Assortative Matching of Exporters and Importers

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Abstract: This paper examines the mechanism determining the matching of exporting firms and importing firms. From transaction data of Mexican textile/apparel exports to the US, we report two new facts on exporter–importer matching at the product level. First, matching is approximately one-to-one. Second, in response to the entry of Chinese exporters into the US market induced by the end of the Multifibre Arrangement (MFA), US importers switched their Mexican partners to those making greater preshock exports whereas Mexican exporters switched their US partners to those making fewer preshock imports. To explain these facts, we present a model combining Becker-type positive assortative matching of final producers and suppliers by their capability with the standard Melitz-type model. The model indicates that the observed matching change is evidence for a new source of gains from trade associated with firm heterogeneity.

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 heterogeneous firms and trade. A robust finding that only firms with high capability (productivity/quality) will engage in exporting and importing has spurred new theories emphasizing gains from trade associated with firm heterogeneity (Melitz, 2003; Bernard, Eaton, Jensen, and Kortum, 2003).[1] These theories consider trade liberalization as the key mechanism linking trade and industry performance because it improves aggregate industrial performance by shifting resources to more capable firms within industries (e.g., Pavcnik, 2002). These new trade theories have been applied to various issues and centered in trade research over the last decade.[2]

In contrast to our current knowledge regarding the firms that trade, we have little information regarding the exporters and importers involved in trade, i.e., the process of matching between exporters and importers in a product market. Do exporters and importers match based on their respective capabilities? Does trade liberalization change this matching process in any systematic way? Does matching matter for the aggregate industrial performance? This paper is one of the first attempts to answer these questions empirically.

Workhorse trade models consider types of international trade wherein the matching between exporters and importers does not play an important role. Perfectly competitive models such as the Ricardian and Heckscher-Ohlin models do not predict any systematic matching pattern because exporters and importers are indifferent regarding with whom they trade in equilibrium.[3] The "love of variety" model also avoids positing any specific matching mechanism, instead predicting that all exporters will trade with all importers.

However, actual matching patterns significantly differ from those predicted by these workhorse trade models. The two graphs in Figure 1 illustrate how Mexican exporters trade with US importers in two HS6 digit textile/apparel product markets. Each small dot on the left side represents a Mexican exporter, whereas each small dot on the right side represents a US importer. Product A has slightly more firms than an average textile/apparel product that Mexico exports to the US, whereas Product B has fairly larger numbers. Each line connecting an exporter and an importer represents a "match" whereby the exporter and the importer transacted the product during June–December 2004. Both graphs clearly indicate that most firms traded with only one firm, that is, matching is approximately one-to-one. Though the graphs show some deviations from this pattern of one-to-one matching, these deviations constitute only a small share of the aggregate trade volume. Section 2 presents the trade volume by "main-to-main" matches, defined as matches where both the exporter and the importer are each other's largest main partner; this trade volume constitutes approximately 80 percent of the aggregate Mexican textile/apparel exports to

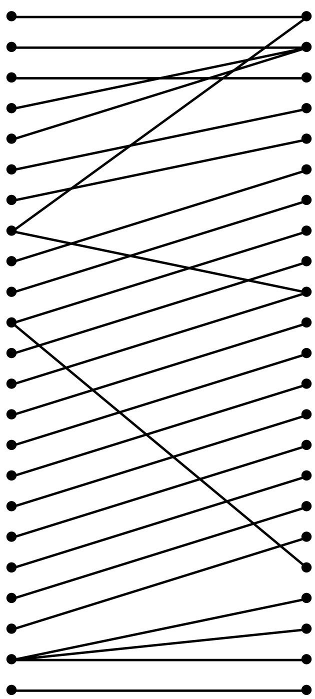
[1] See, for example, Bernard and Jensen (1995, 1999) for such findings that motivated the theories.

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

[3] Because of this prediction, perfectly competitive models are sometimes called "anonymous market" models.

the US. This means that one-to-one matching between main partners is a good approximation of trade relationships in a given product market. Thus, understanding firms' choice of main partner is crucial for understanding trade at the product level.

Figure 1: Exporter-Importer Matching Graphs



low capability importers.

Furthermore, we analyze trade liberalization that enables more foreign suppliers to enter the coun-

Antras, Garicano and Rossi-Hansberg, 2006; Sugita 2014).[4] Second, our findings are related to a recent debate over the size of gains from trade associated with firm heterogeneity (e.g., Arkolakis, Costinot, and Rodriguez-Clare, 2012; Melitz and Redding, 2014a, 2014b).[5] Though the current debate has mainly focused on gains from reallocation of production factors among firms (e.g., Melitz, 2003; Bernard et al. 2003), our findings suggest another type of gains from trade associated with firm heterogeneity. Third, we find that importers with high capability are "good importers" with whom all exporters prefer to trade, but only those with high capability can in fact trade with them. This finding supports policy discussions emphasizing the importance of encouraging domestic firms not only to start exporting but also to export to high capable importers. This view that all importers are not equally valuable to exporters in a non-anonymous market is also shared by a recent random network model by Chaney (2014).

Our paper is also related to the growing body of empirical literature that uses customs transaction data to examine matching between exporters and importers. As pioneering studies, Blum, Claro, and Horstmann (2010, 2011) and Eaton, Eslava, Jinkins, Krizan, and Tybout (2012) document characteristics of exporter–importer matching in Chile–Colombia trade, Argentina–Chile trade, and Colombia–US trade, respectively. Bernard, Moxnes, and Ulltveit-Moe (2013), and Carballo, Ottaviano, and Volpe Martincus (2013) use the Norwegian customs data and the customs data of Costa Rica, Ecuador, and Uruguay to examine exports from one country to multiple destinations. These studies mainly define exporter–importer matching at the country-pair level and document cross-sectional facts on the number of exporters for an importer together with the number of importers for an exporter. We define matching more narrowly at the product level and identify a theoretical mechanism determining product-level matching by examining how matching behavior responds to a trade liberalization shock. Section 2 presents that our finding is compatible with the findings of aforementioned studies by replicating some of their key findings under their definition of matching. 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. However, none of these studies relates observed correlations to the Becker-type positive assortative matching. Section 4.4 presents the comparison of these correlation tests with our empirical test. Finally, regarding dynamic characteristics of matching, Eaton et al. (2012) and Machiavello (2010) conduct pioneering studies on how new exporters acquire or change buyers in Colombian exports to the US and in Chilean wine exports to the UK, respectively. While these two studies consider steady state dynamics, we focus on how matching responds to a specific shock to a market. The above-mentioned empirical studies propose different theoretical mechanisms to explain their findings, but none propose Becker-type positive assortative matching. Note that our treatment–control group

[4] Antras et al. (2006) presents a model where heterogeneous workers match internationally, whereas Sugita (2014) presents a model where Melitz-type heterogeneous firms match internationally. Our model is basically a partial equilibrium version

comparison can identify only the existence of the Becker-type mechanism; however, it is silent about the existence of other mechanisms.

The rest of the paper is organized as follows. Section 2 explains our data set and shows statistics indicating that exporter–importer matching at the product level is approximately one-to-one. Section 3 develops a model of matching of exporters and importers and derives predictions that will be confirmed in later sections. Section 4 explains our empirical strategies. Section 5 presents the main empirical results together with additional results for checking the robustness of the main results. Section 6 concludes the paper.

2 Approximately One-to-One Matching

2.1 Matched Exporter Importer Data

We used the administrative records held on every transaction (shipment) crossing the Mexican border from June 2004 to December 2011 to construct matched exporter–importer data for Mexican textile/apparel exports to the US. The Appendix explains the construction of the dataset. The dataset contains the following information for each Mexican exporter and US importer pair that trade in a HS6 product in a year: (1) exporter-ID; (2) importer-ID; (3) year of transaction; (4) the 6 digit HS product code (from HS50 to HS63); (5) value of annual shipment (in US dollars); (6) quantity and unit; and (7) an indicator of whether their trade is processing reexports (Maquiladora/IMMEX); and other information.

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 from June to December for 2004, we dropped observations from January to May for other years to make each year's information comparable.[6] Third, we dropped one product where the number of importers unreasonably fluctuates, suggesting low data quality.[7]

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 porters report importers' information, which enables us to compare Maquiladora/IMMEX exporters and other normal exporters.

2.2 Exporter Importer Matching at Product Level

2.2.1 Summary Statistics

Table 1 reports summary statistics on the matching between Mexican exporters and US importers for HS6 digit level textile/apparel products. We dropped products traded by only one exporter or only one importer in any year during 2004-07 as these products do not have a potential matching problem.[9] Rows (1) and (2) report statistics on the number of exporters and importers in one product market (HS6 digit level), respectively. Rows (3) and (4) are statistics on the number of exporters selling a product to an importer and the number of importers buying a product from an exporter, respectively.

Table 1 presents that matching between exporters and importers significantly differs from the predictions derived from the conventional "love of variety" model. As this model predicts that all exporters sell to all importers, the numbers in Rows (1) and (2) can be interpreted as the "love of variety" model's

would identify an identical set of matches. Since in reality, a number of firms trade multiple products, our definition of matching is strictly narrower than the one in these previous studies and identifies fewer partners for firms trading multiple products.

where $c \equiv c_x + c_y$

The first order conditions for the maximization in (4) are

$$A\theta_2(x, m_x(x)) = \pi_y(m_x(x)) \text{ and } A\theta_1(m_y(y), y) = \pi_x(m_y(y)).$$

Using $m_x(x) = y$ and $m_y(y) = x$, the above first order conditions become

$$\pi_x(x) = A\theta_1(x, m_x(x)) > 0 \text{ and } \pi_y(y) = A\theta_2(m_y(y), y) > 0, \tag{5}$$

which proves that profit schedules are increasing in capability.

Trade volume within a match $T(x, y)$ is equal to supplier's costs plus supplier's profit. From (3) with $y = 1$ and (5), $T(x, y)$ turns to be increasing in member's capability :

$$T(x, y) = \left(\frac{c_x}{c} C(\theta(x, y)) + f_x\right) + \pi_y(y);$$

$$\frac{\partial T}{\partial x} = \frac{c_x}{c}(\sigma - 1) A\theta_1 > 0 \text{ and } \frac{\partial T}{\partial y} = \frac{c_x}{c}(\sigma - 1) A\theta_2 + \pi_y(y) > 0. \tag{6}$$

Because of fixed costs, a cut-off level of team capability θ_L

is indifferent about partner's capability. Therefore, we assume matching is random in Case I.[18]

We focus on Case C and Case I in the main text of the paper and discuss Case S in Appendix for three reasons. First, our empirical analysis supports Case C but rejects Case I and Case S. Second, Case I is a useful benchmark because it nests traditional Melitz-type models where firm heterogeneity exists only in one side of the market, i.e. either among suppliers ($\theta_1 = \theta_{12} = 0$) or among final producers ($\theta_2 = \theta_{12} = 0$). Finally, the analysis of Case S turns out to be much more complex than the analysis of the other two cases.

In Case C, the matching function $m_x(x)$ is determined to satisfy the following "matching market clearing" condition.

$$M_U [1 - F(x)] = (M_M + M_C) [1 - G(m_x(x))] \text{ for all } x \geq x_L, \tag{8}$$

The left hand side of (8) is the mass of final producers that have higher capability than x and the right hand side is the mass of suppliers who match with them. Under PAM, these are suppliers with higher capability than $m_x(x)$. Figure 3 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 indicates the value of $G(y)$. The left gray area is equal to the mass of final producers with higher capability than x and the right gray area is the mass of suppliers with higher capability than $m_x(x)$. The matching market clearing condition (8) requires the two areas to have the same size for all $x \geq x_L$.

[18] See e.g. Legros and Newman (2007) for a proof of this result. To understand the intuition, consider matching among two final producers $\{X, X\ \}$ and two suppliers $\{Y, Y$

Figure 3: Case C: Positive Assortative Matching (PAM)

(this is why foreign suppliers enter the market), whereby the old matches become unstable. Firms change their partners so that the new matching becomes positively assortative at the global level under the new capability distribution. Because technology θ exhibits complementarity, this re-matching toward positive assortative matching leads to an efficient use of technology and improves the aggregate industrial performance at the global level (e.g. global profits) under normal circumstances.[20]

In the remainder of the paper, we empirically test this implication of the Becker-type PAM to adjust prior matches following trade liberalization. More specifically, we consider what happens to matching between US final producers and Mexican suppliers when the mass of Chinese suppliers increases ($dM_C > 0$). We continue to focus on Case I versus Case C. We discuss Case S in Appendix and some alternative models in Section 5.3. For simplicity, 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.

When the mass of Chinese suppliers increases, some Mexican suppliers stop exporting to the US. Some US final producers stop importing from Mexico, choosing instead to import from China. Others remain in the Mexico-US trade. We now introduce the names of these groups of firms.

Definition 1. Consider Mexican suppliers and their partner US final producers before the exogenous event of an increase in Chinese suppliers. (1) US final producers are called *continuing importers* if they continue importing from Mexico after the event, and *exiting importers* if they stop importing from Mexico after the event; and (2) Mexican suppliers are called *continuing exporters* if they continue exporting to the US after the event, and *exiting exporters* if they stop exporting to the US.

In the following discussion, we focus on how continuing importers and exporters change their partners in response to the Chinese entry into the US market.

In Case I, firms are indifferent about their partner's capability. Even negligible switching costs prohibit any change in matching. Continuing exporters and importers do not change their partners because all incumbent firms are indifferent to them.

Proposition 1. *If the mass of Chinese suppliers increases in Case I, then US continuing importers and Mexican continuing exd* their partners with new Chinese exporters. In the new matching, final producers in area A matches with areas $B + D$ that has an equal mass and represents suppliers having capabilities higher than m

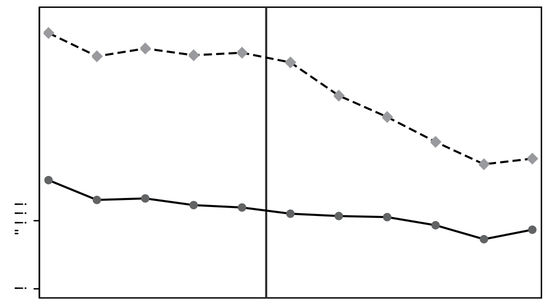
Propositions 1 and 2. We also explain the advantage of our test over the conventional “correlation test” of assortative matching.

4.1 End of the Multifibre Arrangement

The end of the Multifibre Arrangement (MFA) in 2005 provides a shock of exactly the required type, and that we modeled in the last section, namely a sudden increase in Chinese exporters of various capability levels entering the US textile/apparel product markets ($dM_C > 0$).

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. On January 1 of the years 1995, 1998, 2002, and 2005, the US removed various import quotas. At each

Figure 5: Impacts of the end of the MFA on Chinese and Mexican textile/apparel exports to the US



with Chinese exporters in the US market. The right panel in Figure 4 shows Mexican exports to the US for quota-removed products for the treatment group (dashed line) and other textile/apparel products (solid line; control group) from 2000 to 2010. The figure shows that the two series had moved in parallel before 2005, whereas exports of quota-removed products significantly declined after 2005. The parallel movement of the two series before 2005 indicates the absence of underlying differential trends between Mexico–US trade in both quota-removed products and other products. This suggests that the choice of products for quota removal in 2005 was exogenous to Mexican exports to the US.

In sum, the MFA's end in 2005 provides an ideal natural experiment for testing Propositions 1 and 2. It induced a large and arguably exogenous increase in the number of Chinese exporters with various capability levels into the US market for roughly half of textile/apparel products, making the other half a natural control group. [25]

4.2 Proxy for Capability Rankings

Capability rankings for US final producers and Mexican suppliers are needed for each product to test Propositions 1 and 2. Estimating conventional capability measures such as total factor productivity (TFP) is one possibility. However, estimating it at the firm-product level is not feasible even if we had linked the current data set to typical firm-level data that researchers typically use to estimate TFP. As we will explain in Section 4.4, using this method would therefore require currently unavailable data and estimation methodology. Therefore, a different approach is utilized.

Note that in Case I, no firm should change their partners. If the data uphold Case I, this prediction can be confirmed regardless of how we estimate firm capability rankings. Therefore, to test the existence

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We assume that the capability ranking in a fixed set of firms is stable during our sample period 2004–2007. Thereafter, we use the rank measured from 2004 data for the same firm throughout our sample period 2004–2007. We measure the capability rankings only for Mexican continuing exporters and US continuing importers that engaged in the Mexico–US trade between 2004 and 2007.

As a robustness check, we also create rankings based on total product trade volumes in 2004 aggregated across partners and rankings based on unit prices.[26]

4.3 Main Specification

Finally, we need to track partner changes between US importers and Mexican exporters, then isolate partner changes due to Chinese firm entries. Accordingly, we estimate the following four regressions:

$$\begin{aligned} Upgrading_{igs}^{US} &= \beta_1 Binding_{gs} + \lambda_s + \varepsilon_{igs}^{m} \\ Downgrading_{igs}^{US} &= \beta_2 Binding_{gs} + \lambda_s + u_{igs}^{m} \\ Upgrading_{igs}^{Mex} &= \beta_3 Binding_{gs} + \lambda_s + \varepsilon_{igs}^{u} \\ Downgrading_{igs}^{Mex} &= \beta_4 Binding_{gs} + \lambda_s + u_{igs}^{u}, \end{aligned} \tag{9}$$

where i, g, and s index a firm, a HS6 digit product, and a sector (HS2 digit chapters), respectively.

We define dummy variables $Upgrading_{igs}^{c}$ and $Downgrading_{igs}^{c}$ as follows: $Upgrading_{igs}^{c} = 1$ ($c = US, Mex$) if during 2004-07, firm i in country c switched its main partner for product g to a firm with a higher capability rank; $Downgrading_{igs}^{c} = 1$ ($c = Mex, US$) if during 2004-07 firm i in country c switched the main partner of product g to a firm with a lower capability rank. By construction, $Upgrading_{igs}^{c}$ and $Downgrading_{igs}^{c}$ are defined only for US continuing importers and Mexican continuing exporters during 2004-07. Our sample for the regression analysis drops exiting importers and exporters. The sample period of 2004-07 reflects the fact that the 2008 Lehman crisis reduced Mexican exports to the US, potentially confounding the impact of the MFA's end. $Binding_{gs}$ is a dummy variable indicating whether Chinese exports of product g

negative. The correlation test has been conventionally used in labor economics for analyzing many topics such as marriage, education, worker sorting, and so on. For readers of these studies, our test examining the response of matching to the entry of new suppliers may not appear a standard approach. For the analysis of exporter–importer matching, however, our approach has several advantages over the correlation test approach.

First, our test is able to identify the mechanism behind assortative matching. The correlation test merely measures the sign of assortative matching but does not indicate the underlying mechanism. Our approach of analyzing systematic partner changes in response to the entry of new suppliers, however, enables us to test the key mechanism of the Becker-type positive assortative matching model.

Second, the correlation test would require us to estimate some capability measure such as TFP at the firm-product level. In contrast to studies in labor economics where agents' abilities are reasonably observable, several difficulties arise in estimating capability for the analysis of exporter–importer matching. Such estimation would require detailed information per firm about the production outputs and inputs of each product, but information on inputs at the firm-product level is rarely available. Furthermore, no established method exists for estimating firm capability in a matching market. For instance, conventional estimation methods of TFP implicitly assume an anonymous market where matching is irrelevant. This approach enables estimation of sellers' productivity without using buyer information. We are uncertain regarding biases that might arise if these conventional methods are applied for firms in a matching market.

Third, instead of estimating capability, the correlation test could use proxy variables for measuring capability, including firm-size variables such as sales or employment. Two caveats should be noted for this approach. These firm-size variables have no variation at the firm-product level. Additionally, the correlation test based on these firm-size variables may not be at all informative about the sign for sorting true capability, and therefore may lead to an erroneous conclusion. For instance, in our model, all Case i (i = I, S, C), including even Case S of NAM, predict a positive correlation between exporters' and importers' employment across matches because an importer's employment increases along with volume of imported intermediate goods, which in turn increases the employment of the exporter with whom the importer trades.[30] This positive correlation arises from the complementarity of the labor inputs in the

5 Results

5.1 Baseline Regressions

Table 6 reports estimates of β_i ($i = 1, .., 4$) from our baseline regressions for partner changes during 2004–07. The table shows the estimates of each coefficient from linear probability and probit models. Panels A and B report the results for partner changes by US importers and Mexican exporters, respectively. In Panel A, Column (1) shows that the estimate of β_1 under the linear probability model is 0.052, which means that the removal of binding quotas from Chinese exports induced US importers to upgrade their main partners more frequently by 5.2 percentage points. Column (2) shows that the probit model gives a similar estimate.[31] Columns (3) and (4) show that the end of the MFA's impact on partner downgrading for US importers is close to zero, which is statistically insignificant. In Panel B, Columns (5) and (6) show that the impact on partner upgrading for Mexican exporters is also close to zero, which is statistically insignificant. Columns (7) and (8) show that the removal of binding quotas from Chinese exports increases the probability of partner downgrading for Mexican exporters by 12.7 to 15 percentage points.

Overall, we find that β_1 and β_4 are positive and statistically significant. That is, partner upgrading for US importers and partner downgrading for Mexican exporters occur more frequently in the treatment group than in the control group. On the other hand, β_2 and β_3 are close to and not statistically different from zero; no difference exists in probabilities of partner downgrading for US importers and partner upgrading for Mexican exporters between treatment and control groups.[32] These signs of the estimates support PAM Case C and reject random matching 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. The quantitative magnitude might at first appear small. However, they are substantial when compared with the probability of partner changes in the overall sample. The probability of the US importer upgrading its partner in the sample is 3 percentage points, and the probability of the Mexican exporter downgrading its partner in the sample is 15 percentage points.

The positive estimate of β_1 also implies a previously undocumented type of trade diversion induced by NAFTA. Trade diversion is usually documented in terms of prices: with protection from third-country imports (e.g., the MFA), a preferential trade agreement (e.g., NAFTA) induces importers to buy goods from partner countries at high prices. Trade diversion thus takes a form of "mismatching" of importers and exporters. Given MFA import quotas, NAFTA forced the US firms to match with Mexican suppliers of lower capability. The end of the MFA enabled US firms to match with Mexican suppliers of higher ca-

[31] This is also true for other equations in the paper. Thus, we report estimates from linear probability models in the following.

[32] Section 6.4 shows that this lack of partner changes in opposite directions supports rejection of other alternative explanations for the positive estimates of β_1 and β_4.

5.2.2 Additional Controls

Table 5 report estimates of β_1 and β_4 from regressions (9) including additional control variables. Columns may agree with the true capability ranking of exporters. On the other hand, if exporter size is mainly explained by productivity, unit price rankings may become the exact reversal of exporters' true capability rankings. If Case C holds, we should observe

regressions.[37]

To explore the validity of this "segment-switching" hypothesis, we perform three additional regressions in Table 7 testing the following three predictions. If a firm's trade volume in 2004 indicates its segment, both small and large firms should respond to the end of the MFA in heterogeneous ways. First, small "custom" US importers should increase their trade volume more rapidly than large "standardized" US importers, as small "custom" US importers should become more attractive to Mexican exporters and able to match more capable Mexican exporters. Second, small "custom" US importers should upgrade the main partners more frequently than large "standardized" US importers. Finally, partner downgrading by Mexican exporters should be concentrated among those who initially traded with large "standardized" US importers in 2004.

The results of our tests of these three predictions are presented in Table 7, which shows the results of regressions of each of three dependent variables, US importer's import growth (Column 1), US Importer Partner Upgrading dummy (Column 2), and Mexican Exporter Partner Downgrading dummy (Column 3) on a common set of variables: the Binding dummy, the firm's 2004 rank, and the interaction of these two, together with HS-2 digit sector fixed effects. The heterogeneous responses of small firms and large firms should appear in the coefficients of the interaction terms.

No evidence supporting this alternative hypothesis were found in any of these three exercises. The interaction term in Column (1) suggests that the growth of small "custom" US importers relative to large "standardized" US importers is not larger in the treatment group than in the control group. The interaction term in Column (2) suggests that small "custom" US importers do not upgrade main partners more frequently than large "standardized" US importers in the treatment group compared to the control group. Finally, the interaction term in Column (3) suggests that main partner downgrading occurs across the entire range of Mexican exporters' initial rankings and is not concentrated among those who had large trade volumes with their main partners. Overall, we do not find evidence consistent with the segment-switching hypothesis, thus we conclude that this alternative hypothesis cannot explain our main results.[38]

6 Conclusion

The heterogeneous firm trade literature successfully documented the heterogeneity of exporters and importers in terms of capability, however our knowledge about how heterogeneous importers and exporters

[37] The existence of multiple segments within one product category does not change the interpretation of our main regressions if Mexican firms do not switch segments. In the case of PAM, it still holds that Mexican exporters downgrade and US importers upgrade their main partners in the "standardized" segment, while firms do not change partners in the "custom" segment. On the other hand, the existence of multiple segments might help to explain why not all firms changed partners even in the treatment group.

[38] In addition to the evidence presented in Table 7, the segment switching hypothesis would not be consistent with our find30(l523(m-234(inte(2375

trade with each other has been still limited. We have identified a simple mechanism determining exporter and importer matching at the product level: Becker-type positive assortative matching by capability. We have found that when trade liberalization enables foreign suppliers to enter a market, existing firms change partners so that matching becomes positively assortative under a new environment. Our model combining Becker (1973) and Melitz (2003) interprets this rematching as evidence of a new source of gains from trade associated with firm heterogeneity.

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Table 3: Baseline Regressions

A: US Importer's Partner Changes during 2004-07

	$Upgrading^{US} (\beta_1)$		$Downgrading^{US} (\beta_2)$	
	Linear Prob.	Probit	Linear Prob.	Probit
	(1)	(2)	(3)	(4)
Binding	0.052**	0.052***	-0.017	-0.017
	(0.021)	(0.020)	(0.027)	(0.024)
Sector FE (HS2)	Yes	Yes	Yes	Yes
Obs.	718	707	718	707

B: Mexican Exporter's Partner Changes during 2004-07

	$Upgrading^{Mex} (\beta_3)$		$Downgrading^{Mex} (\beta_4)$	
	Linear Prob.	Probit	Linear Prob.	Probit
	(5)	(6)	(7)	(8)
Binding	-0.003	-0.003	0.127***	0.150***
	(0.020)	(0.019)	(0.035)	(0.044)
Sector FE (HS2)	Yes	Yes	Yes	Yes
Obs.	601	522	601	601

Table 4: Partner Changes in Different Periods

A: Gradual Partner Changes

	Partner Changes in Different Periods: Linear Probability Models					
	US Importers			Mexican Exporters		
	$Upgrading^{US} (\beta_1)$			$Downgrading^{Mex}$ (β_4)		
	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)
Sector FE (HS2)	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	964	718	515	767	601	442

B: Placebo Checks

	Partner Changes in Different Periods: Linear Probability Models					
	US Importers			Mexican Exporters		
	$Upgrading^{US} (\beta_1)$			$Downgrading^{Mex}$ (β_4)		
	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)
Sector FE (HS2)	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	449	575	747	393	499	655

Note: The dependent variables $Upgrading^{c}_{igs}$ and Do[illegible]$npUp$

Table 6: Regressions Using Alternative Capability Rankings

Partner Changes during 2004-07: Linear Probability Models

	US importers					
	$Upgrading^{US}(\beta_1)$			$Downgrading^{US}$ (β_2)		
	Baseline	Total Trade	Price	Baseline	Total Trade	Price
	(1)	(2)	(3)	(4)	(5)	(6)
Binding	0.052**	0.052**	0.045**	-0.017	-0.017	-0.011
	(0.021)	(0.021)	(0.018)	(0.027)	(0.027)	(0.024)
Sector FE (HS2)	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	718	718	706	718	718	706

	Mexican Exporters					
	$Upgrading^{Mex}(\beta_3)$			$Downgrading^{Mex}$ (β_4)		
	Baseline	Total Trade	Price	Baseline	Total Trade	Price
	(7)	(8)	(9)	(10)	(11)	(12)
Binding	-0.003	0.001	0.041	0.127***	0.123***	0.067**
	(0.020)	(0.019)	(0.030)	(0.035)	(0.035)	(0.027)
Sector FE (HS2)	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	601	601	591	601	601	591

Note: The dependent variables $Upgrading^{c}_{igs}$and $Downgrading^{c}_{igs}$ 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

Table 7: Segment-Switching Hypothesis

	US importers		Mexican Exporters
	$\Delta \ln Imports$	$Upgrading^{US}(\beta_1)$	$Downgrading^{Mex}$ (β_4)
	OLS	Linear Prob.	Linear Prob.
	(1)	(2)	(3)
Binding	-0.061	0.62***	0.132***
	(0.292)	(0.024)	(0.038)
Rank2004	0.022***	0.002***	-0.001*
	(0.006)	(0.001)	(0.001)
Binding	-0.016**	-0.002*	0.000
*Rank2004	(0.008)	(0.001)	(0.001)
Sector FE (HS2)	Yes	Yes	Yes
R-Squared	0.018	0.060	0.034
Obs.	966	601	718

Note: The dependent variable $\Delta \ln Imports$ in Column 1 is the log difference of firm's import volume between 2004-07. The dependent variables $Upgrading^{c}_{igs}$and $Downgrading^{c}_{igs}$ are dummy variables on whether during 2004-07, firm i in country c

Appendix

A.1 Negative Assortative Matching

In Case S, the market clearing condition becomes

$$M_U[1 - F(x)] = (M_M + M_C)[G(m_x(x)) - G(y_L)]. \tag{11}$$

The left hand side is the mass of final producers with capabilities higher than x and the right hand side is the mass of suppliers with lower capability than $m_x(x)$. Figure 7 describes the matching market clearing condition (11). The left rectangle for suppliers is described as in Figure 3. The right rectangle describes the rectangle for US final producers from Figure 3 but inverted. Therefore, a lower position in

The signs of $I(x)$ and $X(y)$ are generally ambiguous since $\partial T/\partial x > 0$, $\partial T/\partial m_x(x) > 0$, and $m_x(x) < 0$.

Table 8: The Prediction of Case S on the Signs of β_i in Our Regressions

	$I(x)$		
	Non-monotonic	Decreasing	Increasing
Low $\tilde{x}$		$\beta_2 > 0, \beta_3 > 0, \beta_1 = \beta_4 \quad 0$	$\beta_1 > 0, \beta_4 > 0, \beta_2 = \beta_3 \quad 0$
High $\tilde{x}$	$\beta_i > 0 (i = 1, .., 4)$	$\beta_1 > 0, \beta_4 > 0, \beta_2 = \beta_3 \quad 0$	$\beta_2 > 0, \beta_3 > 0, \beta_1 = \beta_4 \quad 0$

treatment group partner downgrading by US final producers and partner upgrading by Mexican exporters. Therefore, if $\tilde{x}$ is high, we should observe $\beta_2 > 0$, $\beta_3 > 0$, and $\beta_1 = \beta_4$ 0.

From Table 8, Case S can predict our finding $\beta_1 > 0$, $\beta_4 > 0$, and $\beta_2 = \beta_3$ 0 in the following two cases. Case A: (A1) import volumes of final producers $I(x)$ are monotonically decreasing in their own capability x and (A2) the number of Mexican suppliers who stop exporting is sufficiently small [i.e. $\tilde{x}$ is high]. Case B: (B1) export volumes of Mexican suppliers $X(y)$ are monotonically decreasing in their own capability y [i.e. $I(x)$ is monotonically increasing in x] and (B2) the number of Mexican suppliers who stop exporting is sufficiently large [i.e. $\tilde{x}$ is low].

A.2 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) total value of shipment (in US dollars); (2) 8 digit HS product code (we use from HS50 to HS63); (3) quantity; (4) name, address, and tax identification number of the Mexican exporter; (5) name, address, and tax identification number (employment identification number, EIN) of the US importer, 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.[39] 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, a company name often included generic words that did not help identify a particular company such as legal terms (e.g., "Co.", "Ltd.", etc.) and words commonly appearing in the industry (e.g., "apparel"). We removed

[39] 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.

these words from company names. Third, we standardized addresses using the software, ZP4, which received a CASS certification of address cleaning from the United States Postal Services. Fourth, we prepared lists of fictitious names, previous names and name abbreviations, a list of addresses of company 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. We used Orbis information for manufacturing firms and intermediary firms (wholesalers and retailers) due to the capacity of our

For any two varieties ω and ω , we have

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

$$\left(\frac{\theta(\omega\ )}{\theta(\omega)}\right)^{\alpha \frac{\rho}{\rho}}$$

the optimal price $p(\theta) = \frac{c\theta^{\beta}}{\rho}$