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Taking in One Another's Clothes?
The Impact of Removal of ATC Quotas on International Trade in Apparel

Patrick Conway
Department of Economics
University of North Carolina
Chapel Hill, NC 27599-3305
patrick_conway@unc.edu

Marco Fugazza
Trade Analysis Branch
UNCTAD
Geneva, Switzerland
marco.fugazza@unctad.org

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Abstract:

Theory predicts that a system of binding bilateral quotas such as observed in the Agreement on Textiles and Clothing (ATC) will cause both trade diversion and trade deflection, with an end result of more trading partners and smaller values traded on average than in the absence of the quotas. Quota removal will reverse this process, leading to trade creation and the focusing of trade in larger values by a smaller group of exporters.

We derive these predictions from a micro-founded model of bilateral trade, and we test these predictions in a panel database of trade among 126 world trading partners in cotton apparel for the period 1994-2006. We find on average that bilateral trade was characterized by the opposite of this prediction: elimination of quotas coincided with an increase in the number of import partners per exporter and a reduction in the average value of exports per import partner. We find that the theoretically predicted impact of quota elimination is observed, but explains a small percentage of variation across exporters; more important is the effect associated with rising world prices for apparel. We also report the results for sub-samples of the period and for China alone.

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On 1 January 2005 the United States (US), Canada and the European Union (EU) eliminated a system of bilateral quotas on imports of textiles and apparel. These quota constraints had been in use in some form since the early 1960s.[1] The phased elimination of the quotas was codified in the Agreement on Textiles and Clothing (ATC) of the World Trade Organization (WTO) during the period 1995-2004.

These quotas were welfare-reducing for the residents of these areas, but they also had the effect of stimulating exports of textiles and apparel from a number of developing economies that might otherwise not have participated in those import markets. This effect is analogous to "trade diversion" (as Viner (1950) characterized it) for the importing countries and a growth stimulus for the developing-country exporters.[2] There is also the potential for "trade deflection" and "trade destruction", as Bown and Crowley (2007) predict: exporters facing a binding quota from these areas will then either deflect their products to third countries or reduce their imports from third countries by substituting to sales to domestic markets.

A "trade diversion" analysis provides straightforward predictions for trade patterns and volumes in the quota-levying countries once these binding quotas were removed: exporter status would be determined by comparative advantage, and larger-volume imports on average would be observed from the same or fewer exporters.[3] To the extent that quota liberalization increased world demand for the products, "world" prices would rise while the liberalized prices in the quota-levying countries would fall. This rise in "world price" would cause supply and demand adjustments throughout the world trading economies.

When we examine the international trade in cotton clothing with the elimination of quotas, we find an expansion on average in the number of trading partners in both textiles and apparel, and a reduction in the average value of trade conducted bilaterally. This is the conundrum referenced in the title: why are countries purchasing less clothing on average from even more trading partners with the removal of the quota system?

The impact of the removal of ATC quotas on prices and volumes imported into the US and EU markets has been studied elsewhere. We are interested in this paper in the third-country effects of quota liberalization. Many developing and transition economies around the world created an

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[1] The Long-Term Arrangement in Cotton Textiles (LTA) in the US was the first incidence of these quotas; they were regularized and extended to other fibers in the Multi-Fiber Arrangement (MFA) from 1974 to 1995,

[2] The concept of trade diversion was introduced in the economic literature on customs unions. As Lipsey (1960, p. 496) states, "The theory of customs unions may be defined as that branch of tariff theory which deals with the effects of geographically discriminatory changes in trade barriers." This is an excellent description of the MFA/ATC system of bilateral quotas as well.

[3] While the concept of trade diversion is put forward by Viner (1950), the predictions of this paper rely upon both his work and that of the many economists to extend his work to elastic demand and supply and to general-equilibrium settings. Lipsey (1970) is a detailed summary of that early work on trade diversion, while Panagariya (2000, section 3) provides a more recent discussion. When we refer to the "Vinerian" logic of trade diversion, it is inclusive of these later extensions.

export-led growth strategy around apparel during the years leading up to 2005. By study of this episode we can evaluate the effectiveness of that strategy.

To decompose the empirical third-party effects of quota liberalization we create a micro-founded model of trade flows based upon the heterogeneous-firm approach of Melitz (2003) and Helpman, Melitz and Rubenstein (2008, hereafter HMR). We estimate this model in the quota period 1994-2004 for a sample of 126 developed and developing countries, and then use the removal of quotas in 2005 as an experiment to identify the refocusing of trade predicted by theory relative to the pattern of the quota-period model. While we do not measure welfare effects explicitly, we are able to track the country-specific evolution in export expansion or contraction.

Our estimation results identify reasonable parameters for the structural model as well as the Vinerian logic of trade diversion in the data. We also identify "trade rediversion" among those countries that benefited from access to the US and EU countries during the quota period: their response to quota removal has been to redirect their exports to larger numbers of other countries in search of markets to replace those of the US and EU. The "comparative advantage" exporters (including the major Asian exporters) in these two industries did not greatly expand the number of trading partners and did increase the average volume of trade per exporter, just as theory predicts. By contrast, the countries that became apparel exporters because of the quota system did not simply shut down. Instead, they sold smaller volumes of their goods to more peripheral markets.

Our attention to the general-equilibrium and third-country effects of removal of quotas distinguishes our work from two recent papers on the removal of the ATC quotas. Harrigan and Barrows (2006) examined the difference in price and quality for US imports in a difference-in-difference framework for the top 20 exporters to the US: there is the time difference, from 2004 to 2005, and the categorical difference in quota-constrained vs. unconstrained imports.[4] The authors first measure the average adjustment in price and quality for each country in the sample; they find a substantial downward average adjustment in price for quota-constrained imports and a much smaller downward adjustment in quality. There are no such downward adjustments for unconstrained imports. The authors then test across countries to determine whether the adjustments in price and quality from 2004 to 2005 are on average significantly different for constrained than for unconstrained categories. The downward price adjustments are statistically significant for all exporters at the 95 percent level of confidence, for China alone and for the non-China exporters. The downward quality adjustments are significant for China alone and for all exporters at the 90 percent level of confidence. This work is done at a quite detailed level of disaggregation, and

[4] The unit for imports is the HS 10 classification. Each classification is designated as either "constrained" or "unconstrained" depending upon whether that classification is part of a quota category binding for that exporter in that year.

signals the expected impact of quota removal on both price and quality. It treats the observation of a binding quota as an exogenous event, however – and this can introduce bias.

Brambilla, Khandelwal and Schott (2007) focus their attention on exporters of textiles and apparel to the US. They work as well with 10-digit HS data onimports from these countries into the US, and they also categorize the imports as being quota-constrained vs. unconstrained using the US quota classifications. They analyze carefully the impact of the quota, and then contrast that with behavior after quota removal: they are careful to distinguish the four stages of sequential quota elimination under the ATC, and to connect the changes in quantity and price with the appropriate stage of quota removal. They find both an increase in quantity and a reduction in price for Chinese goods that is significantly different from that observed in other quota-constrained exporters. They do not calculate quality as in Harrigan and Barrows (2006), and thus cannot draw conclusions on the impacts of price vs. quality. They also treat the quota-constrained period as an exogenous event.

Our approach to the removal of quotas represents both an extension and an aggregation of the results of these two papers. We extend these conceptually by considering the general-equilibrium effects of bilateral trade among all countries, not just those that impose quotas. We model the production/trade relationship between textiles and clothing. We also extend the analysis technically by recognizing that a binding quota will be an endogenous event in this model. On the other hand, we use more aggregated data than the 10-digit HS level used by these two papers. We create an indicator of quota limits and binding quotas based upon aggregating up from the individual quota categories defined by the US and the EU. Details on this procedure are provided in the text and in the appendices at the end of this paper.

I. Taking in each other's clothing.

There is great variation in the participation of countries as exporters in the world markets for cotton apparel, as is evident in Figure 1. For these figures, the 126 countries in the sample are sorted for each year in ascending order by number of importing trading partners. [5] The vertical axis indicates the share of the 126 countries to which each country exports. The blue dashed line indicates the distribution in 2004. There are 22 countries that export to no more than 10 percent of the trading countries, while the best-connected exporter (China) sells into over 90 percent of the markets considered.

We operationalize the Vinerian prediction in response to quota elimination by positing that post-quota this curve will shift down: the comparative-advantage exporters will focus upon the

[5] We examine in this section aggregate cotton apparel (SITC 841 & 842) trade for 126 countries during this period. This is also the sample used in the estimation of part III. COMTRADE does report data on bilateral trade for 169 countries during this period; those excluded are small and not major trading partners, and we lack necessary supplementary data on these. (Italy is the exporter with the most trading partners in the larger sample, reaching 83 and 86 percent of importer countries in textiles and apparel, respectively.)

countries in which quotas limited them, thus discarding periphery markets. The non-comparative-advantage exporters at the lower end of the spectrum would see their access to the previously quota-protected markets eliminated by competition, and thus would also export to fewer countries (or even stop exporting). Figure 1 indicates that the opposite is observed – exporters along the spectrum increased the number of countries served in the period between 2004 and 2006. There is a substantial shift upward from 2004 to 2006: the Vinerian hypothesis is swamped by an apparent rush by exporters to reach new markets and a rush by importers to take in clothing from more sources. While not every country expanded its export reach, Figure 2 illustrates nearly all did. These range from the best-connected (the US, France and China) to Seychelles and Sudan among the least-connected in 2004.

[Figure 1 inserted about here]

[Figure 2 inserted about here]

The second part of the Vinerian prediction concerns the average value of bilateral exports per import partner. With quota elimination, we anticipate that average values will rise for those constrained by quotas and will fall for the others.[6] In considering apparel trade in Figure 3, we observe behavior close to the Vinerian prediction holding more precisely. Countries with binding quotas are also those with larger mean values of exports per importing country: for these there is an increase in mean export value. For the majority of countries in the sample, however, the mean value in 2006 is well below that observed in 2004.

[Figure 3 inserted about here]

These figures highlight the change observed between 2004 and 2006 in the pattern and value of trade, but they make a more fundamental point as well: the most accomplished exporters in apparel traded with a large number of trading partners. While the focus of the debate over the elimination of the ATC has been on the flows of exports from Asia to the US and the EU, the Asian exporters are involved in sales to many more countries than these – in fact, to a majority of the countries in the sample. Table 1 indicates the number of countries receiving exports from seven major exporters of textiles and apparel, respectively. The six Asian countries presented in the table have customers in a great majority of the countries of the world – as does the US. Most countries do not have this great diversification of exports – in fact, in 2004, 69 percent of apparel exporters sold to fewer than half the countries in the sample. The export business is also not driven solely by low labor cost: the lists

[6] More precisely, we expect this to occur for the quantities traded. There will be two competing effects of quota elimination – a rise in quantity and a fall in the price at which the quantity is purchased. Our statement is consistent with a demand elasticity with respect to price greater than unity in absolute value.

of top-20 exporters in terms of number of markets served include a large number of developed countries.[7]

If our extension of Viner's logic to the world economy were correct, we'd anticipate a refocusing of trade in the aftermath of liberalization: fewer lower-cost exporters shipping more on average to each partner. Table 2 contradicts this logic. The proportion of bilateral trading pairs in the sample for which positive (i.e., value greater than zero) exports are observed is rising throughout the period, but it continues to rise in 2005 and 2006. To understand this conundrum, we must examine the pattern and value of trade in a structural model that allows us to separate the Vinerian aspects of quota removal from other driving factors.

II. Modeling the bilateral import-export decision.

To identify the impact of quotas on the pattern and volume of bilateral trade, it is necessary to control for the other factors determining trade in these goods. In this section we provide a structural model of the decision to import from one country to another adapted from HMR to the features of world trade in apparel.

A. Consumer demand. In country j and in time t, each individual b consumes a quantity $\xi_{bjt}(\nu)$ of each variety ν of textiles (or apparel) from a continuum of varieties along the interval $[0\ \beta]$, with β the share of individual income spent on these varieties. He derives utility in a Dixit and Stiglitz (1977) aggregator as below:

$$U_{bjt} = \{\int \xi_{bjt}(\nu)^{\alpha}\, d\nu\}^{(1/\alpha)} \qquad 0 < \alpha < 1 \qquad (1)$$

and optimizes subject to variety price $p_{jt}(\nu)$ and budget constraint $\beta Y_{bjt} = \int p_{jt}(\nu)\, \xi_{bjt}(\nu)\, d\nu$.
If $Y_{jt} = \Sigma_b\, Y_{bjt}$ is the real income of country j in time t, then the country-j expenditure for variety ν is

$$p_{jt}(\nu)\, x_{jt}(\nu) = p_{jt}(\nu)\, \Sigma_b\, \xi_{bjt}(\nu) = [p_{jt}(\nu)/P_{jt}]^{1-\varepsilon}\, \beta Y_{jt} \qquad (2)$$

$$P_{jt} = \{\int p_{jt}(\nu)^{1-\varepsilon}\, d\nu\}^{1/(1-\varepsilon)} \qquad (3)$$

Where $p_{jt}(\nu)$ is the price of variety ν in country j at time t.[8] P_{jt} is the sector's ideal price index, and every product ν has a constant price elasticity $\varepsilon = (1/(1-\alpha))$ defined to be positive.[9] These goods could either be locally produced or produced in foreign countries.

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[7] In apparel, six of the top 10 exporters in terms of numbers of trading partners are developed countries (Italy, Germany, France, Spain, UK and US). In textiles, seven of the top 10 exporters in terms of numbers of trading partners (those above plus Belgium) are developed countries.

[8] This derivation is appropriate for differentiated products with the same quality. If the differentiated products differ as well along a quality dimension, Hallak (2006) demonstrates that a similar derivation will hold with ξ_{bjt} and $p_{jt}(\nu)$ defined in quality-adjusted units. For example, if quality of goods from supplier i is defined θ_i and

B. Quality divergences from $p_{jt}(\nu)$. The country-j market is an imperfectly competitive one, but $p_{ijt}(\upsilon)$ can diverge from the country-j average $p_{jt}(\upsilon)$ if there are differences in country-specific quality. With quality denoted by θ_i for each exporter i (and average quality given value of 1), the equilibrium prices in importer j in period t will have the relation defined in (4).

$$p_{ijt}(\upsilon)/\theta_i = p_{jt}(\upsilon) \qquad \text{for each variety } \upsilon \text{ without quota} \qquad (4)$$

C. Producer characteristics. Suppliers create each product through use of labor. The total cost of production for an individual supplier f is given in labor units as

$$C_{fit}(\nu) = c_{it}a_f(\nu)x_f(\nu) + F_{fit}(\nu) \qquad (5)$$

The first element of the summation is the variable cost, with $x_f(\nu)$ as a measure of total production.[10] The second element is the fixed cost of producing for export; it will be the summation of fixed costs for exporting to all export markets.[11] For each variety ν there is a distribution of suppliers in each country. Supplier-level heterogeneity is decomposed into two parts. First, there is a global distribution of technology. We use labor input per unit of output (or the inverse of productivity) as the index, denoted by "a". (Low values of "a" represent low-cost, or high-productivity, firms, and high values represent the converse.) All suppliers worldwide have technology defined by a supplier-specific draw a_f from the time-invariant distribution g(a) bounded in the range $[a_L\ a_H]$. Second, there is a country-level difference in production cost c_{it} that scales up or down the productivity of all suppliers in that country. Consider a continuum of suppliers in country i at time t. The per-unit variable cost of each country-i firm in time t is defined $c_{it}a_f(\nu)$. Each supplier f in country i will have unit cost $v_{fit}(\nu) = c_{it}\ a_f(\nu)$ in selling in the domestic market and $v_{fijt}(\nu) = c_{it}\ a_f(\nu) + F_{ijt}(\nu)/x_f(\nu)$ in exporting to a foreign country.[12]

If country j imposes binding quotas $q_{kjt}(\nu) < x_{kjt}(\nu)$ on the quantity imported from country k in period t, then the quantity imported from country k will be less than the optimal quantity defined

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the price of product ν from supplier i to country j is $p_{ijt}(\nu)$, then $p_{jt}(\nu)\ x_{jt}(\nu) = (p_{ijt}(\nu)/\theta_i)^{1-\varepsilon}\ Y_{jt}/P_{jt}^{1-\varepsilon}$, where $P_{jt} = \{\int (p_{ijt}(\nu)/\theta_i)^{1-\varepsilon}\ d\nu\}^{1/(1-\varepsilon)}$. We return to this point in the next section.

[9] As Novy (2010) points out, this CES assumption is a restrictive specification. Novy uses a translog gravity function and data from 28 OECD countries between 1991 and 2000 to point out that a more general form will lead to systematic variability in the elasticity of trade with respect to transport costs. We intend to investigate the importance of this for our analysis in future research.

[10] Given the producer's technology, we assume that it is either producing at full capacity or not producing at all.

[11] This fixed cost is exemplified by the distribution network that an exporter must establish prior to servicing a new market.

[12] The total fixed cost $F_{fit} = \Sigma_j F_{ijt}$, where j is summed over the set of countries to which the supplier exports.

by (2) for this variety. This will lead to the protection of domestic industry, the deadweight losses associated with quotas, and a wedge between the price received by the producer and the price paid by the purchaser. τ_{ijt} is one plus the tax-equivalent percent of the wedge created by a binding quota by country j on country-i goods. [13] Without loss of generality, we define a share χ_{ij} that is transmitted through to an increase in $p_{jt}(v)$, the average price of the import variety subject to the quota in country j.[14] The remainder share is transmitted to country-j exporters through lower effective price received for exports.

Not all producers will export to all countries. Define $\Pi_{ijt}(v)$ as supplier profits due to exporting from country i to country j in period t. The zero-profit condition in (6) defines the lowest-productivity firm $a^o_{ijt}(v)$ able to export variety v to country j. A definition of this productivity level is reported in (7).

$$\Pi_{ijt}(v) = [p_{ijt}(v)/[\tau_{ijt}\,(1+s_{ijt})(1+t_{ijt})] - c_{it}a^o_{ijt}(v)]\; x_f\,(v) - c_{it}\,F_{fit}(v) \;= 0 \qquad (6)$$

$$\{(\theta_i/c_{it})p_{jt}(\upsilon)/[\tau_{ijt}\,(1+s_{ijt})(1+t_{ijt})]\} - F_{fit}(v)/\; x_f\,(v) \;= a^o_{ijt}(v) \qquad (7)$$

s_{ijt} is the percent shipping cost from country i to country j and t_{ijt} is the *ad valorem* tariff (or tariff-equivalent of any other non-tariff barrier) imposed by country j on the products of country i. As shipping costs, country-specific production costs, fixed costs or tariffs rise, the critical $a^o_{ijt}(v)$ will fall (i.e., the necessary productivity level to be an exporter to j will rise). As $p_{jt}(v)$, the average import price in country j, rises or country-specific quality rises, $a^o_{ijt}(v)$ will rise. For suppliers in country i with high-productivity draws $a_f < a^o_{ijt}$ there will be non-negative profits in exporting to country j; for firms with $a_f > a^o_{ijt}$ there will be no exporting to country j. Since the cut-off differs by trading partner, those firms in country i unable to export to country j may be able to export to country k so long as their observed "a" falls in the range $[a^o_{ijt}\;\; a^o_{ikt}]$.

Note the important end-point restrictions. The calculation in (6) puts no limits on a^o_{ijt}, but we know that "a" is drawn from the range $[a_L\; a_H]$. If $a^o_{ijt} < a_L$, this indicates that none of the country-i suppliers can be profitable in selling to country j. If $a^o_{ijt} > a_H$, then all country-i suppliers will be profitable in selling in the country-j market.

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[13] It is simplest to think of this as the ratio of the landed price of the good divided by the exporter effective price augmented by transportation costs. The difference is the price of a tradable permit purchased by the producer to export one unit under the quota. The cost of this permit will be considered among the operating costs of the firm, and will reduce its profits. (If the firm is itself the owner of the quota, it will nevertheless be in its interests to consider the permit as an asset to be used or rented – if possible – at a market price.) An alternative model will include quota rents accruing to the exporting country. These rents will raise the rent-inclusive price of the export, and will have different implications for trade patterns.

[14] I.e., $dp_{jt} = (p_{jt}\,\chi_{ij}/\tau_{ijt})\,d\tau_{ijt}$ and the effective exporter price is $p_{jt}\,/\tau_{ijt}$ with $d(p_{jt}\,/\tau_{ijt}\,)/d\tau_{ijt} = -(1-\chi_{ij})\;p_{jt}\,d\tau_{ijt}$

D**. Equilibrium in country j for variety ν.** Demand for variety ν in country j is given by $x_{jt}(\nu)$ in equation (2). Supply of variety ν to country j is determined by the individual firms' zero-profit conditions in equation (6). As the price $p_{jt}(\nu)$ at which the variety can be sold rises, $a^o_{ijt}(\nu)$ rises. This increases (or at worst leaves constant) the number of suppliers in country i willing to export to country j.

The supply from country i to country j (X_{ijt}) and the total supply to country j (X_{jt}) of variety ν can be defined:

$$X_{ijt}(\nu) = {}_{aL}\int^{aoijt(\nu)} x_f(\nu)\, g(a)\, da \qquad (8)$$

$$X_{jt}(\nu) = \Sigma_i\, X_{ijt}(\nu) \qquad (9)$$

Note that both $X_{ijt}(\nu)$ and $X_{jt}(\nu)$ are non-decreasing in the price $p_{jt}(\nu)$ through the "cut-off" productivity values $a^o_{ijt}(\nu)$.

Equilibrium in country j in the market for variety υ is defined by the equality of supply and demand:

$$X_{jt}(\nu) = x_{jt}(\nu) \qquad (10)$$

The equilibrium $p_{jt}(\nu)$ and $a^o_{ijt}(\nu)$ are jointly determined through the zero-profit condition for each supplier country. This equilibrium is not determined in isolation: firms potentially supplying variety ν will also consider exporting to other countries, and will be competing for scarce resources with suppliers of other varieties – and other goods. The set $\{p_{jt}(\nu),\ a^o_{ijt}(\nu)\}$ equilibrate to leave country i at full employment.[15] As different varieties are uniquely associated with different countries, we suppress the index for variety in the sections that follow.

E. Deriving the value of bilateral trade. The landed (i.e., cif) value of textile or apparel imports from i into j in time t is

$$M_{ijt} = [p_{ijt}/(1+t_{ijt})]\, x_{ijt} \qquad (11)$$

$$= [\theta_i/(1+t_{ijt})]\, p_{jt}\, x_{jt}\{x_{ijt}/x_{jt}\}$$

$$M_{ijt} = Y_{jt}\, \Delta_{ijt}\, V_{ijt} \qquad (12)$$

[15] We also anticipate that c_{it} , while fixed at any point in time, could adjust over a longer horizon. One interpretation of c_{it} is as the labor cost in country i, exogenous to each firm at each moment but adjusting over time to achieve full employment.

Where $V_{ijt} = X_{ijt}/X_{jt} = (1/N_{jt})[1+\int_{aojt}^{aoijt} g(a)\,da]$ for $a^o_{ijt} > a^o_{jt}$

or $= (1/N_{jt})[1-\int_{aoijt}^{aojt} g(a)\,da]$ for $a^o_{ijt} < a^o_{jt}$

or $= 0$ for $a^o_{ijt} < a_L$

and where $\Delta_{ijt} = \theta_i\beta(p_{jt}/P_{jt})^{1-\varepsilon}/(1+t_{ijt})$

Bilateral trade values as defined in (12) thus depend on three elements. The GDP of the importing country Y_{jt} represents the purchasing power of the importing economy. Δ_{ijt} represents the cost of an import from exporter i relative to other products available within the economy. V_{ijt} measures the technological competitiveness of country-i producers in the country-j market, inclusive of the impact of tariff barriers to trade.[16] If $a^o_{ijt} < a_L$, then $x_{ijt} = 0$ and $V_{ijt} = 0$. As a^o_{ijt} rises above a_L, the number of exporters from country i to country j will rise and the share V_{ijt} will rise as well. As the number of exporters rise, so also does the value of trade. Country i will have a greater than proportional share of market j in this variety so long as $a^o_{ijt} > a^o_{jt}$, where a^o_{jt} is the average competitiveness parameter of countries exporting to country j in period t. As the tariff rate rises, the landed value of imports will fall.[17]

It will be useful in what follows to consider a specific technology distribution function. We follow HMR in assuming that g(a) follows a constant Pareto distribution across time and country.

$$g(a) = \kappa a^{\mu-1}/(a_H^{\mu} - a_L^{\mu}) \qquad \text{with shape parameter } \mu \qquad (13)$$

The distribution nests the uniform distribution as a special case with $\mu = 1$, but also admits distributions skewed towards a higher marginal cost of production for $\mu > 1$ and distributions skewed toward a lower marginal cost of production for $\mu < 1$. Given this parameterization, the variable V_{ijt} from (12) can be rewritten as

$$V_{ijt} = W_{ijt}/V_{ojt} \qquad (14)$$

With $V_{ojt} = N_{jt}(a_H^{\mu} - a_L^{\mu})(\mu/\kappa)/a^{o\,\mu}_{jt}$

And $W_{ijt} = \{(a^o_{ijt}/a_L)^{\mu} - 1\}$ for $a^o_{ijt} > a_L$

$= 0$ otherwise

[16] We impose an assumption of equal capacity x_f for all firms in all countries for explication, and define the "average" competitiveness through definition of a^o_{jt} such that $(x_{jt}/x_f) = N_{jt}\int_{aL}^{aojt} g(a)\,da$, with N_{jt} the number of countries with positive exports to country j in period t.

[17] Note that the quota wedge does not enter directly into this expression. In equilibrium, the prices of the imperfectly competitive goods at the border differ only by their quality. The quota's effect is to lower the effective price received by the exporter in the quota-levying country by the amount of the quota rent.

V_{ojt} is a measure of average penetration into market j, and exporters in country i take it as given. It will tend to zero as the average a^o_{jt} becomes large. W_{ijt} is the country-i indicator of competitiveness in market j, and is an explicit function of the cut-off productivity a^o_{ijt} in country i.

The positive correlation between the number of export markets served and the mean value of exports per export market noted by HMR and evident in apparel trade during the period 1994-2006 follows from this theoretical feature of the model. Exporting countries with (for example) lower production cost (c_{it}) will have higher cut-off productivity a^o_{ijt} for all importers j. This leads both to export to more countries through (6) and to larger mean value of imports to those countries through (12).

This is not a model that specifies the sources of comparative advantage, and as such is consistent with a wide range of explanations. The relatively lower production cost (c_{it}) could have its source in factor abundance or in technological differences. For the episode at hand (the elimination of binding quotas) this is not a drawback; fundamental determinants of comparative advantage will not be changing over the time horizon considered here.[18]

F. Implications of quota elimination.

Based on Vinerian logic, we predicted two sets of effects of removal of binding quotas on international trade in textiles and apparel. First is the effect of "focusing" the volume of trade: exporters that could not under binding quota export as much as they'd like to the quota-imposing importers will be able to increase the quantities shipped there and potentially decrease the quantities shipped elsewhere. Second is the reversal of trade diversion, trade deflection and trade destruction as indicated by a changing pattern of trade.

The imperfect-competition model of the previous section provides a structure for formal derivation of these two effects. In the notation of equation (12), the quota's effects will be found through changes in both Δ_{ijt} and V_{ijt} for any countries i and j. We identify four categories of countries for which the effects will differ. We denote countries h and j as importers; h is an importer not imposing a binding quota, and j is an importer imposing a quota binding on at least one exporter. We denote countries i and k as exporters, with country i not subject to a binding quota and country k subject to country j's quota. This delineates four categories of trading partners and four sets of comparative static results.

1. **Direct impact of quota**. For importer country j with quota imposed on exporter k:

$$\partial M_{kjt}/\partial \tau_{kjt} = Y_{jt}\, \Delta_{ijt}\, [G(a^o_{ijt})/N_{jt}](\partial a^o_{kjt}/\partial \tau_{kjt})$$

[18] It is valid to assert that changes in the world price of cotton will have systematic effects on the costs in exporting countries. We will control for such global phenomena in estimation through time-specific effects.

$$- (\varepsilon\text{-}1)\, Y_{jt}\, V_{ijt}\, [\theta_i\beta/(1+t_{ijt})]\, (p_{jt}^{-\varepsilon}/P_{jt}^{1-\varepsilon}))](\chi_{kj}\, p_{jt}/\tau_{kjt})$$

$$(\partial a^o_{kjt}/\partial\tau_{kjt}) = -\{(\theta_k/c_{kt})/[\, \tau_{kjt}\, (1+s_{kjt})(1+t_{kjt})]\}\, (1-\chi_{kj})p_{jt}/\tau_{kjt} \;< 0$$

The removal of the quota will cause an increase in a^o_{kjt} for $\chi_{kj} < 1$: to the extent that the quota lowered exporters' per-unit revenue, removal of the quota increases the share of producers able to export profitably. It will also increase the value of landed imports into the quota-imposing country, through the increase in exporters and through the increase in demand for the product after elimination of the wedge τ_{kjt} (so long as $\chi_{kj} > 0$).

The first term in the derivative $\partial M_{kjt}/\partial\tau_{kjt}$ includes the expression $G(a^o_{ijt})$, the cumulative distribution of firms in country i with a less than a^o_{ijt}. This cumulative distribution will be non-negative, but can take the value of zero for $a^o_{ijt} < a_L$ and the value of one for $a^o_{ijt} > a_H$.[19]

2. **Indirect impact on other import partners h of exporter k**:

$$\partial M_{kht}/\partial\tau_{kjt} = Y_{ht}\, \Delta_{kht}\, [G(a^o_{kht})/N_{ht}](\partial a^o_{kht}/\partial\tau_{kjt}) \geq 0$$
$$(\partial a^o_{kht}/\partial\tau_{kjt}) = -\, (\partial F_{kht}/\partial\tau_{kjt})$$

The quota will cause trade deflection to the extent that it lowers the fixed cost of exporting to other import partners. Removing the quota will cause a fall in a^o_{kht}, a potential reduction in the number of import partners, and possibly a reduction in the share of country-k producers exporting to these partners. The inequality in the first expression is contingent upon the value of $G(a^o_{kht})$.

3. **Indirect impact on other exporters i to importer j**:

$$\partial M_{ijt}/\partial\tau_{kjt} = Y_{jt}\, \Delta_{ijt}\, [G(a^o_{ijt})/N_{jt}](\partial a^o_{ijt}/\partial\tau_{kjt})$$
$$- (\varepsilon\text{-}1)\, Y_{jt}\, V_{ijt}\, [\theta_i\beta/(1+t_{ijt})]\, (p_{jt}^{-\varepsilon}/P_{jt}^{1-\varepsilon}))](\chi_{kj}\, p_{jt}/\tau_{kjt})$$

$$(\partial a^o_{ijt}/\partial\tau_{kjt}) \;= \{(\theta_i/c_{it})/[(1+s_{ijt})(1+t_{ijt})]\}\, (\chi_{kj}\, p_{jt}/\tau_{kjt})$$

The price p_{jt} rose in the quota-imposing country (so long as $\chi_{kj} > 0$). Removing the quota will cause p_{jt} to fall. This will have offsetting effects on exports from country i. First, there is the reversal of trade diversion: it reduces the measure of producers a^o_{ijt} in exporter i able to sell into importer j (and perhaps eliminates i as an exporter). Second, the country-j demand for these products will rise due

[19] Using the parametric expression of the previous section, $G(a^o) = [a_H{}^\mu/(a_H{}^\mu - a_L{}^\mu)](1-(a_L/a^o)^\mu)$. Replacing a^o with a_L and a_H, respectively, yields the results in the text.

to the reduced price of these exports, and this will be reflected ceteris paribus in increased exports from country i.

4. **Indirect impact on other import partners h and other exporters i:**

$$\partial M_{iht}/\partial \tau_{kjt} = 0$$
$$(\partial a^{o}_{iht}/\partial \tau_{kjt}) = 0$$

These four are the substitution effects that we anticipate from quota removal for given p_t. Given the size and market share of the quota-levying countries, we should add to these the potential general-equilibrium effects on p_{jt} for each importer j.[20] Removal of the bilateral quotas will reduce consumer price in quota-levying countries, increase demand for apparel and thus increase the observed p_{jt} for non-quota-levying countries.[21]

5. **General-equilibrium effects for other import partners h and other exporters i:**

$$\partial a^{o}_{iht}/\partial p_{ht} > 0$$
$$\partial M_{iht}/\partial p_{ht} < 0 \qquad \text{for } \varepsilon > 1$$

The last comparative static suggests that ignoring general-equilibrium effects on final-good prices in importing countries or production cost in exporting economies (e.g., wages) will limit the explanatory power of the model. The conundrum of the introductory section suggested that increased export reach was a characteristic of many countries.

III. Estimation.

The model of imperfect competition presented in the previous section provides a parsimonious summary of possible determinants of trade pattern and value. Our hypothesis is that elimination of the quota system in the US and EU has had significant effects on the pattern and value of international trade in textiles and apparel. We specifically anticipate that the elimination of quotas will eliminate the patterns of trade diversion, trade deflection and trade destruction that theory predicted as outcomes in the presence of binding quotas. Our estimation strategy is complicated by the fact that we begin from a quota-ridden environment: the "experiment" examined here is the movement from the distorted market to a non-distorted market. It is further complicated

[20] Staritz (2011), using COMTRADE data, reports that the US and fifteen-member EU together represented over 67 percent of total world imports of apparel in both 1995 and 2005.

[21] Viner (1950) did not address this terms-of-trade argument, but Meade (1956) and Lipsey (1957) did. Conway, Appleyard and Field (1989) provide an exposition of the point in a continuum-of-goods model.

by the fact that quotas were removed in four steps, in 1995, 1998, 2002 and 2005. The final two steps were the most important in terms of quantitative impact, but there could also be an "announcement effect" on trade patterns from the introduction of the quota-elimination plan under the ATC in 1995.

Identification of separate pattern-of-trade and value-of-trade equations is a problem in this model with its unobserved fixed cost. Our modeling strategy is quite similar to that of HMR, and thus it is instructive to consider their identification strategy. In HMR, there are stochastic components to fixed and iceberg trade costs, and the first appears only in the export-decision equation (6). The authors introduce a regulation-cost variable to instrument for the unobserved fixed-cost effect.[22] The authors check the robustness of this strategy by introducing a second instrument (religion) for fixed cost and verify that their estimation results are insensitive to choice of instrument.

Our identification strategy does not introduce outside instruments, but rather relies in part upon dividing the data into two subsets. With the earlier subset we derive estimates of the c_i and c_i/θ_i parameters; we use these estimates in the later subset to identify the coefficients of the estimating equations.

Equations (7) and (12) define the landed value of bilateral imports and the decision on whether to export on a bilateral basis as functions of the structural parameters and variables of this model. The ratio (a^o_{ijt}/a_L) is the critical determinant of the pattern of bilateral trade in equilibrium from country i to country j in period t. Combining (12) with (6) yields an expression for the unobserved a^o_{ijt}/a_L.[23] In the following equations we outline our modeling choices for parameterizing this model.

$$\ln(a^o_{ijt}/a_L) = \ln(p_{jt}) - \ln(a_L) - [\ln(c_{it}/\theta_i)] - s_{ijt} - \tau_{ijt} - t_{ijt} - f_{ijt} \quad (15)$$

$$s_{ijt} = b_1 \ln(D_{ij}) + b_{2t} H_t + b_3 DB_{ij} \quad (16)$$

$$\ln(c_{it}/\theta_i) = \hat{c}_i + \zeta_{ijt} \quad (17)$$

$$\tau_{ijt} = b_4 NB_{iUt} + b_5 QB_{Ujt} \quad (18)$$

$$\ln(a_L) = - b_o \quad (19)$$

$$f_{ijt} = b_{6i} H_i + b_7 QB_{iNUit} + b_{8j} H_j + b_{9t} H_t \quad (20)$$

$$\ln(p_{jt}) = b_{10t} H_t \quad (21)$$

---

[22] Identification of the coefficients in the import volume equation is also assured (for HMR and for this model) by the non-linear nature of the estimation equation, a product of the specific Pareto distribution assumed for unobserved productivity.

[23] In this expression, we also use the approximations $s_{ijt} = \ln(1+s_{ijt})$ and $t_{ijt} = \ln(1+t_{ijt})$. These are used for exposition, but not in estimation. We define $f_{ijt}=\ln(F_{ijt}/x_f a_L)$.

The transport cost ratio (s_{ijt}) is not observed annually, but in (16) is proxied by an iceberg model with shipping costs proportional to distance (D_{ij}), with an indicator variable for adjacent countries (DB_{ij}) to capture the potentially lower shipping costs due to propinquity, and with year-specific variation picked up by year-specific dummy variables H_t. The exporter cost/quality ratio $\ln(c_{it}/\theta_i)$ is treated in (17) as a stochastic variable with exporter-specific value $\hat{c}_i$ and random component ζ_{ijt}. The binding quotas in either the US or EU markets are introduced in three ways. QB_{iNUt} represents the "trade deflection" hypothesis (category 2) that the binding quota could lead to willingness by firms in quota-constrained exporter i to sell "excess" product in unrestricted markets.[24] NB_{iUt} is an indicator variable indicating trade with the EU and US, respectively, by countries i not under binding quota: these pick up the "trade diversion" hypothesis (category 3). The QB_{Ujt} is an indicator variable taking the value of one for a country with exports under binding quota when it is the importer in bilateral trade: trade destruction will lead to reduced imports by those countries if there is unexported product due to the binding quota. The lowest-cost technology $\ln(a_L(v))$ is represented by a constant in (19).[25] $f_{ijt}(v)$ is unobserved, but is modeled in (20) as having importer-specific, exporter-specific and time components, along with a trade-deflection effect on countries with binding quotas. Free trade across countries implies a unified quality-adjusted price $\ln(p_{jt})$ that is represented in (21) by a time-specific dummy variable.

The exporter-specific cost/quality ratio $\hat{c}_i$ is unobserved. We instrument for this by partitioning our data. We use the year 1994 as indicative of the quota-driven trading pattern: it represents trading patterns observed prior to the phasing out of the ATC quotas agreed upon in 1995. We estimate a probit model to derive the country-specific estimate $\hat{c}_i$ for that year.[26] We normalize the country-specific estimate in estimation so that $\hat{c}_{China} = 0$. This $\hat{c}_i$ is then a constructed instrument by definition uncorrelated temporally with trade costs. It enters the model symmetrically to the fixed-cost instrument posited by HMR, and plays the same role in identification.

$\ln(a^o_{ijt}/a_L)$ is itself unobserved. However, (14) shows that positive trade will be observed if $\ln(a^o_{ijt}/a_L) > 0$. We define the variable T_{ijt} as a binary indicator of trade. $T_{ijt} = 1$ if $M_{ijt} > 0$, and 0 otherwise.

$$T_{ijt} = 1 \quad \text{if and only if} \quad \ln(a^o_{ijt}/a_L) > 0 \tag{22}$$

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[24] We present the model in which the coefficient on binding quotas in US and in EU have identical coefficients and can thus be combined: e.g., $QB_{iNUt} = QB_{iNEUt} + QB_{iNUSt}$. This is true for all four categories reported here. Estimation results in which the two effects enter separately do not change the conclusions of the paper and are available from the authors.

[25] Category-1 effects of binding quotas are not expected to determine the pattern of trade since none of these quotas was set to zero.

[26] The modified version can be defined (15") below and is estimated for 1994 observations alone.

$$\ln(a^o_{ij94}/a_L)^* = (\kappa_{94} + \alpha_o) + \alpha_1 \ln(D_{ij}) + \alpha_2 \ln(1+t_{ij97}) + \alpha_3 DB_{ij} + \Sigma_i \gamma_i H_i + \zeta_{ij94} \tag{15"}$$

The estimates of γ_i are used as instruments for $\hat{c}_i$ when estimating (15) for years after 1994.

$= 0$ otherwise.

Substituting equations (16)-(21) into (15) yields (23), which when combined with (22) defines a probit specification.[27]

$$\ln(a^{o}_{ijt}/a_L) = \alpha_o + \alpha_1 \ln(D_{ij}) + \alpha_2 \ln(1+t_{ijt}) + \alpha_3 DB_{ij} + \alpha_4 \hat{c}_i + \alpha_5 QB_{Ujt-1} + \alpha_6 NB_{iUt-1} + \alpha_7 QB_{iNUt-1} + \Sigma_i \gamma_i H_i + \Sigma_j \sigma_j H_j + \Sigma_t \kappa_t H_t + \zeta_{ijt} \quad (23)$$

We have adjusted for the problems of missing data while also controlling for variables shown to be important in practice in explaining bilateral trade. The variables QB_{Ujt}, NB_{iUt} and QB_{iNUt} that belong in equation (23) are potentially simultaneously determined with the decision to export bilaterally. To remove that source of simultaneity bias we use the lagged values of these variables in (23). We also use both fixed- and random-effects specifications for the importer-specific effects; the random-effects results are preferred on econometric grounds because of the coefficient bias possible in fixed-effect estimation.[28] We then estimate the equations (22) and (23) over the sample period 1995-2006. The coefficients α_o, α_1, α_2, α_3, α_4 , γ_i , σ_j and κ_t represent the structure of the market, while the coefficients α_5 - α_7 represent the independent effect of the quota system on the pattern of trade.

Since we begin with a quota-ridden equilibrium, our indicator of quota liberalization is defined relative to that 1994 experience. If the exporting country faced a binding quota in 1994 and no binding quota in year t, then the variable QB_{ijt} will be equal to one. If the country faced no quota in 1994 and no quota in year t, then $QB_{ijt} = 0$. If the country faced no quota in 1994 but a binding quota in year t, then $QB_{ijt} = -1$.[29] Exporters without binding quota in either 1994 or year t are given a value 1 for NB_{iUt} for their exports to the EU or US and zero otherwise. The trade-destruction indicators QB_{Ujt} indicate the impact on imports of a change in binding-quota status for country j's exports. Theory predicts that α_5 will be greater than zero (trade destruction will be reversed), α_6 will be less than zero (trade diversion will be reversed), and α_7 will be less than zero (trade deflection will be reversed).

Equation (12) defines the value of bilateral exports in terms of structural parameters. When combined with (13) and (14) it is rewritten in logarithmic form as:

$$m_{ijt} = y_{jt} + \ln(\beta) + \ln(\theta_i) + (1-\varepsilon)[\ln(p_{jt}) + \ln(\tau_{ijt}) - \ln(P_{jt})] + w_{ijt} - v_{ojt} - t_{ijt} + e_{ijt} \quad (24)$$

---

[27] The theory predicts that $\alpha_o = b_o$, $\alpha_1 = b_1$, $\alpha_2 = -1$, $\alpha_3 = b_3$, $\alpha_4 = -1$, $\alpha_5 = b_5$, $\alpha_6 = b_6$, $\gamma_i = b_{7i}$, $\alpha_7 = b_7$, $\alpha_8 = b8$, $\sigma_j = b_{8j}$, $\kappa_t = (b_{2t} + b_{9t} + b_{10t})$.

[28] See, for example, Greene (2005, p. 697) for a description of the bias. We report the random-effect results throughout this paper, and can provide the fixed-effect results on demand.

[29] An exporter facing a binding quota in both period 1994 and year t will also have $QB_{ijt} = 0$.

$$\ln(\theta_i) = \hat{\theta}_i \tag{25}$$

$$w_{ijt} = \ln\{(a^o_{ijt}/a_L)^{\mu} - 1\} = \ln\{\exp[g_1 \rho_{ijt}]-1\} \tag{26}$$

$$\ln(p_{jt}/P_{jt}) = g_{2t} H_t - g_3 (y_{jt-1} - l_{jt-1}) \tag{27}$$

$$\ln(\tau_{ijt}) = g_4 QB_{iUt-1} + g_5 QB_{iNUt-1} + g_6 NB_{iUt-1} + g_7 QB_{Ujt-1} \quad _1 \tag{28}$$

for the observations with $M_{ijt} > 0$. The quality of products exported is indicated by θ_i; the 1994 observations will be used to estimate a measure $\hat{\theta}_i$ for use in subsequent years. The variable w_{ijt} captures the proportion of exporting firms to sell in a given market. It is unobserved, but a consistent estimator of it is derived in (25) using the predicted probability (ρ_{ijt}) of the direction-of-trade probit estimated from (22) and (23). The variable v_{ojt} is unobserved, but is dependent upon importer-specific characteristics modeled with fixed effects. The relative import-cost term $\ln(p_{jt}/P_{jt})$ is unobserved, but is proxied in (26) by a time-specific effect, the lagged value of importer income (y_{jt-1}) and the logarithm of lagged per capita income in the importing country ($y_{jt-1} - l_{jt-1}$). As these rise, other things equal, we expect bilateral imports to rise. In addition to the quota variables defined earlier, the direct impact of the binding quota (category 1) on the value of trade is represented by QB_{iUt-1}. There is also a selection bias inherent in the censored sample of only country pairs with non-zero trade, and that implies that the expected value of e_{ijt} will be non-zero. To correct for this, the inverse Mills ratio z_{ijt} is included with coefficient η.[30]

With these substitutions, the estimating equation (24) can be restated as[31]

$$m_{ijt} = \hat{\theta}_i + \omega_1 y_{jt-1} + \omega_2 l_{jt-1} + \omega_3 \ln(1+t_{ijt}) + \Sigma_t \omega_{4t} H_t + \ln\{\exp[\omega_5 \rho_{ijt}]-1\} + \omega_6 QB_{iUt-1} + \omega_7 QB_{iNUt-1} + \omega_8 NB_{iUt-1} + \omega_9 QB_{Ujt-1} + \Sigma_j \omega_{14j} H_j + \eta z_{ijt} + e_{ijt} \tag{29}$$

The equations (23) and (29) are simultaneously determined equations. The independent effect of ρ_{ijt} in (29) is identified through two channels. First, the cost ratio $\hat{c}_i$ that affects the decision to trade in (16') does not in theory enter (28) separately from ρ_{ijt}. Second, ρ_{ijt} is a non-linear function of the shared explanatory variables. Equation (28) is itself identified by the inclusion of importer-specific variables y_{jt-1} and l_{jt-1}.

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[30] Heckman (1974) provides the derivation of bias inherent in such censoring in the case of female labor supply decisions. Maddala (1983, ch 8.5) outlines the two-stage correction.

[31] In theory, $\omega_o = \ln(\beta)$, $\omega_1 = 1-(1-\varepsilon)g_3$, $\omega_2 = (1-\varepsilon)g_3$, $\omega_3 = -1$, $\omega_{4t} = (1-\varepsilon)g_{2t}$, $\omega_6=g_1$, $\omega_6=(1-\varepsilon)g_4$, $\omega_7=(1-\varepsilon)g_5$, $\omega_8=(1-\varepsilon)g_6$, $\omega_9=(1-\varepsilon)g_7$, $\omega_{10}=(1-\varepsilon)g_8$, $\omega_{12}=(1-\varepsilon)g_9$, $\omega_{11}=(1-\varepsilon)g_9$, $\omega_{12j}=\varphi_j$.

IV. Estimation results.

This structural model of bilateral trade in apparel shares some of the predictions of the gravity model. The value of bilateral trade will rise with the national income of the importer, with the share of income spent on this product, and with Δ_{ijt}. This latter term summarizes the predictions of greater trade through propinquity, lower transport costs, quality differences, general-equilibrium effects on prices, and lower policy barriers to trade.

The appearance of V_{ijt} provides a wrinkle to the gravity model stressed by HMR. There is a possibility of "zeros": there will be some countries in which none of the firms will be able to export to country j. [32]

The imposition of country-specific quotas will bias bilateral trade in predictable ways. The value imported from countries with binding quotas will be limited relative to the non-quota equilibrium, the number of countries exporting to the countries with binding quotas will be at least as large, and the number of countries served by an exporter subject to a binding quota will be at least as large as in the non-quota equilibrium. Estimation of the model will allow quantification of these effects.

The preferred estimation strategy for gravity models has become contested in recent literature due to the twin problems in these data of country-specific heteroskedasticity and common zero values. Santos Silva and Tenreyro (2006) propose a Poisson Pseudo-Maximum Likelihood (PPML) estimator, while HMR use a two-step Heckman correction. Martin and Pham (2009) conduct a comprehensive Monte Carlo test of these and other estimators, and conclude that when suitable instruments are available for the first and second stage, the Heckman correction is preferred. We introduce appropriate instruments in the next sections and will follow the two-step Heckman procedure in estimation.

The cost ratio from 1994.

Equations (22) through (24) represent equilibrium conditions for the apparel market in each year. To create a benchmark for analysis of adjustment in later years, we estimate these equilibrium conditions for the pattern of trade observed in 1994 – the last year before the ATC agreement and the establishment of a schedule for phased removal of quotas.

We estimate the pattern-of-trade equations (22') and (23') for 1994. The exporter-specific cost-quality ratio is estimated directly in this probit through inclusion of exporter-specific dummy variables. There is an unobserved importer-specific effect to represent the importer-specific price differential and any effects of binding quotas. Distance (D_{ij}), 1994 tariffs (t_{ij94}) and shared-border effects (DB_{ij}) are the final determinants.

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[32] Baranga (2008) provides a different interpretation of the HMR results – one of selection bias driven by defining missing trade values as "zeros" in the data set. This is an interesting direction for future research.

$$T_{ij94} = 1 \quad \text{if and only if} \quad \ln(a^{o}_{ij94}/a_L) > 0 \qquad (22')$$
$$= 0 \quad \text{otherwise.}$$
$$\ln(a^{o}_{ij94}/a_L) = \alpha_o + \alpha_1 \ln(D_{ij}) + \alpha_2 \ln(1+t_{ij94}) + \alpha_3 DB_{ij} + \hat{c}_i + \alpha_{4j} H_j + \zeta_{ij94} \qquad (23')$$
$$\text{with } \zeta_{ij94} = \psi_j + \omega_{ij94}$$

The results of this estimation are reported in Table 3.

There are two parts to the top panel to Table 3 reporting alternative techniques for introducing importer-specific non-quota differences of the pattern-of-trade probit (22'-23'). The top-left panel reports results for a fixed-effect estimation and the top-right panel reports results from a random-effects estimation. Both include fixed exporter effects to derive estimates of $\hat{c}_i$ that are nearly identical; those derived from the random-effects probit are used as $\hat{c}_i$ in what follows.
Coefficient estimates are found in the first of each pair of columns, with the standard errors of coefficients in the second of each pair. The coefficients on the distance variable are insignificantly different from the theoretical prediction of -1. There is a positive but insignificant border effect. Increased tariffs have the expected negative effect on the pattern of trade; the effect is significantly larger than zero in the random-effects estimation, but insignificant in the fixed-effect estimation. Random-effects and fixed-effects estimation led to nearly identical coefficients on these variables, except the just-mentioned difference in the tariff coefficient, and on the exporter-specific estimates of cost-quality ratio derived from the two techniques.

The exporter-specific quality measure in 1994.

Quality effects are derived for the quota-ridden equilibrium. The equation (29') is a restatement of (29) with the quota-liberalization variables excluded. It is estimated for 1994 to generate the indicators $\hat{\theta}_i$ of exporter-specific quality.

$$m_{ijt} = \hat{\theta}_i + \omega_1 y_{jt-1} + \omega_2 l_{jt-1} + \omega_3 \ln(1+t_{ijt}) + \Sigma_t \omega_{4t} H_t$$
$$+ \ln\{\exp[\omega_5 \rho_{ijt}]-1\} + \Sigma_j \omega_{6j} H_j + \eta z_{ijt} + e_{ijt} \qquad (29')$$

The bottom panel of Table 3 reports the results of this estimation for textiles and apparel trade in 1994. The signs of the coefficients are for the most part as expected. Importer income increases the value of trade and distance decreases it, as theory predicts. The tariff coefficient takes the wrong sign, but is insignificantly different from zero. The coefficients on firm heterogeneity (μ) and selection bias (η) take the correct sign, but only the selection-bias effect is significant. The exporter-specific quality indicator will also include the impact on value of exporter of binding quotas in 2004.

[Figure 4 inserted around here.]

Figure 4 illustrates the quality and cost ratios estimated for 1994.[33] There is a general negative tendency in the measures: those with high cost-quality ratios also have in general low measures of quality. Burkina Faso, Niger and Sudan illustrate this end of the spectrum. Those with low cost-quality ratios tend to have high quality measures: China, Hong Kong, Taiwan are found together with the US, Italy and France at that end of the spectrum.

Testing the hypothesis using the post-quota years: 2005 and 2006.

Estimation of the three-equation system (22), (23) and (29) for bilateral trade in the years 2005 and 2006 provides the clearest test for the existence of trade creation, trade diversion, trade deflection and trade destruction. In Table 4 we report the results of this estimation for bilateral trade in these two years. Coefficient estimates are reported in the first line, with standard errors in parentheses beneath each. Exporter-specific effects are estimated, as theory suggests, but are not reported here.

The pattern-of-trade probit estimation in the first column uncovers a structure similar to that predicted. The distance effect is significant and has a coefficient close to -1. The probability of positive exports to a country is increased significantly by sharing a border. Importing countries with higher tariffs are significantly less likely to trade with an exporter, on average. Increasing the importer tariff reduces significantly the likelihood that an exporter will sell in that market. The cost-quality ratio has effects nearly proportional to those observed in 1994: the coefficient (-0.94) is insignificantly different from proportionality at negative one. (There are exporter fixed effects specified for each country in addition to this "initial condition".) The likelihood of positive trade between two countries increased sharply in 2006 relative to 2005, as indicated by the coefficient (0.72) of T_{2006}.

An end to trade diversion plays an insignificant and very small role in the pattern of apparel trade, as evidenced by the coefficient (0.02). The trade deflection coefficient is significantly different from zero but positive and large (0.88) rather than negative: export countries with binding quotas in 1994 haven't focused on fewer trading partners once quotas are removed, but rather are likely to export to significantly more countries. The trade destruction effect (0.29) has the expected positive sign, but is insignificantly different from zero.

The second column of Table 4 presents the results of the value-of-trade estimation for apparel. Here once again the structure is as predicted by theory, with one major exception. Importer income and population enter positively and significantly in determining the value of bilateral trade: in this case, the population coefficient (0.08) reflects a smaller effect of population on trade value

[33] The values were rebased for illustration in this figure by subtracting values for Canada so that the Canadian point is at the origin; the others reported are relative to Canada for this illustration.

than was observed for textiles. Higher importer tariffs reduce trade values significantly, and with similar large (-3.04) coefficient. The firm-heterogeneity term and the selection-bias correction both enter with positive and significant coefficients, as predicted. The contradiction to theory comes in the distance coefficient; at (0.35) it is positive, though insignificantly different from zero. The average value of bilateral trade in 2006 was significantly reduced from 2005, in striking contrast to the increase in the propensity to trade noted above.

The quota effects on the value of apparel trade are large and significant. The trade creation effect of removing the quota (1.85) is large, positive and significant. The trade deflection effect (-3.32) is large, negative and significant: countries with binding quotas in 1994 have greatly reduced the average export value to third countries in 2005-2006. The trade diversion effect (0.36) is positive and significant, contrary to theory – countries not under quota in 1994 have expanded their average export value to the quota-levying countries in 2005-2006. Trade destruction also does not work as predicted: countries facing binding quotas in 1994 are importing significantly smaller values (-1.13) of apparel on average from trading partners than in 1994.

Country heterogeneity remains a significant component of the 2005-2006 experience with apparel exporting. In Figure 5 we summarize that country-specific experience. The countries are organized into four groups by the relative values of their country-specific coefficients in the regressions reported in Table 4. The top-right quadrant of Figure 4 includes those countries that, controlling for other factors, had rising propensity to export and rising average value of exports. This group includes many smaller African and East European exporters (Uganda, Estonia, Seychelles, Georgia); these are the unambiguous winners in terms of increased market share among those countries not initially under binding quota. The bottom-left quadrant includes countries that (other things equal) had falling propensity to export and falling average value of exports: this group includes most of the OECD countries as well as Taiwan and Israel. These are the countries that lost market share (as exporters) from the quota elimination. The bottom-right quadrant includes countries that diversified their exports in response to quota elimination: the propensity to export to a given market rose while the average value sold in each market fell with ambiguous effect on world market share. Included here are some OECD countries (France, Australia, Norway), as well as Brazil, Egypt, Morocco, Ukraine, Nicaragua and others from Central America. The top-left quadrant includes the countries that have focused their trade: lower propensity to export and larger average value of exports. These include the countries we associate with a comparative advantage in apparel: China, India, Pakistan, Sri Lanka, Malaysia, Thailand, Bangladesh, Philippines, and South Korea.[34] It also includes other countries that have narrowed their trade, such as Poland, Mozambique, Bolivia,

[34] This quadrant also includes the countries whose apparel was subject to quotas. Since the effects of the quotas are measured directly in estimation, these country-specific effects do not incorporate those bilateral effects measured in Table 4.

Costa Rica and Guatemala. For these, too, the net effect on world market share is ambiguous – more is exported on average to a smaller number of importing countries.

[Figure 5 inserted around here.]

While the significance of individual coefficients is instructive, it is also useful to measure the relative magnitude of effects of the various determinants of the pattern and value of bilateral trade. We do so in Table 5, with a decomposition of the total variation of trade observed in 2005/2006.[35] The exporter-specific characteristics derived from 1994 estimation (the "initial" entries) make a substantial prediction toward both pattern and value of trade in 2005/2006, with the cost-quality ratio from 1994 explaining over a quarter of total variation in the pattern of trade. Importer-specific effects are also important, explaining 14.2 and 15.9 percent, respectively, of the observed pattern and value of trade. Transport costs (as proxied by distance) make an important (7.7 percent) contribution to the pattern of trade, but are relatively unimportant in the value of trade; tariffs have the opposite effect, with almost no contribution to the pattern of trade while explaining 8.2 percent of variation in the value of trade. Firm heterogeneity and selection effects are measured only in the value of trade: the selection effect of the Inverse Mills Ratio makes a small (0.3) contribution to explaining the variation, while firm heterogeneity (specifically, the relatively smaller number of more productive firms in the distribution) has a large (19.1) effect.

Eliminating binding quotas had significant coefficients in Table 4, but as we see in Table 5 this explains almost none of the variation in the pattern of trade and only a small (2.3) proportion of variation in the value of trade. Time-specific effects and variation in exporter-specific effects contribute relatively small shares to total variation, while 46.1 and 38.7 percent of variation in the pattern of trade and the value of trade, respectively, is unexplained by the model estimated here.

Examining the evolution of trade in two sub-periods.

While the end of the quota system began with the 1995 ATC agreement, the bulk of the liberalization that occurred was observed in the period from 2002 to 2005. In this section we estimate the pattern and value equations for the two subperiods 1995-2001 and 2002-2006 to

[35] The decomposition is derived through a sequential addition of variables to the probit and non-linear regression specifications. This is straightforward in the case of the value regression, and represents a decomposition of the sum of squared residuals into the shares explained by each set of regressors. In the case of the probit, we use the log likelihood values in estimation to derive this. The probit regression of T_{ijt} on a constant defined the "zero" log likelihood, while the perfect explanatory power probit will have log likelihood of zero. The percentages of Table 5 represent the marginal contributions of each set of regressors. These percentages change by small amounts when the sequence of derivation is changed, but the qualitative message of Table 5 is unchanged.

uncover differences in the structure of bilateral trade. Our conjecture is that the later period will exhibit greater evidence of quota elimination than the former.

Table 6 reports the results of estimation of the pattern and value of trade in these subperiods.[36] The first two columns summarize the results for the pattern of trade. The effects of distance are significant, but are significantly greater than -1.0: transport costs proved to be less than proportional to the distance traveled. There is an increased propensity to export to one another for countries that are neighbors, and that effect becomes more pronounced in the more liberalized period. The impact of increased importer tariffs on the propensity to trade is negative but insignificant during the more quota-ridden period, but exhibits a stronger, significant negative effect during the more liberalized period.

The quality-adjusted cost advantage has coefficient significantly greater than -1 in the earlier period, but its value (-1.0) in the later period indicates that the conditions observed in 1994 in terms of propensity to export are in fact replicated in the more liberalized period once quota, time and country-specific effects have been controlled for. In the earlier period, the largest average propensity to export was observed in 1996, with a dip in 1997-1999 and a recovery in 2000; in the later period, the average propensity to export grew monotonically from 2002 to 2006. The rise in propensity to export was relatively largest in 2006.

Considering first the earlier period, relaxing quotas was associated with exports to more countries, rather than fewer, once again counter to theory. The trade diversion effect was negative and significant: once quotas are relaxed, those countries not subject to quotas had lower propensity to export on average. Trade deflection ran counter to theory: the significant effect (0.12) indicates that countries formerly with binding quotas were significantly more likely to export to other importers once the quotas were removed. The trade destruction effect was positive though insignificantly different from zero. In the later period, the trade deflection effect became insignificantly different from zero. The trade-diversion effect on propensity to export remained significant and negative, though smaller in magnitude than in the earlier period. The trade destruction effect was positive and significantly different from zero in the 2002-2006 period.

The value of bilateral trade in apparel is also largely stable in its non-quota determinants. The effects of importer income and population are quite similar in the two periods. Importer income has an almost identical elasticity (0.20, 0.21) while the elasticity of bilateral value with respect to population is smaller (0.06, 0.04) while still significantly different from zero. The elasticity of bilateral trade value with respect to importer tariff is negative, large (-6.01, -4.19) and significant in both periods. The effect of distance on value of bilateral exports is positive for apparel in 1995-

[36] The results in Table 4 are derived for a subsample of the data used in the second and fourth columns of Table 6.

2001, changing to a negative but insignificant value in 2002-2006. The firm-heterogeneity effect μ is large (1.95, 1.86), significantly greater than 1, and little changed from earlier to later period. The selection-bias term η is insignificantly different from zero in the earlier period, but becomes larger (0.52) and significantly different from zero in the period of greater quota liberalization. The average value of bilateral exports fell between 1995 and 2000. After a partial recovery in 2001, the average value fell monotonically from then through 2006.

The measures of quota elimination that we use allow us to identify the behavior of that group of countries with binding quotas in 1994. We characterize the trade of that group completely: QB_{iUt} captures the effect of quota relaxation on exports to the quota-setting country, QB_{iNt} captures the effect on exports by this group to countries not levying the quota, and QB_{Uit} captures the impact of quota relaxation on the imports (from all countries) of the goods under consideration. Following theory, we also consider the impact of quota relaxation on the exports to quota-setting countries (NB_{iUt}) by exporters not subject to binding quotas. Estimation results suggest the following conclusions about the direct effects of quota liberalization:

- There is evidence of trade creation with the relaxation of quotas: the coefficient on QB_{iUt-1} in the value-of-trade equation is invariably positive (1.64, 2.22) and significantly different from zero. It is larger in the period of greater quota elimination.
- There is evidence of the elimination of trade diversion. The coefficient on NB_{iUt-1} in the pattern-of-trade equation is negative while the coefficient in the value-of-trade equation is positive. Countries not previously subject to binding quotas were less likely to export to quota-setting countries with liberalization, while those that continue to export are selling larger values on average into the formerly quota-constrained markets.
- The expected effects of trade deflection are not in evidence. Theory predicts that countries subject to binding quotas will sell into third markets, but that behavior will be reversed once quotas are removed. In fact, the coefficients on QB_{iNt-1} indicate that the removal of binding quotas is associated with an increased propensity by these countries to export into third markets. However, as expected, the average value of exports into those markets is reduced.
- There is evidence that trade destruction is reversed with elimination of quotas. Those countries with binding quotas in 1994, indicated by QB_{Uit-1}, experienced a significantly increased propensity to import from exporters with the relaxation of quotas in 2002-2006. The average value of bilateral imports declined significantly.

The exporter-specific effects in the pattern-of-trade equation for the two sub-periods indicate a general increase in the propensity to export not limited to those with binding quotas. Figure 6 illustrates this phenomenon. The exporter-specific effect for the earlier period is charted on the

horizontal axis, and the exporter-specific effect for the later period is charted on the vertical axis. The solid line indicates equal values in the two periods. We observe that, after controlling for other determinants of export propensity, exporters with larger propensity in the earlier period had an increased propensity in the later period. Exporters with lower propensity in the earlier period exhibited even smaller propensity in the later period. This magnification effect distinguishes a group that is diversifying its exports geographically (positive and above the line) from those focusing their exports geographically (negative and below the line) on the same or smaller number of import markets.

[Figure 6 inserted around here.]

[Figure 7 inserted around here.]

The evolution of the exporter-specific effect of average value of exports per trading partner is illustrated in Figure 7, and this tells a different story. The solid line is once again the locus of equal effects in the two periods, but in this case those with positive values in the earlier period tend to have smaller values in the later period (and thus below the line). Those exporters with negative values in the earlier period tend to have larger values in the later period. The vertical distance from point to solid line indicates the increase in average exports from earlier to later period: notice the large positive effect for China, and the large negative effect for Yemen.

These exporter-specific and quota-elimination effects represent a small contribution to the overall shift in the pattern and value of trade. The countries subject to binding quotas play an important role in the evolution of the world market, but it is the changes in bilateral trade among those countries not subject to or imposing binding quotas that define the stylized facts outlined in the introduction.

The China effect.

China and its capacity for exporting textiles and apparel occupy a central position in any debate over global adjustment to removal of quotas. As Akhlaque, Conway and Shah (2010) report, China's share (in value terms) of the combined US and EU markets for apparel rose from 18 percent in 2001 to nearly 36 percent in 2008. The preceding discussion marked significant differences of China from the other countries with binding quotas in 1994 only in the growth in average apparel exports between 1995-2001 and 2002-2006. In this section we redo the estimation strategy of the earlier section, but to the earlier specification we add the same variables interacted with a binary variable taking the value of one if China is either exporter or importer in the observation and zero otherwise. Table 7 reports the results of that estimation for 2002-2006.

The "rest of sample" coefficients correspond well to theory in the pattern of trade: distance as proxy for transport cost has a significant negative coefficient, adjacency has a positive effect on the propensity to export, tariffs have a significant negative impact, and the initial cost/quality ratio from 1994 translates nearly one-for-one into the propensity to export. The trade-diversion effect is negative and significant and the trade-destruction effect is positive and significant, as expected. The trade-deflection effect is positive, contrary to theory, but small in magnitude; there is a steady increase in the propensity to export over time as measured by the year-specific dummy variables.

The "rest of sample" coefficients also conform well to theory in the value-of-trade regression. The importer-specific variables have positive and significant coefficients, distance has a significant negative effect, and the value of trade is reduced for importers with higher tariffs. The firm-heterogeneity effect and the selection-bias term both enter with significant coefficient. The effects from quotas are as expected for exporters facing binding quotas: as the quota is eliminated, the value of exports to the importer that imposed the quota rises while the average value of exports to other countries falls. The year-specific effects indicate that the average values of exports for countries other than China were declining during the years 2002-2005 until jumping sharply in 2006 (the excluded year).

Our conjecture is that any strategic differences in China's trade will show up as significant "China differences" in this table. The surprising result is that very few of these coefficients are significantly different for China. On the pattern of trade, China is significantly less likely to export to an adjacent country than exporters as a whole. It has also a much larger trade-deflection effect. The coefficients of year-specific variables indicate that China had a significantly higher propensity to export on average during 2002-2004. For other variables, however, China's behavior is insignificantly different from world comparators.

On the value of trade, there are a number of important differences. First, the elasticity of trade value with respect to importer GDP is significantly higher than other exporters – its sales into markets are skewed more towards the higher-GDP countries. When quotas are eliminated, China reduced its sales to other countries significantly more than other exporters – it exhibits, other things equal, the Vinerian focusing of the value of trade on the countries formerly under binding quota. Finally, the time pattern of the value of trade has a very different trajectory: while other exporters reduced the value of trade on average into importer markets from 2002 through 2006, China evidences an immense expansion. This is not in response to quota elimination, but rather evidence of a broad-based expansion in the value of trade on average from China as exporter to its importing markets.

Linking the two sectors.

Given the downstream position of apparel from textiles production, it is logical to believe that bilateral trade flows in apparel will be correlated with trade flows in textiles. In fact, they are closely linked along two dimensions. First, because the two industries developed together and are two stages in a final product, it is to be expected that countries with comparative advantage in production of textiles will (other things equal) have existing production of apparel. Second, if a country has comparative advantage in production of textiles, it will look for regional partners to process the textiles into apparel for re-export to the country of origin of the textiles.

We investigated these linkages in Conway and Fugazza (2010), and the details of the analysis can be found there. We used an identical estimation to that reported above for bilateral cotton textiles trade. We used the resulting equations to create predicted values for the bilateral pattern of trade and the value of trade in textiles, and used these predicted values as additional regressors in the apparel trade equations. Two fitted values are introduced: $\hat{s}_{ijt}$ is the prediction that country i will export textiles to country j, while $\hat{s}_{jit}$ is the prediction that country i will import textiles from country j. The $\hat{s}_{ijt}$ variable will pick up the common-cost advantage (or economies of scope) of a textiles producer: if a country has a natural comparative advantage in both, or there are economies of scope, then positive $\hat{s}_{ijt}$ will be correlated positively with export of apparel. The coefficient of $\hat{s}_{jit}$ will take a positive value when there is evidence that textiles exporters more often sell to importers using the textiles for offshore assembly and re-import of apparel to the textile-exporting country.

We do not report the results of those regressions here, but in summary:

- For countries predicted to be textile exporters to country j in period t, the value of apparel exports to country j is also significantly more – this is consistent either with an argument of common comparative advantage in the two sectors or in an argument of economies of scope in internalizing textiles and apparel production within the same supplier.
- An increase in the probability of textiles export from country i to country j also increases significantly the mean value of apparel exports from j to i, by a nearly 0.70 percent. This is an indicator of offshoring. .

The coefficients linking textiles and apparel are significantly different from zero in each specification tested. For the offshoring effect proxied by $\hat{s}_{jit}$, a one-percent increase in the probability of textiles import raises the probability of apparel export to the same country by between 0.7 and 1.03. For the "economies of scope" effect proxied by $\hat{s}_{ijt}$, a one-percent increase in the probability of textiles export to a given country raises the probability of apparel exports to that same country by between 1.77 and 2.60 percent.

V. Conclusions and extensions.

The global story of the removal of quotas on textiles and apparel has been told in large part from the perspective of the quota-setting countries, and in particular the US and the members of the EU. This paper nests that perspective within the global fabric of trade. The removal of the ATC quotas in 2005 served as a shock to which all trading countries must adjust – not just the consumers in the US and EU. The conclusion of this paper supports the Vinerian trade creation story, but with a twist. While the countries presumed to be comparative-advantage exporters of textiles and apparel exhibit the expected increased value of exports to the quota-removing importers, the other exporters whose market has been reduced in the US and EU have expanded their exports to larger numbers of smaller importers than they served during the quota period.

The model presented here proves to be effective in capturing both the pattern and value of international trade in textiles and apparel, and may be useful in other industry-level trade studies. It introduces a number of improvements over the typical gravity-equation or CGE model. First, it identifies the comparative-cost advantage of exporting countries by looking across importers, rather than simply at the US or European market. Second, it incorporates the heterogeneity of suppliers within the exporting country; this proves to be an important factor in explaining the variation of export success by the same country across trading partners. Third, it introduces the impact of the ATC system of bilateral quotas imposed by the US and EU during this period. Fourth, it endogenizes the export-platform explanation for offshoring.

The heterogeneity of suppliers within an exporting economy is advanced in Melitz (2003) and HMR as a useful way to consider the incremental nature of exporter response to export incentives. This proves its worth in the present analysis. The pattern of trade provides us with an insight into that heterogeneity that can be exploited and then applied to distinguish the impact of the quota regime.

The deflection effect of quotas on other importers is evident in the data. First, quotas in the US and EU are associated with exports to more non-quota destinations, even after controlling for importer size, distance, tariffs and other features of the economies. Second, there is evidence that binding apparel quotas in the US are associated with increased apparel exports by those constrained exporters in other countries.

There is strong support in the data for the export-platform argument. If country j exports textiles to country k, then the value of apparel exports from k to j is significantly increased.

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Figure 1: Export Markets in Apparel, before and after quota elimination

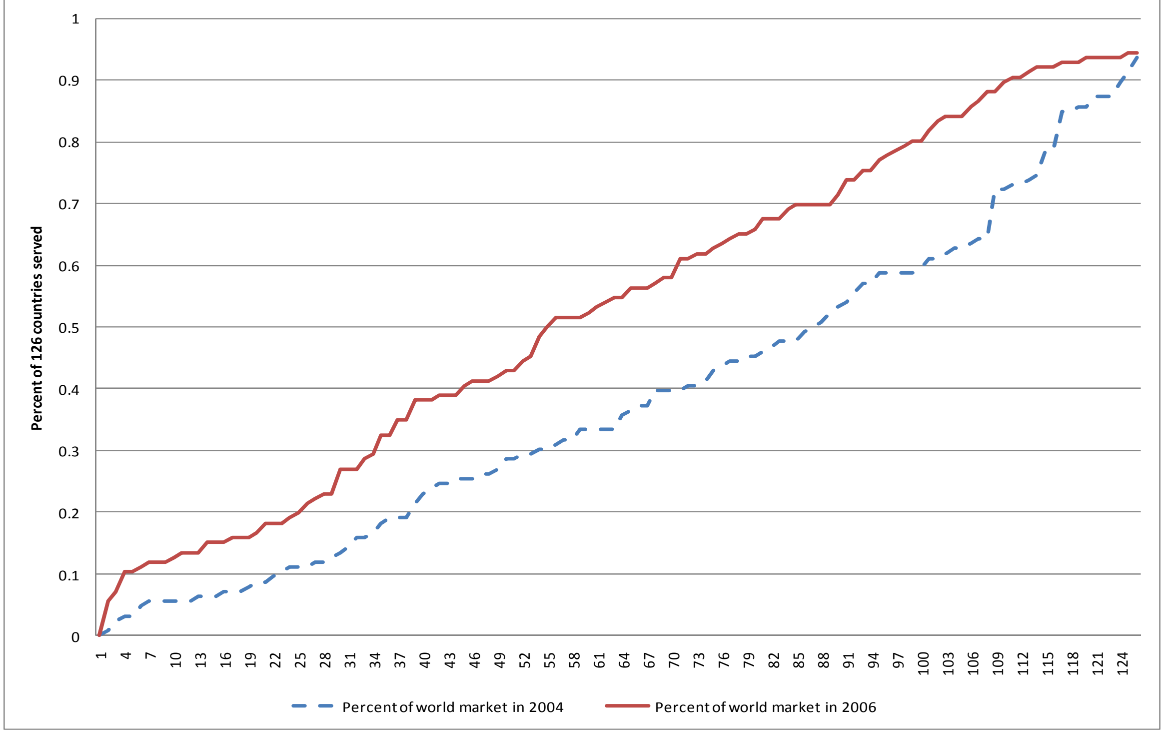


Figure 2: Number of import markets, by exporter, in Apparel

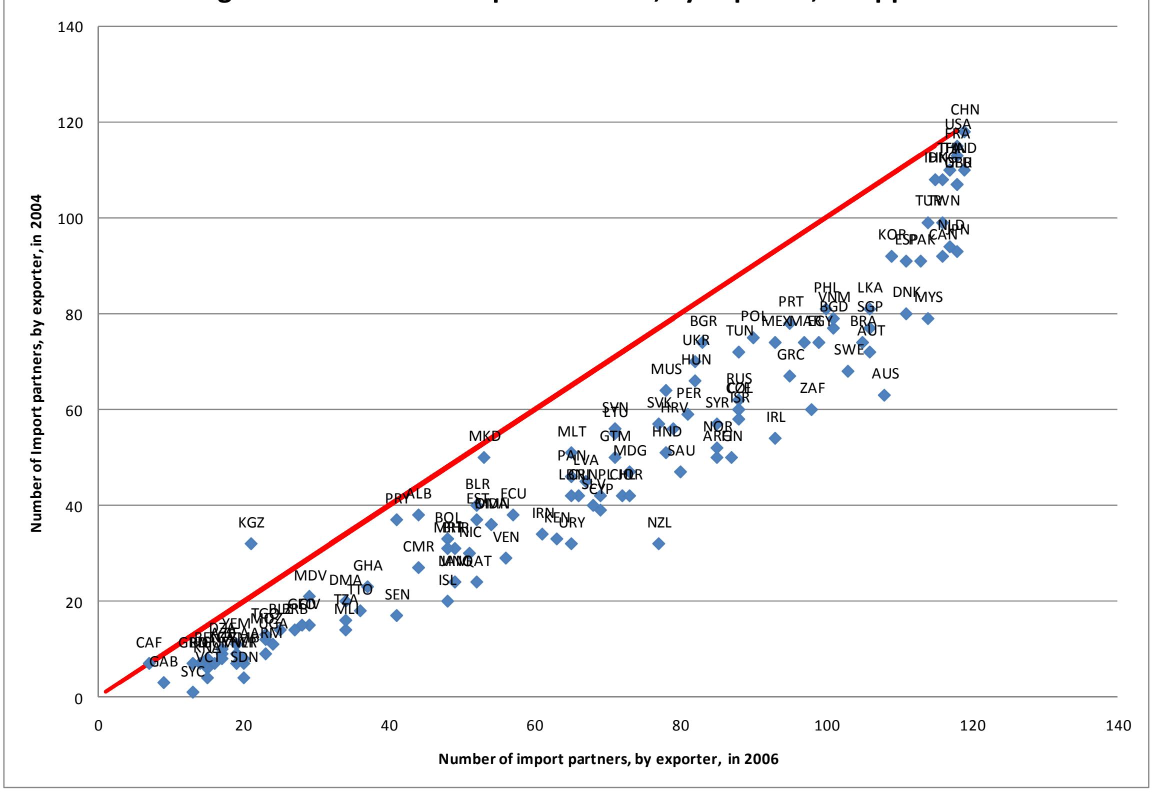


Figure 3: Mean Export Value in Apparel

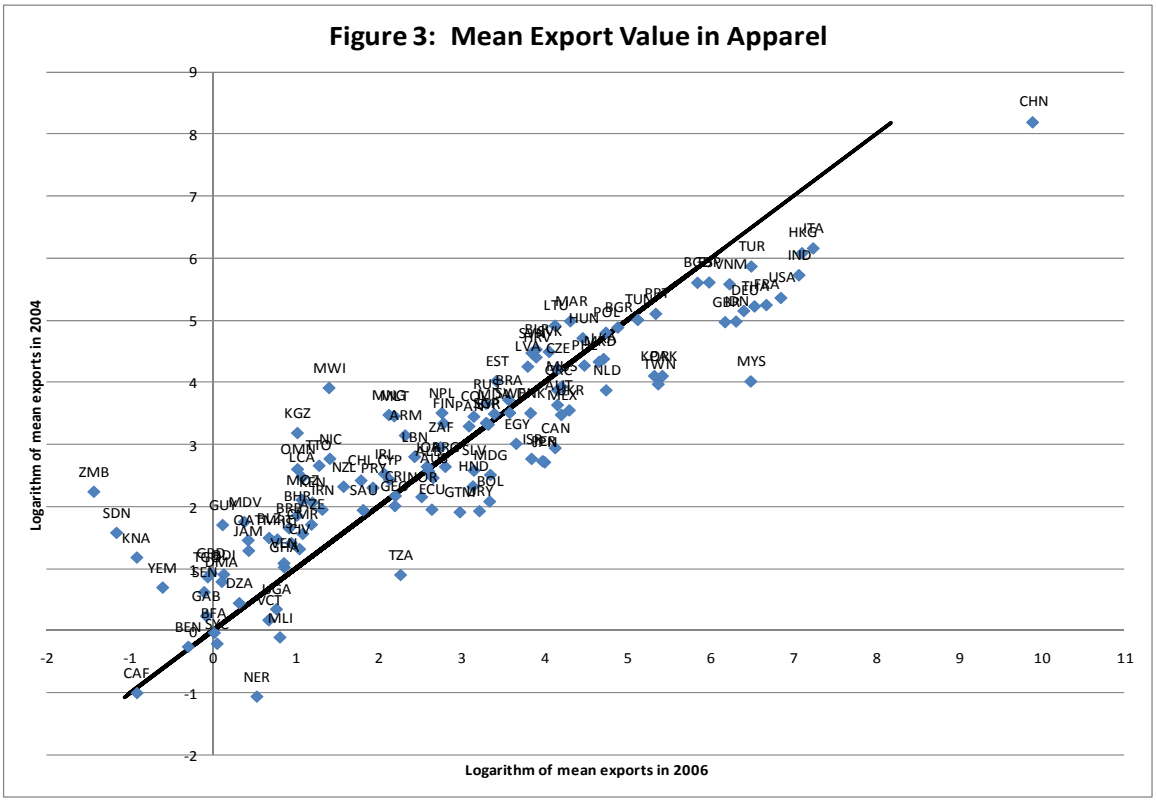
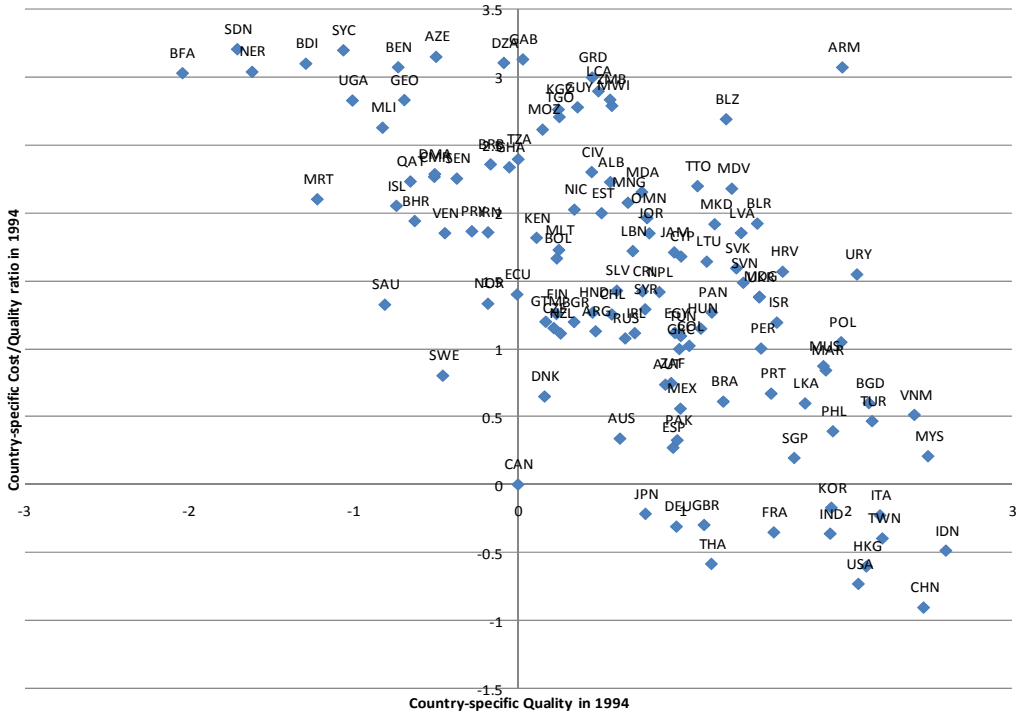
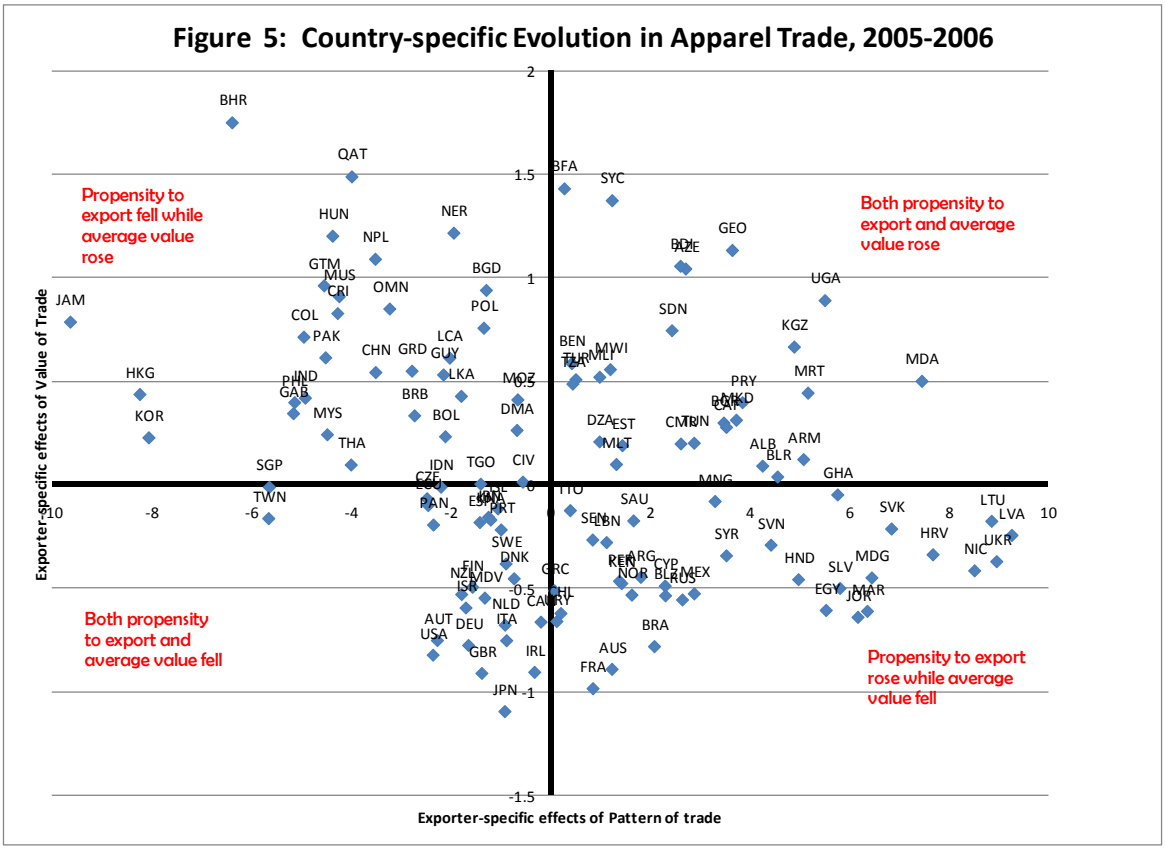


Figure 4: Estimates of Country-specific Quality and Cost Ratios in 1994





Source: COMTRADE, and authors' calculations

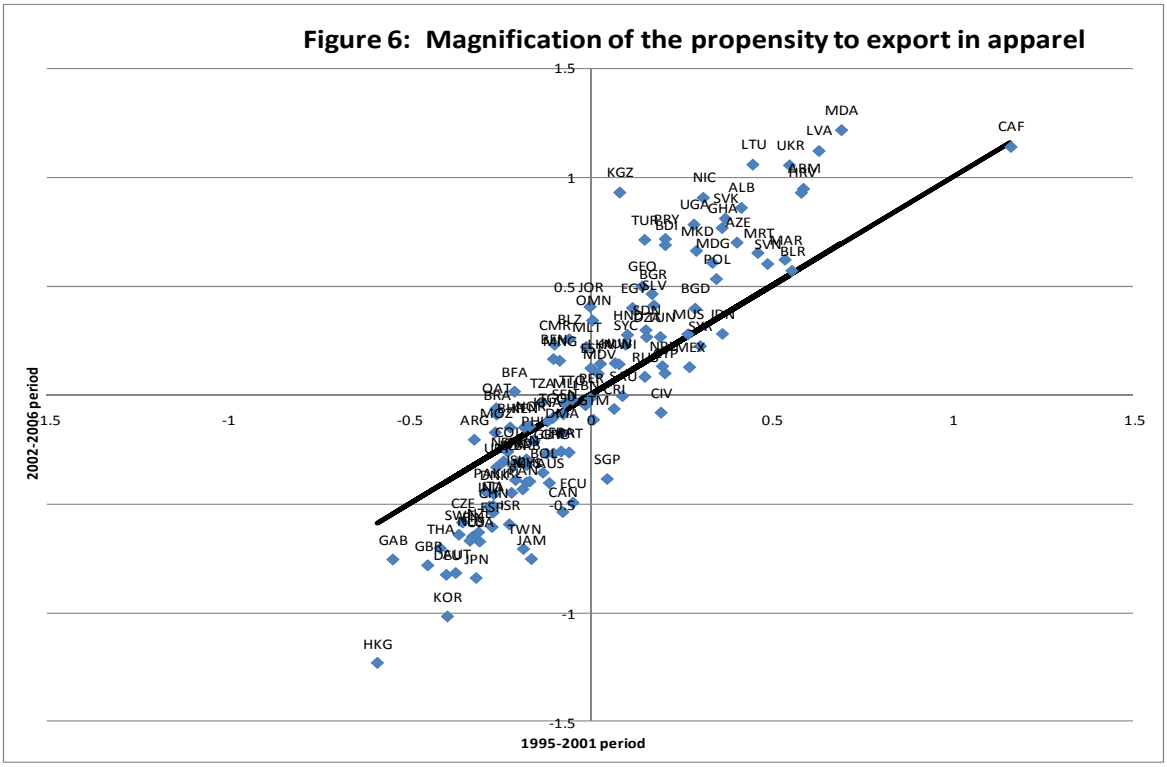


Figure 7: Evolution of the average value of bilateral exports in apparel

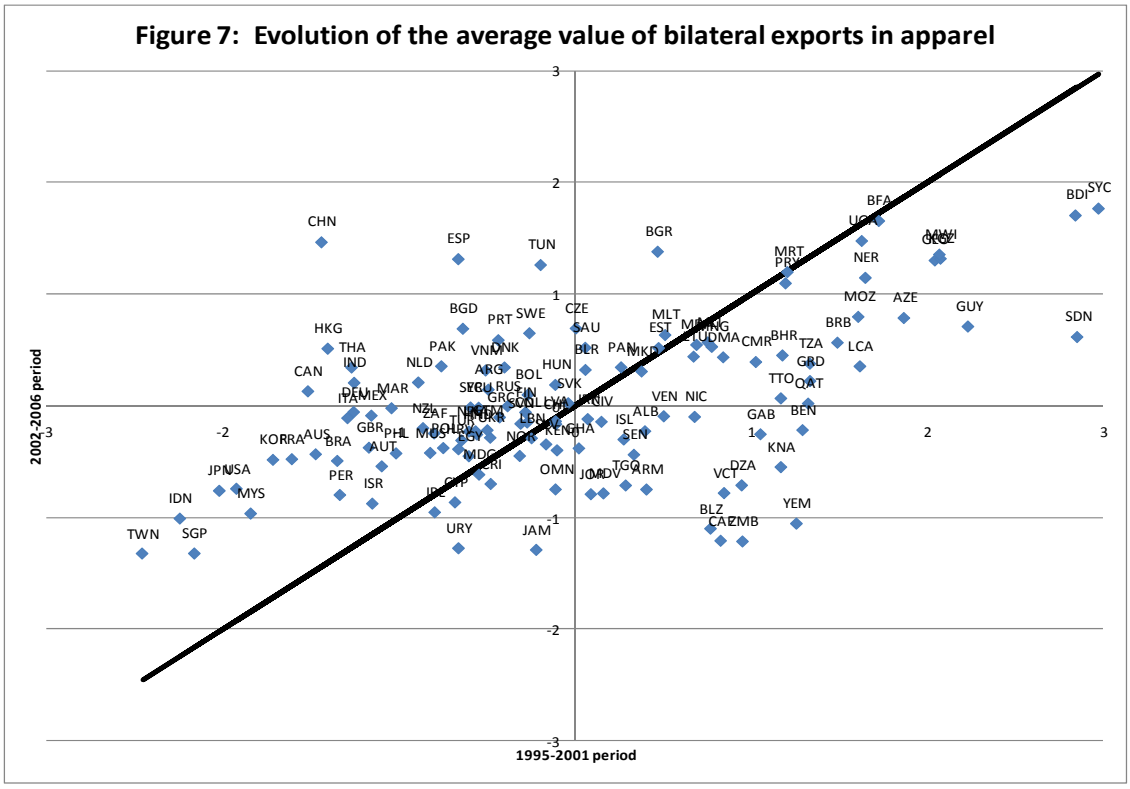


Table 1: The Number of Countries Receiving Apparel Exports (by major exporter)

	China	India	Pakistan	South Korea	Indonesia	Vietnam	USA
1994	92	87	76	84	77	47	92
1995	105	99	85	97	93	50	103
1996	111	105	96	100	101	64	111
1997	108	96	76	84	95	60	107
1998	112	99	73	89	97	63	109
1999	113	104	69	90	100	63	114
2000	117	103	70	86	102	63	111
2001	117	107	79	89	107	71	111
2002	112	108	83	86	106	76	113
2003	117	109	79	87	110	78	116
2004	118	110	91	92	108	79	115

Source: COMTRADE database

Table 2: Proportion of non-zero bilateral trade pairs in sample (126 countries)

Year	**Apparel (841/842)**
1994	31.1
1995	34.5
1996	38.4
1997	30.8
1998	31.8
1999	32.1
2000	34.3
2001	35.1
2002	35.3
2003	37.1
2004	39.1
2005	41.8
2006	54.2

Source: COMTRADE database

Table 3: The Pattern and Value of Trade in the Quota-ridden 1994 equilibrium.

The Pattern of Trade						
Fixed-effect probit	Coefficient	Standard Error		**Random-effect probit**	Coefficient	Standard Error
$\ln(D_{ij})$	**-0.98**	0.04		$\ln(D_{ij})$	**-0.97**	0.03
DB_{ij}	0.15	0.20		DB_{ij}	0.14	0.16
$\ln(\tau_{ij94})$	-1.30	2.32		$\ln(\tau_{ij94})$	**-4.33**	1.72
N	11780			N	15500	

The fixed-effect probit includes both importer and exporter-specific fixed effects. The random-effect probit includes exporter-specific indicators and random effects clustered by importer.
Standard errors are robust. The exporter fixed effects are used to derive the cost/quality ratio estimator.
Coefficients significant at 95 percent level of confidence are printed in bold.

The Value of Trade		
Non-linear regression	Coefficient	Standard Error
$\ln(Y_{jt})$	**0.23**	0.01
$\ln(L_{jt})$	**0.06**	0.02
$\ln(1+t_{ijt})$	0.60	6.67
$\ln(D_{ij})$	-0.32	1.51
μ	1.50	1.53
η	**0.71**	0.13
N	4744	
R^2	0.87	

The non-linear regression includes exporter-specific fixed effects to be used as a quality indicator. Standard errors are robust. Coefficients significantly different from zero at the 95 percent level of confidence are printed in bold.

Table 4: Trade in Apparel in 2005/2006: the role of quotas

	Apparel (SIC 841, 842)	
	(22) and (23)	(29)
$\ln(D_{ij})$	**-0.83**	0.06
	(0.02)	(0.12)
DB_{ij}	**0.37**	
	(0.09)	
$\ln(1+t_{ijt})$	**-0.71**	**-3.29**
	(0.27)	(0.35)
$\ln(\hat{c}_i)$	**-0.94**	
	(0.04)	
QB_{iUt-1}		**1.85**
		(0.13)
QB_{iNt-1}	**0.88**	**-3.03**
	(0.13)	(0.34)
NB_{iUt-1}	0.02	**0.36**
	(0.21)	(0.07)
QB_{Ujt-1}	0.29	**-1.03**
	(0.28)	(0.06)
T_{2006}	**0.72**	**-0.28**
	(0.02)	(0.10)
y_{jt-1}		**0.21**
		(0.00)
l_{jt-1}		**0.08**
		(0.02)
M		**2.12**
		(0.14)
H		**0.71**
		(0.10)
Exporter-specific effects	Y	Y
N	31000	14615
Log likelihood	-9895.0	
R^2	0.45	0.61

Robust standard errors in parentheses; coefficients significantly different from zero at the 95 percent level of confidence are printed in bold. The estimates in the first column are calculated simultaneously with importer random effects (not reported). Pseudo-R^2 reported for probit estimation, with calculation technique described in footnote 34.

Table 5: Decomposition of Variation in Apparel Trade in 2005/2006

Component	Pattern of Trade	Value of trade
Initial exporter-specific quality		11.5
Initial exporter-specific cost-quality ratio	26.0	
Random effects, importers	14.2	
Importer country characteristics		15.9
Distance (as transport cost)	7.7	0.8
Tariffs	0.0	8.2
Firm heterogeneity		19.1
Inverse Mills Ratio selection		0.3
Effects of eliminating binding quotas	0.0	2.3
Time-specific effects	2.6	0.0
Exporter-specific effects	3.4	3.2
Random error	46.1	38.7
Total	100.0	100.0
Memo items:		
Sum of Squared Residuals		214970.1
Log Likelihood, probit, constant only	-21462.4	

Table 6: The Pattern and Value of Trade in Apparel: before and after

	Pattern of Trade		Value of Trade	
	1995-2001	2002-2006	1995-2001	2002-2006
Constant	**9.44**	**10.64**		
	(0.18)	(0.20)		
$\ln(D_{ij})$	**-0.82**	**-0.81**	0.28	-0.29
	(0.01)	(0.01)	(0.17)	(0.15)
DB_{ij}	**0.32**	**0.45**		
	(0.04)	(0.06)		
$\ln(1+t_{ijt})$	-0.08	**-0.95**	**-5.86**	**-4.28**
	(0.18)	(0.18)	(0.16)	(0.24)
$\ln(\hat{c}_i)$	**-0.87**	**-0.89**		
	(0.03)	(0.03)		
μ			**1.80**	**1.51**
			(0.22)	(0.18)
η			-0.01	**0.40**
			(0.07)	(0.07)
QB_{iUt-1}			**1.64**	**2.22**
			(0.17)	(0.12)
QB_{iNt-1}	**0.12**	-0.01	**-0.35**	0.03
	(0.04)	(0.04)	(0.08)	(0.06)
NB_{iUt-1}	**-0.48**	**-0.37**	**1.31**	**0.78**
	(0.10)	(0.15)	(0.11)	(0.08)
QB_{Ujt-1}	0.08	**0.13**	**-0.86**	**-0.58**
	(0.04)	(0.04)	(0.05)	(0.04)
$\ln(y_{jt})$			**0.20**	**0.21**
			(0.00)	(0.00)
$\ln(l_{jt})$			**0.06**	**0.04**
			(0.01)	(0.01)
T_{1995} / T_{2002}	**0.08**	**-1.04**	**0.45**	**0.88**
	(0.02)	(0.02)	(0.04)	(0.19)
T_{1996} / T_{2003}	**0.32**	**-0.94**	-0.04	**0.75**
	(0.02)	(0.02)	(0.07)	(0.17)
T_{1997} / T_{2004}	**-0.14**	**-0.82**	-0.04	**0.43**
	(0.02)	(0.02)	(0.05)	(0.15)
T_{1998} / T_{2005}	**-0.06**	**-0.69**	**-0.18**	-0.09
	(0.02)	(0.02)	(0.04)	(0.13)
T_{1999}	**-0.07**		**-0.23**	
	(0.02)		(0.04)	
T_{2000}	**0.08**		**-0.68**	
	(0.02)		(0.04)	
Log likelihood	-36659.7	-24253.6		
Importer groups	125	125		
N	124000	77500	40916	31639
R^2			0.84	0.80

Random-effect estimation (random effects in importer dimension) in the probit. Standard errors are reported in parentheses. Coefficients significantly different from zero are printed in bold. Exporter fixed effects in value-of-trade equation.

Table 7: The Pattern and Value of Trade: comparing China to the whole for 2002-2006

	Pattern of trade		Value of Trade	
	Rest of sample	China difference	Rest of sample	China difference
$\ln(y_{jt})$			**0.19**	**0.05**
			(0.01)	(0.02)
$\ln(l_{jt})$			**0.10**	**-0.12**
			(0.01)	(0.06)
$\ln(D_{ij})$	**-0.80**	0.02	**-0.30**	-0.01
	(0.01)	(0.11)	(0.07)	(0.09)
DB_{ij}	**0.50**	**-1.26**		
	(0.06)	(0.28)		
$\ln(1+t_{ijt})$	**-0.91**	-1.39	**-4.55**	0.39
	(0.18)	(0.83)	(0.20)	(1.07)
$\ln(\hat{c}_i)$	**-1.01**	-0.03		
	(0.03)	(0.06)		
μ			**1.10**	
			(0.08)	
η			**-0.18**	
			(0.08)	
QB_{iUt-1}			**1.86**	**-1.56**
			(0.12)	(0.48)
QB_{iNt-1}	**0.07**	**0.55**	**-0.29**	**-1.23**
	(0.03)	(0.27)	(0.07)	(0.27)
NB_{iUt-1}	**-0.51**		**0.88**	
	(0.15)		(0.06)	
QB_{Ujt-1}	0.15	0.33	**-0.70**	-0.10
	(0.04)	(0.32)	(0.05)	(0.25)
T_{2002}	**-1.03**	**0.81**	**-0.61**	**2.16**
	(0.02)	(0.35)	(0.10)	(0.36)
T_{2003}	**-0.92**	**0.81**	**-0.72**	**2.17**
	(0.02)	(0.35)	(0.10)	(0.36)
T_{2004}	**-0.81**	**0.84**	**-1.03**	**2.44**
	(0.02)	(0.35)	(0.09)	(0.36)
T_{2005}	**-0.69**	0.17	**-1.46**	**4.43**
	(0.02)	(0.20)	(0.08)	(0.26)
Log likelihood	-24335.9			
Importer groups	125		125	
N	77500		21887	
R^2	0.46		0.62	

Random-effect probit estimation (random effects in importer dimension) for pattern of trade. Exporter-specific fixed effects introduced in "whole sample" but not reported here. Bolded values are significant at 95 percent level of confidence. Each pair of columns represents one regression. The first column (Rest of Sample) includes the variables as defined in the equations in the text, while the second column (China difference) includes in the equation the same terms interacted with a binary variable defined to be one when China was either the exporter or the importer. These "China difference" coefficients are then the difference between China's value and the value for the rest of the sample.

Appendix : **Characteristics of restraints on textiles and apparel imports to the US and EU.**

The system of bilateral quantitative restraints (or quotas) on textile and apparel imports was an enduring feature of the US and European Union (EU) commercial policy system. From its inception in the early 1960s with the Long-Term Arrangement in Cotton Textiles (LTA), through its codification in the Multi-Fiber Arrangement (MFA) from 1974 to 1995, and to its 1995-2005 form in the Agreement on Textiles and Clothing (ATC), the system provided protection to US and EU producers of textiles and apparel.[37]

In the negotiations that led to the adoption of the ATC in 1995, the US and EU agreed to dismantle the system of quantitative restraints sequentially. A large number of restraints was removed at the beginning of 1995, 1998 and 2002, but those remaining governed trade in the categories of textiles and apparel most produced in the US and EU. These remaining restraints were removed on 1 January 2005. The ATC by its end had evolved into a complicated interlocking set of bilateral agreements on quantities exported. They acted as export restraints, but they were binding in any given year on only a small subset of the countries under restraint. Specific limits and group limits interacted in non-transparent ways to limit a given country's exports.

The basic unit of the quota system was the restraint category, or quota category. These categories were defined as aggregated subgroups of textile and apparel products with some shared characteristic or raw material. The system of import restraints defined by the US identified 11 aggregated categories of yarns, 34 aggregated categories of textiles, 86 categories of apparel and 16 categories of miscellaneous textiles (e.g., towels). Together these categories spanned the entire set of US textile and apparel imports. The EU identified 41 categories of yarns, 28 categories of textiles, 42 categories of apparel and 32 categories of miscellaneous textiles for a total of 143 categories – although some of these categories were further subdivided by raw material.[38] Each category included multiple products. For example, US category 225 (blue denim) was aggregated from 16 distinct HS product lines. Products included in each category were similar, but could have significant differences: for example, the "blue denim" category included denim made from both cotton and man-made fibers. There is no corresponding category for the EU: its blue-denim imports would have been classified EU category 2 (woven cotton fabric, with 105 CN product lines) or EU category 3 (synthetic woven fabric, with 80 CN product lines).

Limits under the system of restraints were divided into specific limits and group limits. Specific limits governed the import of goods within the specific quota category. Group limits placed aggregate limits on a subset of the quota categories. If a country's exports were subject to group limits but not specific limits, then the suppliers of that country (or more likely, a government agency supervising these exports) could choose any mix of goods shipped to the US so long as in aggregate the totals did not exceed the group limit. Some group limits covered only two quota categories: e.g., US group 300/301, covering US quota categories 300 (carded cotton

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[37] Francois et al. (2007) provides a detailed discussion of this chronology. There were actually six groupings that imposed bilateral quotas under the MFA and ATC: in addition to the EU and US, there were Canada, Norway, Finland and Austria. The work in this paper focuses upon the US and EU, but the analysis will be extended to the others in future research.

[38] The categories for the US, and the correspondence between those categories and the HS classification of imports, are published by the Office of Textiles and Apparel (OTEXA), Department of Commerce, at http://otexa.ita.doc.gov/corr.htm. The categories for the EU, and concordance with CN category, are published in EEC Council Regulation 3030/93 of 12 October 1993.

yarn) and 301 (combed cotton yarn). Others spanned a large number of categories: for example, Subgroup 1 in Hong Kng included US quota categories 200, 226, 313, 314, 315, 369 and 604. In many cases, a country had its exports bound by both specific limits and group limits.

Under the MFA and ATC, exporting countries were given flexibility in meeting these restraints. In each category, the agreement specified a percentage by which the country could either exceed or fall short of its restraint. In those cases, a maximum percent of possible "carryforward" or "carryover" is specified in the agreement. With carryover, the country transfers an unused part of last year's quota to this year. With carryforward, the country exceeds its quota in this period by counting the excess against quota in the following year.[39]

Not all exporters were subject to quantitative limits. Under the MFA and ATC, restraints were negotiated whenever a country's exports caused (or threatened to cause) market disruption in the US or EU. Of the 152 countries exporting cotton knit shirts to the US (US categories 338 and 339) in 2004, only 32 were subject to quantitative limits and of these only 11 exported as much as 90 percent of the quota limit to the US. Similarly, of the 156 countries exporting knit shirts (cotton and other fabrics) to the EU in 2004 only 25 were subject to quantitative limits, and of those only four exported more than 90 percent of the quota limit to the EU.

Quotas in these agreements were defined for product categories narrower than the 3-digit SITC classification used in this paper. We use a mapping rule in classifying a country subject to a quota limit or a binding quota. First, we define the set of quota categories that covered products in the 652 and 841/842 SITC classifications. Second, we defined a country as subject to a quota limit if the US or EU had specified a quota limit for that exporting country in any one of those categories. Third, following Dean (1990) and Dean (1995), we categorized an exporting country as subject to a binding quota if its observed quantity exported in that year was greater than 90 percent of the quota limit. We used data provided by the OTEXA Division of the US Department of Commerce and by the EU to calculate this percentage.

Table A1 indicates the countries subject to quota limits in 1994 – these were the countries i designated with 1 in Q_{Ui94}. Those with binding quotas in 1994 are marked with an asterisk. The totals of countries with quota limits and with binding quotas are given in parentheses at the top of each column. Note that the number of countries with quota limits is relatively small compared to the total universe of potential exporters. Note also that the percentage of countries with binding quotas is relatively high due to the aggregation performed here. In any single quota category, the number of countries subject to binding quotas will typically be closer to 10 percent. See Conway (2010) for examples.

Table A2 reports the correlation between quota limits and binding quotas for the US and EU in 1994. The correlation is calculated over the 79 countries for which at least one importer had established a quota limit in either cotton textiles or cotton apparel in 1994.

[39] Information on flexibility is drawn from "Summary of Agreements", OTEXA, January 2003 and from Annex 8, EEC Council Regulation 3030/93, as updated in EC Commission Regulation 930/2005.

Table A1 -- Quota limits (and binding quotas) in 1994			
US – textiles (25/13)	**EU – textiles (41/11)**	**US – apparel (44/34)**	**EU – apparel (46/16)**
ARE, BRA, CHN*,	ALB, ARE, ARG,	ARE*, BGD*, BHR,	ALB, ARE, ARM,
COL, CZE, EGY*,	ARM, AZE, BGR*,	BRA, CHN*, COL*,	AZE, BGD, BGR,
HKG*, HUN, IDN*,	BLR, BRA, CHN*,	CRI*, CZE, DOM*,	BLR*, BRA, CHN*,
IND*, LKA, KOR*,	CZE*, EGY, EST,	EGY*, FJI*, GTM*,	CZE, EGY, EST,
MAC, MUS, MYS*,	GEO, HKG, HUN,	HKG*, HND, HUN,	GEO, HKG*, HUN,
PAK*, PHL*, POL,	IDN*, IND*,	IDN*, IND*, JAM*,	IDN*, IND*,
ROM*, SGP, SVK,	KGZ, KOR*, KSV,	KEN, KOR*, KWT,	KGZ, KOR*, KSV,
THA*, TUR*, TWN*,	LTU, LVA, MDA,	LAO*, LKA*, MAC*,	LKA*, LTU, LVA,
URY	MKD, MLT, MYS,	MKD*, MMR, MUS*,	MAC*, MAR, MDA,
	PAK*, PER, POL*,	MYS*, NPL*, OMN*,	MKD, MLT, MNG,
	ROM, SGP, SVK,	PAK*, PHL*, POL*,	MYS*, PAK*, PHL*,
	SVN, THA*, TJK	QAT*, ROM*, RUS*,	POL, ROM*, SGP,
	TKM, TUN, TWN*,	SGP*, SLV*, SVK,	SVK, SVN, THA*,
	UZB, VNM*	THA*, TUR*, TWN*,	TJK, TKM, TUN,
		UKR*, URY	TWN*, UKR*, UZB,
			VNM*

Sources: authors' calculations

Table A2: **Correlation of Quota Limits and Binding Quotas in Apparel, 1994**

	Q_{US94}	QB_{US94}	Q_{EU94}	QB_{EU94}
Q_{US94}	1.00	0.83[a]	-0.15	0.21[b]
QB_{US94}		1.00	-0.10	0.22[b]
Q_{EU94}			1.00	0.40[a]
QB_{EU94}				1.00

Source: authors' calculations. a 1% and b 5%

There is a strong positive but not perfect correlation between countries facing binding quotas from the two importers. By contrast, the set of countries facing quota limits in apparel is not significantly correlated.

Country List (with acronyms)

ALB	Albania	GRD	Grenada	NLD	Netherlands
ARG	Argentina	GTM	Guatemala	NOR	Norway
ARM	Armenia	GUY	Guyana	NPL	Nepal
AUS	Australia	HKG	Hong Kong	NZL	New Zealand
AUT	Austria	HND	Honduras	OMN	Oman
AZE	Azerbaijan	HRV	Croatia	PAK	Pakistan
BDI	Burundi	HUN	Hungary	PAN	Panama
BEN	Benin	IDN	Indonesia	PER	Peru
BFA	Burkina Faso	IND	India	PHL	Philippines
BGD	Bangladesh	IRL	Ireland	POL	Poland
BGR	Bulgaria	IRN	Iran	PRT	Portugal
BHR	Bahrain	ISL	Iceland	PRY	Paraguay
BLR	Belarus	ISR	Israel	QAT	Qatar
BLZ	Belize	ITA	Italy	RUS	Russia
BOL	Bolivia	JAM	Jamaica	SAU	Saudi Arabia
BRA	Brazil	JOR	Jordan	SDN	Sudan
BRB	Barbados	JPN	Japan	SEN	Senegal
CAF	Central African Rep	KEN	Kenya	SGP	Singapore
CAN	Canada	KGZ	Kyrgyz Rep	SLV	El Salvador
CHL	Chile	KNA	St. Kitts/Nevis	SVK	Slovakia
CHN	China	KOR	Korea	SVN	Slovenia
CIV	Cote d'Ivoire	LBN	Lebanon	SWE	Sweden
CMR	Cameroon	LCA	St. Lucia	SYC	Seychelles
COL	Colombia	LKA	Sri Lanka	SYR	Syria
CRI	Costa Rica	LTU	Lithuania	TGO	Togo
CYP	Cyprus	LVA	Latvia	THA	Thailand
CZE	Czech Republic	MAR	Morocco	TTO	Trinidad/Tobago
DEU	Germany	MDA	Moldova	TUN	Tunisia
DMA	Dominica	MDG	Madagascar	TUR	Turkey
DNK	Denmark	MDV	Maldives	TWN	Taiwan
DZA	Algeria	MEX	Mexico	TZA	Tanzania
ECU	Ecuador	MKD	Macedonia	UGA	Uganda
EGY	Egypt	MLI	Mali	UKR	Ukraine
ESP	Spain	MLT	Malta	URY	Uruguay
EST	Estonia	MNG	Mongolia	USA	United States
FIN	Finland	MOZ	Mozambique	VCT	St. Vincent/Gre
FRA	France	MRT	Mauritania	VEN	Venezuela
GAB	Gabon	MUS	Mauritius	VNM	Vietnam
GBR	Great Britain	MWI	Malawi	ZAF	South Africa
GEO	Georgia	MYS	Malaysia	ZMB	Zambia
GHA	Ghana	NER	Niger	ZWE	Zimbabwe
GRC	Greece	NIC	Nicaragua		