\theta_L = f.$$

In Case C, the matching market clearing condition,

$$M_U[1 - F(x)] = (M_M + M_C)\,[1 - G(m_x(x))] \text{ for } x \geq x_L,$$

determines matching function $m_x(x)$. Then, Θ is obtained as a function of x_L:

$$\Theta(x_L) = \begin{cases} M_U \int_{x_L}^{\infty} \theta\,(x, m_x(x))\,dF(x) & \text{for Case C} \\ M_U \int_{x_L}^{\infty} \theta^x(x)dF(x) + (M_M + M_C) \int_{y_L(x_L)}^{\infty} \theta^y(y)dG(y) & \text{for Case I,} \end{cases}$$

where $\theta\,(x, y) = \theta^x\,(x) + \theta^y\,(y)$ for additive separable Case I. Notice that $\Theta\,(x_L)$ is a decreasing function of x_L.

In Case C and Case I, team with the cutoff team capability is determined by

$$A\theta_L = \frac{\delta\theta_L(x_L)}{\sigma\Theta(x_L)} = f$$

Since $\theta_L(x_L)$ is increasing and $\Theta(x_L)$ is decreasing in x_L, the above equation uniquely determine x_L.

A.2 Proofs

This section proves Lemma 1 and that the supplier capability cutoff y_L rises after the MFA end. Both results are derived from a classic theorem in the matching theory with transferable payoffs.

Theorem 1. *Among feasible matching, stable matching maximizes the aggregate payoffs of participants in a frictionless matching market.*

Theorem 1 was developed by Koopmans and Beckmann (1957) and Shapley and Shubik (1972) for the case with finite agents and by Gretsky, Ostroy and Zame (1992) for the case with continuums of agents.

We compare equilibria of two different environments I and J (e.g. before and after the end of the MFA). Label variables in the corresponding equilibria by "I" and "J", respectively. In the current model, the aggregate payoff of firms is $A\Theta - Mf$ and individual firms take A as given. Thus, Theorem 1 implies:

Corollary 1. *If equilibrium matching of environment J is feasible under environment I, then $A^I\Theta^I - M^I f \geq A^I\Theta^J - M^J f$. The inequality is strict when equilibrium matching of environment J is not stable under environment I.*

Then, we establish the following lemma.

Lemma 2. *(i) Suppose equilibrium matching of environment J is feasible under environment I. If $M^I > M^J$, then $\Theta^I > \Theta^J$. (ii) Suppose equilibrium matching of environment J is feasible and not stable under environment I. If $M^I \geq M^J$, then $\Theta^I > \Theta^J$.*

Proof. (i) Since equilibrium matching of environment J is feasible under environment I, $A^I\Theta^I - M^I f \geq A^I\Theta^J - M^J f$ from Corollary 1. Since $M^I > M^J$, this implies $\Theta^I > \Theta^J$. (ii) Since equilibrium matching of environment J is feasible and not stable under environment I, $A^I\Theta^I - M^I f > A^I\Theta^J - M^J f$ from Corollary 1. Since $M^I \geq M^J$, this implies $\Theta^I > \Theta^J$ □

Proof for $dy_L > 0$ for Case C and Case I

Call the environment after the MFA end *A-environment* and the environment before the MFA end *B-environment*. Label equilibrium variables of A-environment by "A" and those of B-environment by "B".

Lemma 3. *$y_L^A > y_L^B$ in Case C and Case I.*

Proof. Suppose $y_L^A \leq y_L^B$. This means that the mass of produced varieties and active final producers increase: $M^A > M^B$ and $x_L^A < x_L^B$. Since equilibrium matching of

B-environment is feasible under A-environment, Lemma 2 implies $\Theta^A > \Theta^B$. In Case C and Case I, $\theta_L = \theta(x_L, y_L)$, $x_L^A < x_L^B$ and $y_L^A \leq y_L^B$ imply $\theta_L^A < \theta_L^B$. From $\theta_L = \frac{\sigma f}{\delta}\Theta$ in (6), we have $\Theta^A < \Theta^B$. Contradiction. □

Proof for Lemma 1

Call the environment after the MFA end *A-environment,* the environment of the no-rematching equilibrium *NR-environment*, and the environment before the MFA end *B-environment*.

Claim 1. $\Theta^A = \Theta^{NR}$ in Case I.

Proof. An equilibrium of NR-environment agrees with an equilibrium of A-environment because no rematching occurs after the MFA end in Case I. □

Claim 2. $y_L^A > y_L^{NR} > y_L^B$ in Case C.

Proof. Suppose $y_L^{NR} \leq y_L^B$. This means $x_L^{NR} < x_L^B$ and $M^{NR} > M^B$. Since $\theta_L = \theta(x_L, y_L)$ holds in Case C and Case I, $y_L^{NR} < y_L^B$ and $x_L^{NR} < x_L^B$ imply $\theta_L^{NR} < \theta_L^B$. From $\theta_L = \frac{\sigma f}{\delta}\Theta$ in (6), this means $\Theta^{NR} < \Theta^B$. Since equilibrium matching of B-environment is feasible under NR-environment, Lemma 2 and $M^{NR} > M^B$ imply $\Theta^{NR} > \Theta^B$. This contradiction implies $y_L^{NR} > y_L^B$.

Suppose $y_L^A \leq y_L^{NR}$. By a similar argument above, we have $x_L^A \leq x_L^{NR}$ and $M^A \geq M^{NR}$ so that $\theta_L^A \leq \theta_L^{NR}$ and $\Theta^A < \Theta^{NR}$. Since equilibrium matching of NR-environment is feasible and not stable under A-environment, Lemma 2 and $M^A \geq M^{NR}$ imply $\Theta^A > \Theta^{NR}$. Contradiction. □

Claim 3. $\Theta^A > \Theta^{NR} > \Theta^B$ in Case C and $\Theta^{NR} > \Theta^B$ in Case I.

Proof. Suppose $\Theta^{NR} \leq \Theta^B$, which implies $\theta^{NR} \leq \theta^B$ from (6). Since equilibrium matching of B-environment is feasible and not stable under NR-environment, Lemma 2 implies $M^{NR} < M^B$. From $M = M_U[1-F(x_L)]$, this means $x_L^{NR} > x_L^B$. In Case C and Case I, $\theta_L = \theta(x_L, y_L)$, $y_L^{NR} > y_L^B$ from Claim 2, and $\theta_L^{NR} \leq \theta_L^B$ imply $x_L^{NR} < x_L^B$. Contradiction.

Suppose $\Theta^A \leq \Theta^{NR}$, which implies $\theta^A \leq \theta^{NR}$ from (6). Since equilibrium matching of NR-environment is feasible and not stable under A-environment, Lemma 2 implies $M^A < M^{NR}$. From $M = M_U[1-F(x_L)]$, this means $x_L^A > x_L^{NR}$. In Case C, $\theta_L = \theta(x_L, y_L)$, $y_L^A > y_L^{NR}$ from Claim 3, and $\theta_L^A \leq \theta_L^{NR}$ imply $x_L^A < x_L^{NR}$. Contradiction. □

From $P = c/\left(\rho\Theta^{1/(\sigma-1)}\right)$, Claims 1-3 prove Lemma 1.

A.3 Negative Assortative Matching

Solving the Model

In Case S, the market clearing condition becomes

$$M_U[1 - F(x)] = (M_M + M_C)\left[G\left(m_x(x)\right) - G(y_L)\right] \text{ for all } x \geq x_L. \tag{12}$$

The left hand side is the mass of final producers with higher capability than x and the right hand side is the mass of suppliers with lower capability than $m_x(x)$.

An equilibrium is obtained as follows. The condition (12) determines $m_x(x)$ for all $x \geq x_L$. Then, Θ is obtained as a decreasing function of x_L:

$$\Theta(x_L) = M_U \int_{x_L}^{x_{max}} \theta\left(x, m_x(x)\right) dF(x).$$

A suppliers with y_{max} matches with a final producer with x_L and receives whole team profits because $\pi_x(x_L) = 0$:

$$\pi_y(y_{max}) = \Pi(\theta(x_L, y_{max})) = A\theta\left(x_L, y_{max}\right) - f.$$

The profit of the supplier with y_{max} is obtained by integrating the first order condition:

$$\pi_y(y_{max}) = \int_{y_L}^{y_{max}} \pi_y'(y)dy = A\int_{y_L}^{y_{max}} \theta_2(m_y(t), t)dt.$$

From $A = \frac{\delta}{\sigma\Theta}$ and $y_L = m_x(x_{max})$, the above two equations imply

$$\begin{aligned} A\theta\left(x_L, y_{max}\right) - f &= A\int_{m_x(x_{max})}^{y_{max}} \theta_2(m_y(t), t)dt \\ \frac{\delta}{\sigma\Theta(x_L)}\left[\theta\left(x_L, y_{max}\right) - \int_{m_x(x_{max})}^{y_{max}} \theta_2(m_y(t), t)dt\right] &= f. \end{aligned} \tag{13}$$

The above equation uniquely determines x_L since the left hand side is monotonically increasing in x_L.

Supplier Exit after the MFA End

Following section A.2, call the environment after the MFA end *A-environment* and the environment before the MFA end *B-environment*. Label equilibrium variables of A-environment by "A" and those of B-environment by "B". Then, we establish the following lemma.

Lemma 4. *$y_L^A > y_L^B$ in Case S.*

Proof. Suppose $y_L^A \leq y_L^B$. This means that the mass of produced varieties and active final producers increase: $M^A > M^B$ and $x_L^A < x_L^B$. Since equilibrium matching of B-environment is feasible under A-environment, Lemma 2 implies $\Theta^A > \Theta^B$.

From $y_L = m_x(x_{max})$, equation (13) implies

$$\frac{\delta}{\sigma\Theta^A}\left[\theta\left(x_L^A, y_{max}\right) - \int_{y_L^A}^{y_{max}} \theta_2(m_y^A(t), t)dt\right]$$
$$=\frac{\delta}{\sigma\Theta^B}\left[\theta\left(x_L^B, y_{max}\right) - \int_{y_L^B}^{y_{max}} \theta_2(m_y^B(t), t)dt\right] = f.$$

Since $\Theta^A > \Theta^B$ and $\theta\left(x_L^A, y_{max}\right) < \theta\left(x_L^B, y_{max}\right)$ from $x_L^A < x_L^B$, it must hold that

$$\int_{y_L^B}^{y_{max}} \theta_2(m_y^B(t), t)dt > \int_{y_L^A}^{y_{max}} \theta_2(m_y^A(t), t)dt.$$

Since $y_L^A \leq y_L^B$, this implies

$$\begin{aligned}\int_{y_{LB}}^{y_{max}} \int_{m_y^A(t)}^{m_y^B(t)} \theta_{12}(z,t)dzdt &= \int_{y_{LB}}^{y_{max}} \left[\theta_2(m_y^B(t), t) - \theta_2(m_y^A(t), t)\right] dt \\ &= \int_{y_{LB}}^{y_{max}} \theta_2(m_y^B(t), t)dt - \int_{y_L^B}^{y_{max}} \theta_2(m_y^A(t), t)dt \\ &\geq \int_{y_{LB}}^{y_{max}} \theta_2(m_y^B(t), t)dt - \int_{y_L^A}^{y_{max}} \theta_2(m_y^A(t), t)dt \\ &> 0. \end{aligned} \tag{14}$$

On the other hands, the matching market clearing condition implies for $y \geq y_L^B$, it must hold

$$M_U\left[1 - G(m_y^A(y))\right] = \left(M_M + M_C^A\right)\left[G(y) - G(y_L^A)\right],$$
$$M_U\left[1 - G(m_y^B(y))\right] = \left(M_M + M_C^B\right)\left[G(y) - G(y_L^B)\right].$$

Taking a difference of both sides, we obtain for $y \geq y_L^B$,

$$M_U \left[G(m_y^B(y)) - G(m_y^A(y))\right] = \left(M_M + M_C^A\right)\left[G(y) - G(y_L^A)\right] \\ - \left(M_M + M_C^B\right)\left[G(y) - G(y_L^B)\right] > 0$$

since $M_C^A > M_C^B$ and $G(y_L^A) \leq G(y_L^B)$ from $y_L^A \leq y_L^B$. Thus, we have $m_y^B(y) > m_y^A(y)$ for all $y \geq y_L^B$. From $\theta_{12} < 0$, this implies

$$\int_{y_{LB}}^{y_{max}} \int_{m_y^A(t)}^{m_y^B(t)} \theta_{12}(z,t) dz dt < 0,$$

which contradicts with (14). □

Partner Change after the MFA End

Assumption 1. *If the mass of Chinese suppliers M_C increases, then the total mass of suppliers in the US $(M_C + M_M)[1 - G(y_L)]$ increases.*

Under this assumption, the capability cutoff for importing x_L falls. The following lemma shows the direction of US importer's partner change is heterogeneous.

Lemma 5. *Under Assumption 1, there exists a threshold capability $\tilde{x} \in (x_L, x_{max})$ such that when the mass of Chinese supplier increases, continuing US final producers with $x > \tilde{x}$ switch their Mexican partners to those with higher capability (partner upgrading), while continuing US final producers with $x < \tilde{x}$ switch their Mexican partners to those with lower capability (partner downgrading).*

Proof. Totally differentiating (12), we obtain the partner change of importers with capability x:

$$dm_x(x) = \frac{\Gamma(x)}{g(m_x(x))}, \Gamma(x) \equiv g(y_L)dy_L - \frac{G(m_x(x)) - G(y_L)}{(M_M + M_C)} dM_C. \qquad (15)$$

Since $dy_L > 0$, $dM_C > 0$, and $m'_x(x) < 0$, $\Gamma(x)$ is increasing in x and $\Gamma(x_{max}) = g(y_L)dy_L > 0$ since $y_L = m_x(x_{max})$. Since Assumption 1 implies

$$d\left(M_C + M_M\right)\left[1 - G(y_L)\right] = \left[1 - G(y_L)\right]dM_C - \left(M_C + M_M\right)g(y_L)dy_L > 0,$$

$\Gamma(x_L) \equiv g(y_L)dy_L - \frac{1-G(y_L)}{(M_M+M_C)}dM_C < 0$. Since $\Gamma(x)$ is continuous, there exists $\tilde{x} \in (x_L, x_{max})$ such that $\Gamma(x) > 0$ for $x > \tilde{x}$ and $\Gamma(x) < 0$ for $x < \tilde{x}$. $\square$

To understand the intuition for this lemma, it is useful to consider how firms with maximum capabilities change partners. Suppose x_L falls from x_L^B to x_L^A and y_L rises from y_L^B to y_L^A. Since final producers with maximum capability x_{max} always match with suppliers who have the cutoff capability y_L, they upgrade partner suppliers with y_L^B to y_L^A. On the other hand, since suppliers with maximum capability y_{max} always match with final producers with the cutoff capability x_L, they downgrade final producers from x_L^B to x_L^A. This in turn means that final producers with x_L^B downgrade partner suppliers. Since a matching function is continuous, there is a threshold $\hat{x}$ of the lemma.

A.4 Data Construction

Customs transaction data Our primary data set is a Mexican customs transaction data set for Mexican textile/apparel exports to the US. The data set is created from the administrative records held on every transaction crossing the Mexican border from June 2004 to December 2011. The Mexican customs agency requires both individuals and firms who ship goods across the border to submit a customs form (pedimento aduanal in Spanish) that must be prepared by an authorized agent. The form contains information on: (1) the date of clearing customs; (2) total value of shipment (in US dollars); (3) 8 digit HS product code (we use from HS50 to HS63);

(4) quantity and unit; (5) name, address, and tax identification number of the Mexican exporter; (6) name, address, and tax identification number (employment identification number, EIN) of the US importer; (7) an indicator of a duty free processing reexport program (the Maquiladora/IMMEX program), and other information.

Assign firm IDs We assigned identification numbers to both Mexican exporters and US importers (exporter-ID and importer-ID) throughout the data set. It is straightforward to assign exporter-IDs for Mexican exporters since the Mexican tax number uniquely identifies each Mexican firm. However, a challenge arises in assigning importer-IDs for US firms. It is known that one US firm often has multiple names, addresses, and EINs. This happens because a firm sometimes uses multiple names or changes names, owns multiple plants, and changes tax numbers. Therefore, simply matching firms by one of three linking variables (names, addresses, and EINs) would wrongly assign more than one ID to one US buyer and would result in overestimating the number of US buyers for each Mexican exporter.

We used a series of methods developed in the record linkage research for data cleaning to assign importer-ID.[33] First, as the focus of our study is firm-to-firm matching, we dropped transactions for which exporters were individuals and courier companies (e.g., FedEx, UPS, etc.). Second, we standardized the format of addresses using the software, ZP4, which received a quality certification of address cleaning (CASS certification) from the United States Postal Services. Third, we remove generic words in company names that did not help identify a particular company such as legal terms (e.g., "Co.", "Ltd.", etc.). Fourth, we prepared lists of fictitious names, previous names and name abbreviations, a list of addresses of com-

[33] An excellent textbook for record linkage is Herzog, Scheuren, and Winkler (2007). A webpage of "Virtual RDC@Cornell" (http://www2.vrdc.cornell.edu/news/) at Cornell University is also a great source of information on data cleaning. We particularly benefitted from lecture slides on "Record Linkage" by John Abowd and Lars Vilhuber.

pany branches, and a list of EINs from data on company information, Orbis made by Bureau van Dijk, which covered 20 millions company branches, subsidiaries, and headquarters in the US.[34] Fifth, for each HS2 digit industry, we matched names within customs data and names between customs data and name lists from Orbis mentioned above. In conducting our matching, we used fuzzy matching techniques allowing small typographical errors and abbreviation.[35] To increase the accuracy of fuzzy matching, we removed words commonly appearing in the industry (e.g., "apparel") from the two names compared if such word appears in both of the two names. Also we do not apply fuzzy matching techniques to very short names. Sixth, we conducted similar matches for addresses and EINs. For address, we also use fuzzy matching techniques for street name matching and city name matching.

From these operations, we obtain matched pairs of names, those of addresses and those of EINs. Then, using these matched relations and the network theory software, igraph in R, we created clusters of information (names, addresses, EINs) in which one cluster identifies one firm. We identified a cluster basically under the following rule. Each entry in a cluster matches with some other entries in the cluster either by EIN or by names and addresses. After automatically creating clusters, we manually check them and separate entries that should not be matched. Finally, we assigned importer-IDs for each cluster.

Data Cleaning Some information was dropped from the dataset. First, we dropped exporters who are individuals or courier companies (e.g., FedEx, UPS, etc.) because we focus on firm to firm matching. Second, as the dataset contains information only

[34]The primary source of US company information in Orbis (2012 version) is Duns&Bradstreet. We used Orbis information for manufacturing firms and intermediary firms (wholesalers and retailers) due to the capacity of our workstation.

[35]The two names compared are "fuzzy matched" if one of the followings is satisfied: (1) they are close with each other in terms of the Jaro-Winkler metric, which is available in the Record Linkage package of R; (2) they agree on the number of the first n letters; (3) the longer one of the two names includes the shorter one.

from June to December for 2004, we dropped observations from January to May for other years to make each year's information comparable.[36] Third, we dropped one product (HS570210) where the number of importers unreasonably fluctuates, suggesting low data quality.[37] Finally, we dropped transactions by exporters who do not report importer information for most transactions. For a given HS6 product and a given year, we dropped an exporter from the final data if the total value of transactions without importer information constituted more than 20 percent of the exporter's annual export value. This resulted in dropping approximately 30–40 percent of exporters and 60–70 percent of export values. These dropped exporters are mostly Maquiladora/IMMEX exporters.

A5. Variable Construction

Product-level Variables Dummy variable $Binding_{gs}$ equals one if Chinese exports of product g to the US faced a binding quota in 2004, which we construct from Brambilla et al. (2010). Brambilla et al. (2010) constructed an indicator for binding quotas on Chinese exports to the US for each HS-10 digit category. Since HS product categories of Mexico and the US are the same only up to the first 6 digits, we aggregated their indicator up to the HS-6 digit level. A quota is defined as binding if the fill rate, i.e. the realized import value over the quota value, is greater than 0.8. Our results are robust to the choice of other cut-offs. We constructed our indicator as follows. Let x^m_{j2004} be US imports of HS-10 digit product j from Mexico in 2004. Let g be a HS-6 digit product and $J(g)$ be the set of US HS-10 digit products in category g. Thereafter, we constructed a dummy variable indicating whether Chinese exports of HS-6 digit product g to the US faced binding quotas in

[36] We conducted our main analysis (Tables 2 and 3) without conducting the latter two operations and obtained similar results.

[37] The number of US importers were 5 in 2004, 4 in 2005, 254 in 2006, 532 in 2007, 3 in 2008 and 123 in 2009.

2004 as:

$$Binding_g = I\left\{\frac{\sum_{j\in J(g)} x^m_{j2004} I\{\text{quota on } j \text{ was binding in 2004}\}}{\sum_{j\in J(g)} x^m_{j2004}} \geq 0.5\right\}, \tag{16}$$

where the indicator function $I\{X\} = 1$ if X is true and $I\{X\} = 0$ otherwise. We chose the cut-off value as 0.5 but the choice of this cut-off is unlikely to affect the results because most of values inside the indicator function are close to either one or zero.

Product type dummies "Men", "Women", "Wool", "Cotton", and "Manmade" equal one if the description of the HS6 product include words "men", "women", "wool", "cotton", or "manmade", respectively. $\#Exporters_{gs}$ is the number of exporters of product g in 2004, $\#Importers_{gs}$ is the number of importers of product g in 2004, and $TotalTrade_{gs}$ is the total trade volume of product g in 2004 .

Firm-level and Firm-product-level Characteristics $OwnRank_{igs}$ is firm's normalized rank in terms of trade volume in product g that falls in $[0, 1]$. For exporter i, define $ExRank_{igs}$ as firm i's rank based on its trade volume of product g with the main partner in 2004 among exporters of product g in 2004 (small $ExRank_{igs}$ means large export volume). Similarly, define $ImRank_{igs}$ for importers. Then, the exporter's normalized rank is $OwnRank_{igs} = (ExRank_{igs} - 1) / (\#Exporters_{gs} - 1)$ so that $OwnRank_{igs}$ falls in $[0, 1]$. $OwnRank_{igs}$ becomes zero for the highest ranked (largest) exporter becomes and one for the lowest ranked (smallest) exporter. Similarly, for the importers, $OwnRank_{igs} = (ImRank_{igs} - 1) / (\#Importers_{gs} - 1)$.

Dummy variable $NorthernState_{igs}$ equals one if exporter i of product g is located in one of the northern states of Mexico: Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon and Tamaulipas. $Maquiladora_{igs}$ is the ratio of firm i's Maquiladora trade volume of product g over the firm's total trade volume of product

g in 2004. $\ln TotalTrade_{gs}$ is the log of total trade volume of product g in 2004.

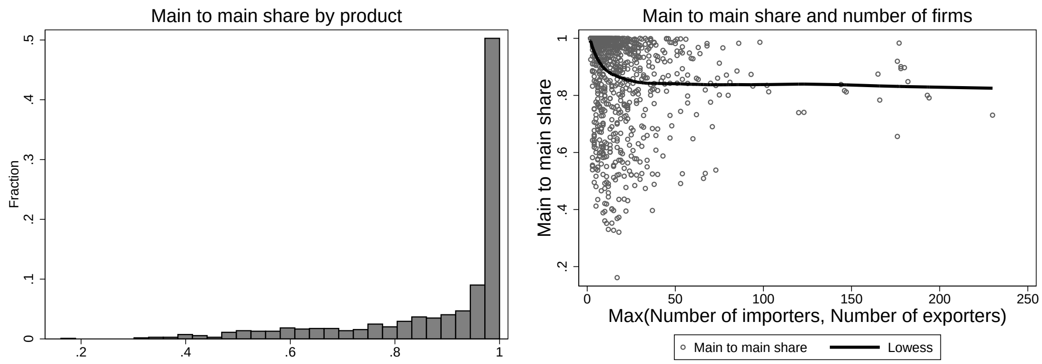
Dummy variable $US\,Intermediary_{igs}$ equals one either if firm i is a US intermediary firm or if firm i is a Mexican exporter and its US main partner is an intermediary firm. US intermediary firms are identified as follows. One US importer is typically matched with several records of US firms in Orbis data since Orbis data record branches and subsidiaries as distinct records. The US importer is identifies as an intermediary firm if one of matched records report retail or wholesaling as its main industry code and if none of matched records report manufacturing as its main industry code.

Other firm-level characteristics include the following. $\#Partners_{igs}$ is the number of partners with whom firm i trade in product g in 2004. $Main\,Partner\,Share_{igs}$ is the ratio of firm i's trade volume of product g with the main partner over firm i's total trade volume of product g in 2004. $\ln Trade_{igs}$ is the log of firm i's total trade volume of product g in 2004.

A6. Main to Main Share at Product Level

Two panels in Figure 5 draw the distribution of main-to-main share across product-year combinations. A histogram in the left panel strikingly shows that main-to-main shares exceed 0.9 for most combinations with the median 0.97 and the 25 percentile 0.86. The right panel in Figure 5 plots main-to-main shares against the maximum of the number of importers (n_m) and that of exporters (n_x), $\max\{n_m, n_x\}$. This exercise is motivated by the love of variety model with symmetric firms that predicts main-to-main share equals $1/\max\{n_m, n_x\}$. An estimated Lowess curve is above 0.80 and almost horizontal, which implies that main-to-main share is not related with the number of firms. Figure 5 remains very similar when the horizontal axis expresses either n_m or n_x.

Figure 5: Main-to-Main Shares for HS 6 Digit Textile/Apparel Products



Note: Both panels draw main-to-main share across product-year combinations of HS 6 digit textile/apparel products and years 2004-2007. The left panel draws a histogram. The right panel plots main-to-main shares against the maximum of the numbers of exporters and importers.

A7. Summary Statistics and Treatment Control Group Comparison

Table 8 documents summary statics of product level characteristics. Column (1) reports means and standard deviations of each product level characteristics for the control group, with the number of observations in Column (2). Column (3) and Column (4) report the difference in each characteristics between the treatment and control groups. We regress each characteristics of product g on the treatment dummy $Binding_{gs}$ and report the OLS coefficient b of the dummy in Column (3). Column (4) reports the OLS coefficient b of the dummy from a similar regression with HS 2 digit fixed effects, which captures the difference between the two groups within the same HS 2 digit sectors. Column (5) reports the number of observations for the regressions for Columns (3) and (4). Though a simple comparison in Column (3) shows that the two groups differ in many characteristics, with HS 2 digit fixed effects the difference becomes smaller and insignificant for many characteristics as shown in Column (4).

By the nature of the MFA end, the control group consists of products that were already liberalized before 2002. Thus, the treatment group that were protected in 2004 show more exporters and importers and greater trade volume then the control group.

Table 9 reports similar summary statistics for importer-product level characteristics. Even with HS 2 digit fixed effects, the treatment group shows more trade volume and a higher share of processing trade (Maquiladora/IMMEX).

Table 10 reports similar summary statistics for exporter-product level characteristics. Even with HS 2 digit fixed effects, Mexican exporters in the treatment group export more with more partners, have a higher share of processing trade (Maquiladora/IMMEX) and trade less likely with intermediary firms.

Table 8: Product-level Characteristics in 2004

Product-level Characteristics in 2004					
	Control group		Treatment-Control Difference		
	Means	Obs.	b	b (w. HS2 FE)	Obs.
	(1)	(2)	(3)	(4)	(5)
#Exporters	7.89	230	8.065***	6.028***	375
[s.d.](s.e.)	[15.11]		(2.110)	(1.687)	
#Importers	10.47	230	9.986***	8.742***	375
	[15.11]		(2.789)	(2.395)	
#Importers/	1.49	230	-0.195*	0.105	375
#Exporters	[1.27]		(0.104)	(0.103)	
LnTotalTrade	11.84	230	1.334***	1.254***	375
	[2.58]		(0.291)	(0.312)	
Main to Main share	0.89	230	0.006	-0.015	375
	[0,18]		(0.017)	(0.018)	
Men	0.07	230	0.172***	0.054	375
	[0.25]		(0.039)	(0.040)	
Woman	0.11	230	0.273***	0.080*	375
	[0.32]		(0.046)	(0.046)	
Wool	0.03	230	0.013	-0.030	375
	[0.18]		(0.022)	(0.027)	
Cotton	0.18	230	0.160***	0.066*	375
	[0.38]		(0.047)	(0.039)	
Manmade	0.33	230	0.046	0.136***	375
	[0.47]		(0.051)	(0.041)	

Note: For each characteristics, Columns report the followings: Column (1): mean and standard deviation for the control group of products for which imports from China did not face binding US quota in 2004; Column (2): the number of products in the control group; Column (3): the coefficient of a treatment group dummy in a regression of the characteristics on the dummy; Column (4):the coefficient of a treatment group dummy in a regression of the characteristics on the dummy and HS 2 digit fixed effects; Column (5) the number of observations in regressions for Columns (3) and (4). Significance: * 10 percent, ** 5 percent, *** 1 percent. Definitions of the Characteristics: $\#Exporters_g$ and $\#Importers_g$ are the numbers of exporters and importers of product g in 2004, respectively. $LnTotalTrade_g$ is the log of trade volume of product g in 2004. Main to Main share is the main to main share of the product in 2004. Men, Women, Wool, Cotton, and Manmade are dummy variables indicating whether products are Men's, Women's, cotton, wool and man-made (chemical).

Table 9: Importer-Product Level Characteristics in 2004

Importer-Product Level Characteristics in 2004

	Control group		Treatment-Control Difference		
Own Characteristics					
	means	Obs.	b	b (w. HS2 FE)	Obs.
	(1)	(2)	(3)	(4)	(5)
US Intermediary	0.33	1570	-0.002	-0.033	3429
[s.d.](s.e.)	[0.47]		(0.016)	(0.022)	
LnTrade	7.86	2408	0.785***	0.571***	5374
	[3.24]		(0.093)	(0.119)	
N of Partners	1.12	2408	0.013	0.012	5374
	[1.32]		(0.027)	(0.034)	
Maquiladora	0.25	2408	0.198***	0.130***	5374
	[0.42]		(0.013)	(0.016)	
Main Partner Share	0.76	124	0.012	-0.011	396
	[0.21]		(0.020)	(0.027)	
Main Partner's Characteristics					
	Control group		Treatment-Control Difference		
	Mean	Obs.	b	b (w. HS2 FE)	Obs.
Northern State	0.15	2408	-0.027***	0.002	5374
[s.d.](s.e.)	[0.36]		(0.010)	(0.012)	

Note: For each characteristics, Columns report the following: Column (1): mean and standard deviation for the control group of products for which imports from China did not face binding US quota in 2004; Column (2): the number of products in the control group; Column (3): the coefficient of a treatment group dummy in a regression of the characteristics on the dummy; Column (4):the coefficient of a treatment group dummy in a regression of the characteristics on the dummy and HS 2 digit fixed effects; Column (5) the number of observations in regressions for Columns (3) and (4). Significance: * 10 percent, ** 5 percent, *** 1 percent. Definitions of the Characteristics: $LnTrade_{ig}$ is the log of firm i's trade volume of product g in 2004. $Maquiladora_{ig}$ is the share of Maquiladora/IMMEX trade in firm i's trade of product g in 2004. $\#Partners_{ig}$ is the number of firm i's partner in product g in 2004. $US\,Intermediary_i$ is a dummy variable indicating whether either US importer or US main partner is an intermediary firm. $NorthernState_{ig}$ is a dummy indicating whether firm i's Mexican main partner of product g is located in a Northern state in Mexico.

Table 10: Exporter-Product Level Characteristics in 2004

Exporter-Product Level Characteristics in 2004					
Own Characteristics					
	Control group		Treatment-Control Difference		
	Mean	Obs.	b	b (w. HS2 FE)	Obs.
	(1)	(2)	(3)	(4)	(5)
Maquiladora	0.33	1818	0.122***	0.093***	4131
[s.d.](s.e.)	[0.46]		(0.015)	(0.019)	
Northern State	0.24	1818	-0.103***	0.002	4131
Dummies	[0.43]		(0.012)	(0.015)	
LnTrade	7.60	1818	1.562***	0.963***	4131
	[3.52]		(0.109)	(0.139)	
N of Partners	1.5	1818	-0.036	0.213***	4131
	[2.01]		(0.056)	(0.072)	
Main Partner Share	0.73	296	0.018	-0.014	724
	[0.21]		(0.016)	(0.022)	
Main Partner's Characteristics					
	Control group		Treatment-Control Difference		
	Mean	Obs.	b	b (w. HS2 FE)	Obs.
US Intermediary	0.31	1219	0.020	-0.053**	2833
[s.d.](s.e.)	[0.46]		(0.018)	(-0.024)	

Note: For each characteristics, Columns report the following: Column (1): mean and standard deviation for the control group of products for which imports from China did not face binding US quota in 2004; Column (2): the number of products in the control group; Column (3): the OLS coefficient β of a dummy indicating the treatment group when the characteristics is regressed on the dummy; Column (4): the OLS coefficient β of a dummy indicating the treatment group when the characteristics is regressed on the dummy and HS 2 digit fixed effects; Column (5) the number of observations in regressions for Columns (3) and (4). Significance: * 10 percent, ** 5 percent, *** 1 percent. Definitions of the Characteristics: $LnTrade_{ig}$ is the log of firm i's trade volume of product g in 2004. $Maquiladora_{ig}$ is the share of Maquiladora/IMMEX trade in firm i's trade of product g in 2004. $\#Partners_{ig}$ is the number of firm i's partner in product g in 2004. $US\,Intermediary_{ig}$ is a dummy variable indicating whether firm i's US main partner of product g is an intermediary firm. $NorthernState_i$ is a dummy indicating whether firm i is located in a Northern state in Mexico.

A.8. Import Growth of US Importers

Table 11 presents the analyses on the import growth rate of US importers that were mentioned in Section 6.2 to reject alternative explanations. Columns (1) and (2) concern the segment switching hypothesis. The hypothesis predicts small sized US importers in a "custom" segment should grow more than large sized US importers in a "standardized" segment. This heterogeneous growth should be stronger in the treatment group than in the control group. To test this hypothesis, Column (1) regresses US importer's import growth on the binding dummy and the firm's own rank and Column (2) adds the interaction of the firm's own rank with the binding dummy. Note that small OwnRank indicates large size. The positive coefficient of own rank in Row (1) shows small sized US importers grow more than large US importers. However, a small and insignificant interaction term in Column (2) shows this heterogeneous effect is almost the same between the treatment and control groups, which is inconsistent with the segment switching hypothesis.

Columns (3) and (4) concern the production capacity hypothesis. If US importers in the treatment switch to Mexican exporters with greater preshock exports mainly to seek greater production capacity, we should see the following two patterns. First, US importers in the treatment group should show greater import growth than those in the control group. Second, the difference should be driven by US importers in the treatment group who actually upgrade partners. To test these two predictions, Column (3) regresses US importer's import growth on the binding dummy and Column (4) adds the partner upgrading dummy and its interaction with the binding dummy. Columns (3) and (4) show that the import growth of US importers is not correlated with either whether the firms belong to the treatment group or whether the firms actually upgrade partners. Thus, the demand for production capacity alone is unlikely to explain the observed partner upgrading.

Table 11: Import Growth of US Importers during 2004-2007

	$\Delta \ln Import_{igs}$			
	(1)	(2)	(3)	(4)
Binding	-0.034	-0.019	-0.127	-0.140
	(0.222)	(0.289)	(0.256)	(0.259)
OwnRank	3.069***	3.088***		
	(0.367)	(0.382)		
OwnRank*Binding		-0.042		
		(0.782)		
Up_{igs}^{US}				-0.191
				(1.062)
Up_{igs}^{US}*Binding				0.374
				(1.238)
Constant	-2.035***	-2.042***	-0.547	-0.551
	(0.750)	(0.737)	(0.782)	(0.792)
HS2 FE	Yes	Yes	Yes	Yes
R^2	0.144	0.144	0.014	0.014
Obs.	718	718	718	718

Note: The dependent variable $\Delta \ln Import_{igs}$ is the log difference of US firm i's import volume of product g with the main partner during 2004-07. $Binding_{gs}$ is a dummy variable indicating whether product g from China faced a binding US import quota in 2004. $OwnRank_i$ is the normalized rank of firm i in 2004. Up_{igs}^{US} is a dummy variable indicating whether during 2004-07 US firm i switched the main partner of HS-6 digit product g in Mexico to the one with a higher capability rank. All regressions include HS-2 digit product fixed effects. Standard errors are in parentheses and clustered at the HS-6 digit product level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

References

Herzog, Thomas N., Fritz J. Scheuren, and William E. Winkler. *Data quality and record linkage techniques*. Springer, 2007.