Does Tariff Liberalization Kick the Good Apples Out? Theory and Evidence

Alan C. Spearot*
University of California - Santa Cruz

June 30, 2010

Abstract

This paper examines the liberalization of a common tariff when imported varieties vary in quality and cost. Varieties of higher quality and/or lower cost (a) are imported at lower absolute demand elasticities and (b) earn higher revenues. By virtue of larger demand elasticities, low revenue varieties benefit the most from tariff liberalization. Further, if varieties are substitutable, low revenue varieties may benefit at the expense of high revenue varieties. These predictions are confirmed using a case study of US Uruguay Round tariff cuts, where within products, low revenue exporters experienced large gains, and high revenue exporters experienced negligible gains.

1 Introduction

If one point has been made abundantly clear by the theory of international trade, it is that trade is often driven by heterogeneity. This heterogeneity can result from classical

*Email: acspearot@gmail.com. Address: Economics Department, 1156 High Street, Santa Cruz, CA, 95064. The paper benefited substantially from a conference discussion by Peter Morrow, and three anonymous referees. I also thank Pol Antras, David Hummels, Wolfgang Keller, Volodymyr Lugovskyy, Phillip McCalman, Thanh Xuan Nguyen, Anson Soderbery, Robert Staiger and seminar participants at the 2009 Otago Workshop on International Trade, the London School of Economics, the 2009 Asia Pacific Economics Association Annual Conference, the 2009 Empirical Investigations in Trade and Geography conference, and the University of Colorado for very helpful comments. I also thank James Allen from the New Zealand Ministry of Foreign Affairs and Trade for HS8 trade data used for an earlier working paper. All remaining errors are my own.

Ricardian differences in relative autarky prices, to the modern treatment of heterogeneity at the firm level. Regardless of the source, heterogeneity almost always reflects in prices and/or market shares. And, as many authors have documented (Schott 2004, in particular), trade data exhibits substantial variation in unit values and trade volumes within precise product categories.

However, despite the massive amount of heterogeneity in varieties across trading partners within narrowly defined products, the rules of the GATT/WTO, on a basic level, seem designed for a more homogenous environment. With regard to tariffs, this point is particularly salient, as outside of special safeguards, retaliatory measures, and all-or-nothing regional agreements, members have very little latitude regarding tariffs applied to different varieties of the same product. One particular guiding principle, "non-discrimination", imposes that all GATT/WTO members receive equal treatment, usually via a common, or "most favored nation" (MFN), tariff. This applies within any product, across all export sources without preferential status, and (obviously) does not discriminate by quality or other characteristics. Further, this equal treatment rule extends to the process of liberalization, and allows for no consideration of which exporters stand to gain more or less from lower tariffs.

To push this idea further, consider the import of "Men's or Boys' Shirts, of Cotton" (HS6 code 620520) by New Zealand in 1999. Overall, New Zealand imported varieties within this product category from 50 different countries. While the average pre-tariff free-on-board unit value was $20, exporter-specific unit values varied substantially. On one end of the spectrum, Belgium exported varieties at an average of $75 per unit. On the other end, Indonesia exported at an average of $3.60 per unit. Clearly, imports from Belgium and imports from Indonesia are in fact very different. Yet, the WTO mandates that these products are treated equally in setting tariffs, and when liberalizing tariffs.

Overall, there is a clear friction between the precise intent of WTO rules regarding tariffs, and the natural differentiation which occurs in trade flows. Critically, even though the WTO prefers (and promotes) the multilateral process over other preferential or regional schemes, it remains unclear how the effects of MFN liberalization accrue within products that exhibit significant within-product differentiation. In what way should MFN tariff reductions influence bilateral trade flows? Are certain countries more likely to gain from MFN liberalization based on the fundamental characteristics of the products they sell? Overall, how are the benefits of additional import market access distributed across *competing* and *differentiated* exporters?

This paper answers these questions. Using a simple theoretical model, I show that the liberalization of a common ad-valorem tariff need not increase bilateral imports of all varieties. In particular, if varieties are differentiated by quality and/or production cost, I show that liberalization of a common tariff may increase imports of low revenue varieties at the expense of high revenue varieties. In analyzing the effects of US Uruguay Round tariff cuts, I find robust support for the model. Specifically, I find that the benefits of import tariff liberalization are largest for low revenue varieties and smaller and insignificantly different from zero for high revenue varieties.

The key to the model is the degree to which demand elasticities vary across varieties. Specifically, varieties will be sold at a lower (absolute) demand elasticity if they are of higher quality and/or produced at a lower cost. In both cases, varieties earn larger revenues. Since demand is fairly inelastic for these varieties, changes to tariffs have a fairly small direct effect on the value of bilateral imports. This is in stark contrast with varieties of low quality and/or produced at a high cost. In these cases, revenues are fairly small, and equilibrium demand elasticities are relatively large. Thus, for these varieties, changes to tariffs have a relatively large effect on the value of bilateral imports

In equilibrium, the effects of changes to a common tariff are aggregated across all varieties, and competition is generally tougher when tariffs fall. That is, when tariffs fall, so does the residual demand for each variety, all else equal. It is the resolution of the tension between this aggregate effect and the effects related to demand elasticities which determine the varieties that benefit from tariff liberalization and to what extent. In particular, I show that the aggregate effect may in fact be larger than the direct effect for some varieties. As detailed above, these are the varieties that earn relatively large revenues before tariffs are cut. Thus, as a novel result, I show that tariff liberalization may in fact decrease imports of varieties that earn large revenues before the tariff cut. In contrast, I show that varieties earning low revenues always benefit from tariff liberalization by virtue of the high demand elasticity at which these varieties are sold. Overall, I show that the traditional negative effects of tariffs are amplified for low revenue varieties, and smaller and/or of opposite sign for high revenue varieties.

Empirically, the model is evaluated using a case study of tariff reductions by the United

States resulting from Uruguay Round GATT negotiations. Despite being a result of bargaining within the GATT, this case study is sensible on a number of levels. For one, data are available at the HS10 level, which provides a useful amount of detail within narrowly defined products (for example, "Grand Pianos" and "Upright Pianos" are varieties of the same product). Second, for most products, reductions to MFN tariffs were relatively quick, most of which occurring over the period 1995-1999. Third, the evidence suggests that import growth rates before the Uruguay Round agreements were drafted were independent from whether or not an HS8 product received a tariff cut after the Uruguay Round was completed. Finally, the US HS8 tariff data provides information on whether non-tariff barriers were present. As these policy instruments are outside the scope of the model, such information is crucial, and not available in other datasets such as TRAINS.

Using a number of different specifications, I find evidence which is broadly supportive of the model. Regressing bilateral import growth rates on tariffs and an interaction with pre-Uruguay Round import values, I find that within-products, bilateral import elasticities (with respect to tariffs) were large, significant, and negative for the export sources with the smallest pre-Uruguay Round import values. Indeed, as export sources approach the extensive margin, the elasticity of bilateral imports to tariffs approaches -10. In contrast, estimated elasticities are small and often insignificantly different from zero for export sources with the largest pre-Uruguay Round import values. Further, I find that this result is sharpened when focusing on products which are more likely to exhibit product differentiation, and in products with below-median levels of exporter concentration. Finally, the results are fairly robust to a large set of supplemental regressions which control for non-US tariff cuts, alternate product definitions, an exporter-specific response to US tariffs, potential outlier exporters, and exporters which are heavily hedged in preferential arrangements with the US.

Related literature

This paper adds to a number of different areas related to trade, trade policy, and firm heterogeneity. Most notably, the results are reminiscent of the classic Alchian-Allen hypothesis, and the subsequent empirical work by Hummels and Skiba (2004), in which higher per-unit transportation costs shift the distribution of exports toward higher price goods, and higher tariffs do the opposite. Thus, when distance is non-trivial, countries tend to "ship the good apples out". In contrast, when tariffs are high, countries tend to export a lower price bundle of exports. Relative to Hummels and Skiba (2004), my model extends the literature in a crucial way, where I allow for both positive and negative correlations between prices and demand elasticities. That is, quality differences yield a negative relationship between prices and absolute demand elasticities, and cost differences yield a positive relationship. Given that the effects of tariffs are governed by differences in demand elasticities, and demand elasticities boil down to variety-specific revenues, I show that the critical exporter characteristic in predicting the effects of tariff liberalization is not quality or price but earned revenues pre-tariff-cut.

The rather robust response of the extensive margin is similar to Kehoe and Ruhl (2009), who document the effects of various types of structural change on bilateral relationships, and in particular, the extensive margin of trade. Indeed, motivated in-part by the results in Kehoe and Ruhl (2009), Arkolakis (2009) presents a framework based on endogenous marketing costs that generates a larger response to trade liberalization by smaller varieties. While similar to the results in my paper, the results are driven by a completely different mechanism. Further, there is one crucial qualitative difference in equilibrium predictions, where the Arkolakis framework guarantees that all firms gain from liberalization, which is not the case in my paper.[1] Indeed, in the forthcoming empirical work, the top-20% of exporters (within-products) rarely increase trade after tariff liberalization occurs.

There is a relatively recent literature examining the design of the WTO within the context of heterogeneous countries and products. Saggi (2004) compares optimal tariffs set on an MFN basis with those set via unconstrained discrimination in a n-country oligopoly model with heterogeneous suppliers. Generally, Saggi's model suggests that moving from non-cooperative discrimination to non-cooperative MFN benefits low cost suppliers since the optimal tariffs applied to their exports would be lower. The model does not examine the removal of tariffs on an MFN basis, and the corresponding effects on trade, which is the focus of my work. Thus, rather than asking what happens when tariffs are liberalized via MFN, it queries how and why we are in an MFN environment in the first place.[2]

[1] Via a CES demand assumption, all firms in the Arkolakis (2009) framework receive the same percentage demand shock resulting from tariffs. Thus, all firms gain from a reduction in a common iceberg transport cost, but differ in their supply response based on the marginal cost of reaching a larger fraction of consumers.

[2] In later work, Saggi and Sara (2007) uses a two country model to examine the National Treatment clause when products may differ in quality. A similar result is reached as in Saggi (2004), where a national

On broader level, my paper is related to the work of Rose (2004) and Subramanian and Wei (2007), who estimate the effects of GATT/WTO membership on bilateral trade flows. However, neither examines the effects of MFN liberalization at the product level, which as discussed above, contains critical information on the precise characteristics of trade flows. Most importantly, the model suggests that this particular class of empirical studies is misspecified by failing to allow for differential effects of GATT/WTO membership as a function of pre-GATT/WTO market penetration. In this way, the results detailed below may also motivate modifications of the standard Anderson and Van Wincoop (2003) gravity model.

In terms of the US case study employed in this paper, a number of papers are relevant. Romalis (2006) shows that MFN liberalization by the United States increased both the degree of openness and the growth rates of developing countries. Ludema and Mayda (2009) examine the relationship between exporter concentration and observed tariff concessions by the US. In particular, they show that the US offered larger tariff concessions in products with a more concentrated group of export sources. Finally, very recent work by Feenstra and Weinstein (2010) adapts the methods from Feenstra (1994) to estimate the gains for trade using a non-CES (translog) demand system. Their estimates imply pricing/mark-up behavior which is consistent with Melitz and Ottaviano (2008) - the model at the heart of my paper.

The rest of the paper is organized as follows. Section two presents a simple theoretical model and an extension. Section three details the dataset, and tests the predictions from section two. In section four, I briefly conclude.

2 Theory

Consumers

The key to the model is the way in which consumers value product variety and quality. Similar to Melitz and Ottaviano (2008), I assume that consumer preferences are quasi-linear, non-homothetic, and exhibit love-of-variety within a differentiated sector. However, I depart from Melitz and Ottaviano by assuming that within the differentiated sector consumers earn

treatment clause tends to help those exporters selling the most competitive goods (highest quality goods).

utility based on "quality-adjusted consumption" of each variety. Preferences of this type can be defined as follows:

$$U = x_0 + \theta \int_0^1 \lambda_i q_i di - \frac{1}{2}\eta \left(\int_0^1 \lambda_i q_i di \right)^2 - \frac{1}{2}\gamma \int_0^1 (\lambda_i q_i)^2 \, di \tag{1}$$

Here, q_i is the consumption of variety i, and λ_i is its associated quality. Thus, quality-adjusted consumption of variety i is defined as $\lambda_i q_i$. The precise role of quality will be discussed shortly. Further, x_0 is the numeraire good, where θ (> 0) and η (> 0) determine the substitution pattern between the differentiated industry and the numeraire. Finally, γ (> 0) represents the degree to which consumers value product variety. For the moment, I assume that there exists a unit measure of varieties supplied to the import market, all of which able to profitably produce. In a later extension, I will allow for a flexible extensive margin of trade in which the measure and composition of firms is endogenous. The budget constraint faced by consumers is written as,

$$x_0 + \int_0^1 p_i q_i di \leq I$$

where I is income of the representative consumer, and p_i is the price of variety i. Solving the maximization problem of the representative consumer yields the following inverse demand function for each variety,

$$p_i^c = \lambda_i \left(A - \gamma \lambda_i q_i \right) \tag{2}$$

where,

$$A = \theta - \eta \int_0^1 \lambda_i q_i di$$

Here, p_i^c is the price at which consumers purchase varieties. In a moment, I will add a tariff which creates a wedge between the price consumers pay and the price suppliers receive. Also, note that the demand intercept, A, embodies the competitiveness of the import market. All else equal, the import market is more competitive if the quality-adjusted consumption of all varieties, $\int_0^1 \lambda_i q_i di$, is larger.

Before moving to the firm's problem, it is instructive to examine the effects of variety-specific quality, λ_i, on the demand for each variety. First, note that by differentiating (2), the willingness to pay for a variety is increasing in quality if:

$$\frac{\partial p_i^c}{\partial \lambda_i} = A - 2\gamma\lambda_i q > 0$$

This will be satisfied in equilibrium, as $A - 2\gamma\lambda_i q > 0$ when marginal revenue is positive. Of note, this condition will also guarantee that quantity demanded is increasing in quality, in equilibrium.[3]

Second, note the equation for demand elasticity as a function of variety specific quality and price:

$$\epsilon_{D,i} = \frac{\partial q_i}{q_i}\frac{p_i^c}{\partial p_i^c} = -\frac{p_i^c}{A\lambda_i - p_i^c}$$

Two results are apparent in the equation for $\epsilon_{D,i}$. First, conditional on quality, varieties sold at lower prices will be sold at lower absolute demand elasticities. Further, conditional on price, higher quality varieties (higher λ_i) will be sold at lower absolute demand elasticities. Given that consumers will tend to spend higher shares of their income on varieties with a lower quality-adjusted price, in equilibrium, there will be a negative relationship between the equilibrium absolute elasticity of demand and variety-specific revenues. The relationship between revenues and elasticities is crucial for the main theoretical results of the paper, and the link to the empirics.

Firms

For this particular model, each supplier will produce one variety, and thus suppliers are also indexed by i. Further, supplier i will produce variety i at a constant marginal cost, c_i. I will not assume a specific relationship between the marginal cost of production c_i and the quality of each variety, λ_i (different from Baldwin and Harrigan, 2008, and Johnson, 2009). It will soon be clear that the relationship between marginal costs and quality has no bearing

[3] Indeed, defining $\epsilon_{D,\lambda_i} = \frac{\partial q_i}{q_i}\frac{\lambda_i}{\partial \lambda_i}$ as the elasticity of quantity demanded with respect to quality (at constant prices), and $\epsilon_{D,i} = \frac{\partial q_i}{q_i}\frac{p_i^c}{\partial p_i^c}$ as the elasticity of demand, I can write the following:

$$-\epsilon_{D,i} = 1 + \epsilon_{D,\lambda_i}$$

Thus, as long as the elasticity of demand is less than -1, or equivalently, that firms are operating on the elastic part of their residual demand curve (ie. when marginal revenue is positive), ϵ_{D,λ_i} must be positive and quantity demanded must rise with quality.

on the results outside of their relationship to the observed distribution of revenues within products.

For simplicity, I assume that all suppliers are foreign (no domestic sector). To sell a variety in the import market, the supplier must pay an ad-valorem tariff τ for each unit sold. Hence, the relationship between the consumer price detailed above and the price that producers receive is $p_i^c = (1+\tau)p_i^s$. This yields the following inverse demand function that suppliers use to optimally set production for the import market.

$$p_i^c = \frac{\lambda_i}{t}\left(A - \gamma\lambda_i q_i\right)$$

Here, $t = (1+\tau)$. Suppliers choose quantities to maximize profits:

$$\pi\left(\lambda_i, c_i\right) = \max_{q_i}\left\{\frac{\lambda_i}{t}\left(A - \gamma\lambda_i q_i\right)\cdot q_i - c_i q_i\right\}$$

Optimal production of each variety for the import market, $q\left(\lambda_i, c_i\right)$, is written as:

$$q\left(\lambda_i, c_i\right) = \frac{A - \frac{c_i}{\lambda_i}t}{2\gamma\lambda_i}$$

The price received for each variety is written as:

$$p\left(\lambda_i, c_i\right) = \frac{\lambda_i}{t}\left(\frac{A + \frac{c_i}{\lambda_i}t}{2}\right)$$

Finally, the pre-tariff value of imports from supplier i is written as:

$$v\left(\frac{c_i}{\lambda_i}\right) = \left(\frac{A^2 - \left(\frac{c_i}{\lambda_i}\right)^2 t^2}{4\gamma t}\right) \tag{3}$$

As trade data reports the value of trade, and not the profits of each supplier, equation (3) is the object of interest. The value of trade will be affected by tariffs through two channels. The first is directly via the negative effect of tariffs on variety-specific marginal revenue. This can be seen by the negative impact of tariffs on the numerator of (3), and the positive impact of tariffs on the denominator of (3). However, there are also indirect effects of tariffs through the competitiveness term, A. This can be seen by substituting the optimal quantity of each variety into the equation for A:

$$A = \theta - \eta \int_0^1 \frac{A - \frac{c_i}{\lambda_i} t}{2\gamma} di$$

Solving for A, we have,

$$A = \left(\frac{2\gamma}{2\gamma + \eta}\right)\theta + \left(\frac{2\gamma}{2\gamma + \eta}\right)\frac{\eta}{2\gamma} t\widetilde{c} \tag{4}$$

where $\widetilde{c} = \int_0^1 \frac{c_i}{\lambda_i} di$. In (4), higher tariffs increase A. Intuitively, higher tariffs decrease quality-adjusted production for the import market, thus making the market less competitive. This yields a higher residual demand for each variety, A. Finally, a useful result for the next section will be the elasticity of A with respect to t.

$$\epsilon_A \equiv \frac{\partial A}{\partial t}\frac{t}{A} \equiv \frac{\eta t \widetilde{c}}{2\gamma\theta + \eta t \widetilde{c}} \in (0, 1) \tag{5}$$

While A is clearly increasing in t, on a percentage basis, A increases slower than t.

Trade Liberalization

As stated in the introduction, the goal of this section is to evaluate how the effects of trade liberalization are distributed across suppliers that may not sell varieties of the same quality, or varieties produced at the same marginal cost. By taking logs and then fully differentiating (3), I can write the following:

$$\frac{\partial v_i}{v_i} = \frac{2A\partial A - 2t\left(\frac{c_i}{\lambda_i}\right)^2 \partial t}{A^2 - \left(\frac{c_i}{\lambda_i}\right)^2 t^2} - \frac{\partial t}{t}$$

Solving for $\frac{c_i}{\lambda_i}$ in (3) and substituting into the above equation yields a simple relationship between the marginal effect of tariffs and the value of imports prior to the change in tariffs.

$$\partial v_i = \frac{A^2 \overbrace{(\epsilon_A - 1)}^{<0}}{2\gamma t}\frac{\partial t}{t} + v_i \frac{\partial t}{t} \tag{6}$$

Written in terms of elasticities:

$$\epsilon_{v,i} = \frac{\partial v_i}{\partial t}\frac{t}{v_i} = \frac{A^2 \overbrace{(\epsilon_A - 1)}^{<0}}{2\gamma t v_i} + 1$$

In (6), the marginal effect of tariffs is a function of two terms. The first is a negative effect which is common across all suppliers. The second is specific to the value of imports prior to the change in tariffs. Note that higher tariffs decrease imports of variety i only if the value of imports prior to higher tariffs is sufficiently small. Precisely, given $\frac{\partial t}{t} > 0$, $\partial v_i < 0$ only if:

$$v_i < \frac{A^2 (1 - \epsilon_A)}{2\gamma t}$$

In contrast, when v_i is sufficiently high, it is possible that higher tariffs increase trade. To see this, using (3), the highest possible value of trade is written as:

$$v^{\max} = v(0) = \frac{A^2}{4\gamma t}$$

Substituting $v^{\max}$ into ∂v_i, we have:

$$\partial v_i^{\max} = \frac{A^2 (2\epsilon_A - 1)}{4\gamma t}\frac{\partial t}{t}$$

Thus, $\partial v_i^{\max} > 0$ if $\epsilon_A > \frac{1}{2}$. Using (5), this occurs if:

$$\frac{\eta}{\gamma} > \frac{2\theta}{\widetilde{c}t}$$

Thus, if η is sufficiently large compared with γ, the largest suppliers will lose market access after trade liberalization and gain market access with higher tariffs. As can be seen in (5), movements to A are increasing in η, and decreasing in γ. Intuitively, as varieties become more substitutable (relatively lower values of γ), bilateral trade will respond more to how tariffs affect aggregate demand rather than variety-specific demand.

The main results of this section are summarized in the following proposition.

Proposition 1 *Higher MFN tariffs necessarily reduce trade only from imported varieties* *earning relatively small revenues. In contrast, if $\frac{\eta}{\gamma} > \frac{2\theta}{\widetilde{c}t}$, higher MFN tariffs increase trade from imported varieties earning relatively large revenues. Generally, the negative effects of tariffs are amplified for low revenue varieties, and mitigated or reversed for high revenue varieties.*

The intuition for Proposition 1 can be explained as follows. Holding the level of competition (A) fixed, every variety, low revenue or high revenue, benefits from a tariff cut. However, imported varieties earning relatively low revenues benefit the most from a tariff cut. As these varieties are either low quality and/or high cost, equilibrium demand elasticities for their varieties tend to be quite large (in absolute terms). As a cut in tariffs can be thought of as a percentage reduction in the supply price of each variety, the response to changes in the supply price via a tariff cut is particularly large. This is in stark contrast with high quality/low cost varieties, which tend to be sold at relatively low demand elasticities, and earn relatively large revenues. The response of these varieties to changes in tariffs is relatively small.

When noting that the tariff changes in this model are pervasive and identical across all imported varieties (MFN tariff cuts), competition is more fierce after the tariff cut. This is embodied in the residual demand level, A, which falls as tariffs fall. In equilibrium, the fall in A may be larger or smaller than the direct effects detailed in the preceding paragraph. In cases where the direct effects are particularly small - for low cost and/or high quality varieties, who tend to earn large revenues - the fall in A is larger in absolute terms and the value of imports of these varieties falls in response to lower MFN tariffs.

Discussion

The result detailed above is not the first to look at the relationship between product characteristics and bilateral trade flows. For example, recent work by Johnson (2009) has allowed for a precise impact of quality, via prices, on trade flows. Further, Hummels and Skiba (2004) examine how trade costs and tariffs affect the price-composition of exports. However, to my knowledge, the above framework is the first to demonstrate that the impact of import liberalization may in fact be negative for some measure of imported varieties.

This main result is mostly closely related to the classic Alchian-Allen hypothesis, and the subsequent empirical work by Hummels and Skiba (2004), in which transportation costs shift the distribution of exports toward higher quality goods. In their work, per-unit costs of shipping lower the relative price of high quality goods, and thus increase the relative demand for these goods. In the parlance of Alchian-Allen, when distance plays a non-trivial role in exporting decisions, countries "ship the good apples out". Along with per-unit trade costs, Hummels and Skiba allow for an ad-valorem component, such as tariffs. Theoretically, they show that higher tariffs reduce the relative demand for high quality goods, thus lowering the average FOB price of exports.

Relative to Hummels and Skiba (2004), my model extends the literature in a crucial way, where I allow for elasticity differences that are arbitrarily correlated with prices. To be more specific, consider an example in which all imported varieties are produced at the same marginal cost, but yet differ in quality. In this case, higher quality varieties earn higher revenues, and are sold at lower equilibrium demand elasticities. If raising tariffs, high quality varieties will suffer less than low quality varieties, by virtue of the equilibrium demand elasticity at which each are sold. Thus, higher tariffs increase the relative demand for high quality goods - the opposite of what Hummels and Skiba (2004) predict. The critical difference is that the quality component in my model may shift/skew the demand curve such that higher price goods are sold at lower demand elasticities. In contrast, the model in Hummels and Skiba (2004) is consistent with a restricted version of the model where quality and costs and correlated in such a way to ensure that demand elasticities are always larger with higher prices.

Granted, I take no stance on the relationship between quality and production cost - a relationship which is important for many issues. Further, I cannot predict whether bilateral trade flows increase or decrease following liberalization due to product quality or efficiency issues. However, taking such a stance and/or making such predictions is not required, and is one of the novel features of the model discussed above. That is, the ultimate effects of tariffs are governed by differences in demand elasticities, and demand elasticities boil down to revenues pre-tariff cut. Critically, varieties produced of high quality or at a low cost both earn relatively large revenues and are sold at relatively low demand elasticities. Hence, the critical variety-level characteristic is simply earned revenues pre-tariff cut.

From a trade policy perspective, the results in Proposition 1 seem in direct conflict with the intent of the central tenet of the WTO: the principle of non-discrimination. Under this rule, any concession given to a WTO member must be extended to every other member. In its most simple form, the principle of non-discrimination is central to the paradox discussed above. That is, even tariff reductions that are non-discriminatory do in fact discriminate along natural margins.

Relative to the design of the WTO, this could be viewed in two ways. Although the intentions of non-discrimination are likely "good", this paper details how the effects of tariff liberalization on trade may be negative for the most established exporters. This runs contrary to the prevailing view that MFN tends to increase efficiency for participating parties.[4] Further, as established exporters tend to be developed nations, this might suggest a new reason why current WTO negotiations are at a stalemate, as those nations with the largest bargaining power have the most to lose from broad tariff cuts.

On the other hand, the main result from this section may provide a new rationale for Article XXIV in the GATT, and its successor in the WTO, where discriminatory tariffs are permitted via the formation of customs unions or regional free-trade areas. Perhaps the original signatories of the GATT envisioned a setting in which the scope of benefits via multilateral liberalization were limited.[5] Relative to this paper, this suggests that preferential liberalization, or perhaps even preferential agreements, may act as a safety valve for relationships that may deteriorate naturally under MFN. This is clearly a topic of interest to be pursued in a follow-up paper.

Extensive Margin

Finally, an aspect absent from the above model is a treatment of the extensive margin. As bilateral trade values, the object of interest in the forthcoming empirical analysis, are recorded at the country level and not the variety level, it is crucial to address the extent to which aggregation and entry of new varieties matters for the above results. To examine these issues, I now derive a model in which a continuum of exporters (indexed from 0 to 1)

[4] As detailed in Jackson (1997), there are three arguments which support the use of MFN. One is that MFN prevents policies which distort bilateral patterns of comparative advantage. Further, some argue that MFN results in more liberalization than under preferrential systems. Finally, others argue that allowing for discriminatory tariffs would increase the costs of rule formation, where many tariff lines would be more costly to impose and enforce when compared to a single tariff line applied to all exporters.

[5] Indeed, Irwin, Mavroidis, and Sykes (2007) describe this as one of Keynes' original concerns during the framing of the GATT. While this was mainly argued within the context of Great Britain's imperial relationships, Keynes seems to express a notion that the post-war trading system ought not to be constrained by MFN.

supply to a common import market. Each exporter l is identical with the exception of the distribution of quality-adjusted marginal costs, and the pool of potential exporting firms, N_l. Precisely, I assume that, for exporter l, quality-adjusted costs are distributed from 0 to $\widetilde{c}_{\max}$ with Pareto shape parameter k_l (> 0). The upper-bound on costs, $\widetilde{c}_{\max}$, is assumed to be non-binding, and thus larger than the demand intercept, A. Thus, the distribution of quality-adjusted costs for each country l is written as:

$$G_l\left(\frac{c}{\lambda}\right) = \frac{\left(\frac{c}{\lambda}\right)^{k_l}}{\left(\widetilde{c}_{\max}\right)^{k_l}}$$

Here, higher values of k_l yield a higher quality-adjusted cost, on average.

Next, I derive the relationship between quality-adjusted costs and import values. Recall the equation for (pre-tariff) import value of any variety i:

$$v\left(\frac{c_i}{\lambda_i}\right) = \left(\frac{A^2 - \left(\frac{c_i}{\lambda_i}\right)^2 t^2}{4\gamma t}\right)$$

As A represents the vertical intercept of the demand curve for each variety, firms cannot sell unless their post-tariff price is less than or equal to A. This will occur if $\left(\frac{c_i}{\lambda_i}\right) \in \left[0, \frac{A}{t}\right]$. Thus, assuming that quality-adjusted costs are distributed according to $G_l\left(\frac{c}{\lambda}\right)$, the average import value from country l is written as:

$$\begin{aligned} \overline{v}_l &= \frac{1}{G_l(\frac{A}{t})}\int_0^{\frac{A}{t}} \left(\frac{A^2 - \left(\frac{c}{\lambda}\right)^2 t^2}{4\gamma t}\right) g_l(\frac{c}{\lambda})d\frac{c}{\lambda} \\ &= \frac{A^2}{2\gamma t(k_l+2)} \end{aligned} \tag{7}$$

In (7), note that by taking logs and differentiating, there would be no differential impact of tariffs as a function of country specific factors (in this case, k_l). This changes, however, when allowing for the full extensive margin of trade to play a role. To see this, note that total imports from country l, V_l, are equal to the average multiplied by the number of varieties imported from country l. The number of varieties imported from l is simply equal to the number of potential varieties N_l multiplied by the fraction of those varieties which are imported, $G_l(\frac{A}{t})$. Precisely, $V_l = N_l G_l(\frac{A}{t})\overline{v}_l$, which can be simplified as follows:

$$V_l = \frac{N_l}{\widetilde{c}_m^{k_l}} \frac{A^{2+k_l}}{2\gamma t^{1+k_l}(k_l+2)}$$

Taking logs of V_l and differentiating with respect to k_l :

$$\frac{\partial \log(V_l)}{\partial k_l} = \log\left(\frac{A}{\widetilde{c}_m t}\right) - \frac{1}{k_l+2} < 0$$

The inequality follows from the assumption that $\widetilde{c}_m$ is non-binding.[6] Thus, holding the level of potential exporters, N_l, constant, the value of imports from exporter l is decreasing in k_l. Thus, unless the number of potential exported varieties varies strongly with the distribution of quality-adjusted costs, exporters with the highest quality-adjusted cost earn the lowest revenues.

With this relationship in mind, I now show that the results from the basic model described above remain despite including a flexible response at the extensive margin. Precisely, taking logs of V_l and differentiating with respect to t, the elasticity of import value with respect to tariffs for country l is written as follows::

$$\epsilon_{v,l} = k_l \underbrace{(\epsilon_A - 1)}_{<0} + \underbrace{(2\epsilon_A - 1)}_{?}$$

Again $\epsilon_A \in (0,1)$, as higher tariffs decrease competitiveness and increase the residual consumer demand for each variety.[7] In the equation for $\epsilon_{v,l}$, higher values of k_l increase the

[6] $\widetilde{c}_m t > \widetilde{c}_m > A$ implies that $\log\left(\frac{A}{\widetilde{c}_m t}\right) < 0$

[7] To see that $\epsilon_A \in (0,1)$, first note that A is written as:

$$A = \theta - \eta \int_0^1 \left(\underbrace{N_l G_l(\frac{A}{t})}_{l \text{ Exporters}} \times \overbrace{\frac{1}{G_l(\frac{A}{t})} \int_0^{A/t} \lambda q(\frac{c}{\lambda}) g_l(\frac{c}{\lambda}) d\frac{c}{\lambda}}^{\text{Avg. quality-adjusted quantity from } l} \right) dl$$

Subsitituting the equilibrium value of $q(\frac{c_i}{\lambda_i})$, taking deriviatives with respect to t, and simplifying, it can be shown that:

$$\epsilon_A = \frac{\int_0^1 \frac{N_l A(\frac{A}{t})^{k_l}}{2\widetilde{c}_m^{k_l}\gamma} \frac{k_l}{k_l+1} dl}{A + \int_0^1 \frac{N_l A(\frac{A}{t})^{k_l}}{2\widetilde{c}_m^{k_l}\gamma} dl} \in (0,1)$$

negative impact of tariffs. Thus, countries with a higher average quality-adjusted cost benefit the most from the liberalization of MFN tariffs. As countries with a higher k_l also earn lower revenues before the tariff cut, I can thus state that when aggregating to the country level, countries that export relatively low quality and/or high cost goods tend to benefit the most from tariff liberalization.

3 Tariffs and bilateral trade: The US and the Uruguay Round

In this section, I use detailed import data from the United States, along with applied MFN tariffs, to estimate the degree to which the effects of MFN tariffs differ within products. To do this, I use HS10 bilateral import data from the UC Davis Center for International Data, as described in Feenstra, Romalis, and Schott (2001). HS8 tariff data is obtained from the US International Trade Commission and from Romalis (2004), and HS6 MFN tariff data from TRAINS for non-US countries.[8] More information regarding the construction of the sample will be provided shortly.

The theory described in section two focused on the effects of a unilateral reduction in a common tariff. As such, I will restrict the sample to focus on the effects of ad-valorem MFN tariffs on MFN imports. Precisely, the sample will include observations that satisfy the following two conditions:

1. Bilateral imports are subject to MFN tariffs

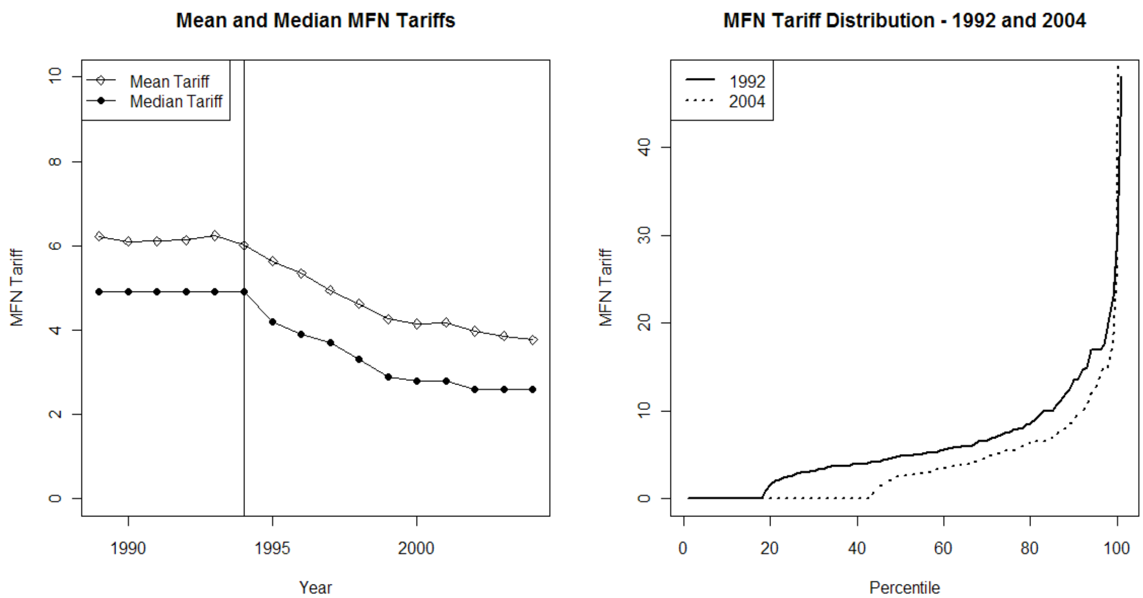
2. No non-tariff barriers during the period 1989-2004

The first condition removes non-MFN trade from the dataset. A robust set of fixed effects will control for products which may be affected by preferential, GSP, or other non-MFN arrangements with non-MFN countries. In the second, I remove products for which at some point in the sample, non-tariff barriers are observed.

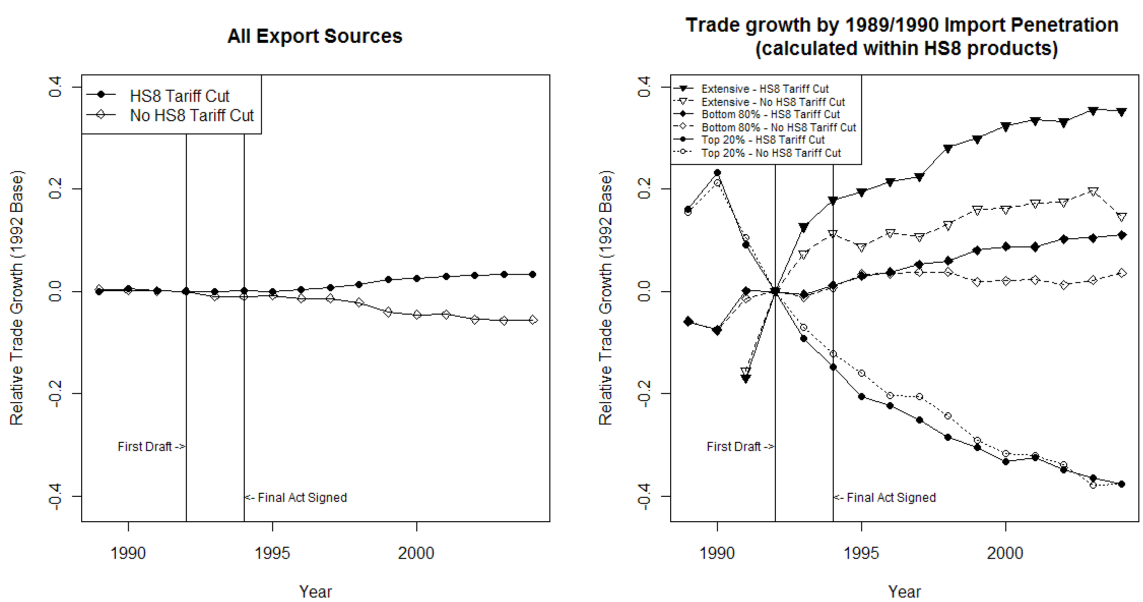
Before presenting the precise regression framework (which will further restrict the sample), I first detail the reductions in US import tariffs which resulted from the Uruguay Round.

[8] The Romalis data is also obtained from the UC Davis Center for International Data.

Figure 1: US MFN Tariffs and Bilateral Import Growth Rates



Notes: The left-hand chart reports the Mean and Median HS8 MFN tariff for the US. The right-hand chart reports the empirical distribution of HS8 MFN tariffs in 1992 and 2004.



Notes: To construct these charts, for each HS10-Exporter pair, I first calculate log($\text{Imports}_t/\text{Imports}_{1992}$) for all years t. Then, growth rates in each year t are centered around Exporter-HS4 averages. Then, these centered growth rates are used to calculate average relative growth rates according to various product groupings. In the left-hand chart, averages are constructed separately for HS8 varieties that received a tariff cut, and those that did not. In the right-hand chart, I breakdown the averages from the left-hand chart within large and small HS10-Exporter pairs that exported in either 1989 or 1990, and those that did not. Precisely, "Extensive" represents HS10-Exporter observations that did not export to the US under MFN in 1989 or 1990. "Bottom 80%" represents HS10-Exporter observations that were in the bottom 80% of their HS8 product group in 1989-1990. "Top 20%" represents HS10-Exporter observations that were in the top 20% of their HS8 product group in 1989-1990.

Two particular characteristics of this round of tariffs cuts are presented in the top-half of Figure 1. In the top-left panel, I have plotted mean and median tariffs across HS8 products for each year, 1989-2004. The last year prior to the enactment of the Uruguay Round (1994) is denoted by the vertical line. Notably, there is very little movement in tariffs prior to the enactment of the Uruguay Round. Directly after, tariffs fell steadily, flattening out between 2000 and 2004. Overall, mean and median tariffs fell by roughly 50%. In the top-right panel of Figure 1, I plot the empirical distribution of MFN tariffs in 1992 and 2004 (which will be the years over which I evaluate the effects of tariffs). In this chart, two features are worth noting. First, US MFN reductions in the Uruguay Round doubled the number of MFN tariffs that were zero in 2004. Second, the reduction in US tariffs seems relatively uniform over most percentiles of US MFN tariffs.

Next, I will provide some illustrative evidence on the effect of MFN tariff reductions, and a differential effect of tariff reductions by market penetration before the tariff cut. This evidence is presented in the bottom-half of Figure 1. To begin, focus on the bottom-left panel of Figure 1, where I have plotted relative trade growth for products that received a tariff cut and products that did not. To calculate relative trade growth, I first calculate the log of the ratio of imports in year t to imports in 1992 for each HS10-Exporter pair. Then, for each year, I de-mean these growth rates across Exporter-HS4 pairs. Thus, in each year, average trade growth relative to 1992 is equal to zero. In the bottom-left panel of Figure 1, I have decomposed this "zero" into HS8 products that received a tariff cut, and HS8 products that did not. Further, I have denoted the first draft of the final act of the Uruguay round, which occurred at the end of 1991, and the year in which the final act was signed, 1994, by vertical black lines. Clearly, products that received a tariff cut experienced positive trade growth relative to those products that did not. More notably, trade growth rates for each product group were indistinguishable from one another prior to 1992. This suggests that after controlling for factors unrelated to tariff cuts (the Exporter-HS4-Year fixed effects), products which received a tariff cut were not growing differently than those that did not receive a tariff cut.[9]

[9] This is a statistically robust statement. Regressing the log change in imports between 1989 and 1992 on the log change in tariffs between 1994 and 2000 and Exporter-HS4 fixed effects yields an insignificant relationship between pre-Uruguay round trade growth rates and future tariff cuts. Precisely,

$$\log(\frac{v_{i,j,92}}{v_{i,j,89}}) = \underset{(1.121)}{-0.715} \cdot \log(\frac{t_{i,00}}{t_{i,94}}) + Exp\_HS4$$

In the bottom-right panel of Figure 1, I have further decomposed these "zeros" by the relative position of each HS10-Exporter observation in their respective HS8 product category. Precisely, I decompose the averages in the left-panel by whether a HS10-Exporter reported positive trade values in 1989 or 1990, and if they did, whether they are in the bottom 80% or top 20% of their HS8 import category over the period 1989-1990. The results from doing so are striking. The group that benefited the most from a tariff cut relative to their no-tariff cut control group were those HS10-Exporter pairs that did not report any trade in 1989 or 1990 (labeled "Extensive"). Further, there was also a positive, though smaller, effect of tariff cuts relative to the no-tariff cut control for HS10-Exporters that reported trade over 1989-1990 but were in the "Bottom 80%" of their particular HS8 import group. Finally, perhaps the most striking of all three groups, there was an *indistinguishable to arguably negative* effect of tariff cuts relative to the no-tariff cut control for HS10-Exporters that reported trade over 1989-1990 and were in the "Top 20%" of their particular HS8 import group. Overall, the evidence in the bottom-half of Figure 1 details a differential impact of MFN tariffs which is consistent with the theory developed in section two. I now test the robustness of these features using a broad set of regressions.

Specification #1 - Tariffs and Value

Given that tariffs only changed once and over a relatively short period, the empirical strategy will be similar Trefler (2004), where I use long differences to evaluate the effects of tariffs on bilateral trade. Further, the following two additional restrictions are placed on the sample to facilitate a clean examination of tariffs and their long-run effects on bilateral imports:

1. HS8 tariff cuts from 1989-1994 and 2000-2004 must both be equal to zero

2. HS10-Exporter observations must be observed in both 2004 and 1992

The first condition tightens the empirical framework, restricting the sample to no tariff reductions during the base period (1989-1994), a policy period in which tariffs, if reduced, were reduced fairly quickly (1994-2000), and a run-out period in which the effects of previous

where i represents HS10 varieties and j represents exporters. Standard errors are robust and clustered by Exporter and HS4 product.

tariff reductions may still be filtering through the economy but with no new tariff cuts (2000-2004). The second condition allows for the calculation of an import growth rate which starts before any tariff reductions occurred (1992), and four years after tariff reductions ended (2004). Along with the earlier restrictions regarding MFN tariffs and non-tariff barriers, these two additional restrictions leave us with roughly 36,000 HS10-Exporter pairs.

The object of interest will be the growth rate in trade over the period 1992-2004. This growth rate will be labeled $\log(v_{i,j,04}/v_{i,j,92})$, where $v_{i,j,s}$ measures the value of imports in nominal US dollars of HS10 variety i from exporter j in year s. The growth rate will be regressed on a number of factors within a number of different specifications, though the common regressor in each will be the log change in MFN tariffs over the period 1994-2000. Precisely, I will measure tariffs as in section two, where $t_{i,s} = 1 + \tau_{i,s}$. Here, $\tau_{i,s}$ is the percentage point MFN tariff for HS10 variety i in year s (though understanding that tariffs are set at the HS8 level). To calculate a measure of import elasticity, I will measure the change in tariffs using log differences, $\log(\frac{t_{i,00}}{t_{i,94}})$, similar to the way in which I measure the change in import value for each HS10-Exporter.

The first specification, which is meant to be as parsimonious as possible, is one which regresses growth rates in bilateral imports on growth rates in tariffs, and an interaction with pre-tariff-cut import value. Precisely, the specification is written as follows:

$$\begin{aligned}\log(\frac{v_{i,j,04}}{v_{i,j,92}}) &= \left(\beta_{US}\cdot\log(\frac{t_{i,00}}{t_{i,94}}) + \beta_{US\_V}\cdot\log(\frac{t_{i,00}}{t_{i,94}})\cdot\log(v_{i,j,Pre}) + \beta_{V}\cdot\log(v_{i,j,Pre})\right)\cdot D_{i,j} \\ &+ \left(\beta_{US\_Zero}\cdot\log(\frac{t_{i,00}}{t_{i,94}}) + \beta_{Zero}\right)\cdot(1-D_{i,j}) + Fixed + \epsilon_{i,j} \qquad (8)\end{aligned}$$

In (8), I regress $\log(\frac{v_{i,j,04}}{v_{i,j,92}})$ on $\log(\frac{t_{i,00}}{t_{i,94}})$, and a full interaction with $\log(v_{i,j,Pre})$, the log of total imports reported over the period 1989-1990 of variety i from exporter j, and a dummy variable, $D_{i,j}$, identifying whether imports of HS10 variety i were observed from exporter j over the period 1989-1990.[10] According to the theory in section two, I hypothesize that β_{US} is significantly negative and β_{US_V} is significantly positive. Further, I hypothesize that β_{US_Zero} is significantly negative.

Finally, I will include a robust set of fixed effects at the Exporter-Industry/Product level to control for trends unrelated to changes in MFN tariffs. For example, some exporter-

[10] $\log(v_{i,j,89\_90})$ is forced to zero for observations in which $D_{i,j} = 0$

Table 1: Regression Results: Tariff Cut - Import Value Interaction

β_{US}	β_{US_v}	β_V	β_{US_Zero}	β_{Zero}	n	R2	Fixed	# Fixed	Clusters
-5.17***		-0.24***		-2.41***	36008	0.066	Exp_HS2	2682	Exp,HS2
(1.83)		(0.01)		(0.14)					
-16.3***	0.9***	-0.23***	-8.67***	-2.29***	36008	0.067	Exp_HS2	2664	Exp,HS2
(3.97)	(0.22)	(0.01)	(2.53)	(0.17)					
-6.48***		-0.24***		-2.46***	36008	0.06	Exp_HS4	11265	Exp,HS4
(1.53)		(0.02)		(0.19)					
-16.69***	0.83*	-0.23***	-9.96***	-2.36***	36008	0.059	Exp_HS4	11246	Exp,HS4
(6.34)	(0.46)	(0.02)	(2.47)	(0.23)					

Notes: The dependent variable is the log ratio of import value in 2004 to 1992 from exporter j in HS10 industry i. The excluded group is $D_{i,j}$, which is the dummy variable identifying positive bilateral imports from exporter j in HS10 product i during the years 1989 and 1990. Fixed effects are estimated using a within procedure according to the groups listed in the column "Fixed". Standard errors are heteroskedasticity robust and clustered by the groups listed in the column "Clusters" according to the multi-level procedure in Cameron, Gelbach, and Miller (2006). The labels *, **, and *** identify estimates which are significantly different from zero at the 10%, 5%, and 1% levels, respectively.

industry pairs may be declining or growing due to development or a long-run adjustment toward different industries. Also, some exporters may have preferential status in some sub-products, and thus there may be trends unrelated to MFN tariff reductions which are accounted for using fixed effects at an Exporter-Industry or Exporter-Product level.

Table 1 reports the results from estimating (8), with and without the tariff-value interaction. First, focus attention on rows 1 and 3, where I report the results from estimating (8) without an interaction between tariffs and value. Here, the long-run bilateral import elasticity with respect to tariffs, estimated by β_{US}, is negative and significant for all specifications. The implied elasticities are quite high (between -7 and -5), likely due to the long measure of trade growth, but not implausible.

The first bit of support for the model in section two is presented in rows 2 and 4. In these rows, I have estimated (8) including an interaction between $\log(\frac{t_{i,00}}{t_{i,94}})$ and $\log(v_{i,j,Pre})$. Here, the results are quite striking. In these rows, the interpretation of β_{US} is the long-run import elasticity for the smallest *positive* import observations. The theory predicts that these elasticities should be more negative than the average - indeed, these elasticities are much more negative than the average elasticities presented in rows 1 and 3. However, the most important element in rows 2 and 4 are the estimates for β_{US_V}, which are positive for both choices of fixed effects. In terms of inference, β_{US_V} is positive and significantly different from zero.

To put more structure on the estimates, note that within positive observations of $\log(v_{i,j,Pre})$, the 1st and 99th percentiles of $\log(v_{i,j,Pre})$ are 7.9 and 18.3, respectively. At these values of $\log(v_{i,j,Pre})$, the implied bilateral import elasticities are -9.16 and 0.18, respectively. Clearly, the larger export sources are predicted to gain very little, and possibly lose, from tariff liberalization. Further, note that the estimates for β_{US_Zero}, which are between -8 and -10, are highly significant in all specifications, and in-line with the implied elasticities for the 1st percentile of $\log(v_{i,j,Pre})$ (-9.16, as calculated earlier). Thus, the estimated elasticities for the smallest positive observations of $\log(v_{i,j,Pre})$ are very similar to the estimates for the observations where $v_{i,j,Pre} = 0$. Overall, these results are supportive of the model developed in section two.

Specification #2 - Relative market penetration

A drawback of the approach in (8) is that there is no accounting for variation in initial HS10-Exporter import values within products, which is a feature at the heart of the model in section two. Thus, in this section, I present results for an alternate specification in which I measure market penetration over 1989 and 1990 in relative amounts within products.

In particular, I will construct six sub-groups, five of which based on quintiles of positive imports, which identify different levels of market penetration within a given product. For example, consider the construction of these sub-groups for HS4 products. For each HS4 product, all HS10-Exporter observations in which imports to the US were not observed over the year 1989-1990 are placed in group zero. This group is identified by a dummy variable $D^0_{i,j}$. Next, HS10-Exporter observations for which imports occurred during 1989-1990 are grouped into quintiles within each HS4 product. These quintiles will be identified in order by dummy variables $D^1_{i,j}$, $D^2_{i,j}$, $D^3_{i,j}$, $D^4_{i,j}$, and $D^5_{i,j}$, with the lowest 20% of positive imports within each HS4 product identified by $D^1_{i,j}$, and the highest 20% of positive imports identified by $D^5_{i,j}$.

Table 2 presents the mean and median import values over 1989-1990 for each of these groups, after dropping HS4 products without five HS10-Exporter observations with positive trade (i.e. dropping HS4 products where quintiles are not defined). Further, the table reports the number of HS10-Exporter observations in each category, and the percentage of total observations. The point to be taken from Table 2 is that the top 20% of HS10-Exporter observations are, on average, just shy of 10X larger than those in the 60-80th percentile. A

Table 2: Mean Import Value in 1989-1990 for HS4 Quintiles

	Group 0	Group 1	Group 2	Group 3	Group 4	Group 5
Mean Import Value ($)	0	54,781	276,002	951,754	3,361,647	28,450,104
Median Import Value ($)	0	26,483	146,148	483,932	1,577,547	7,744,353
Count (%)	4451 (12.5)	6165 (17.4)	6219 (17.5)	6194 (17.4)	6286 (17.7)	6098 (17.2)

Notes: This table reports the average and median trade value by relative market penetration, calculated assuming that products are defined at the HS4 level. Also reported are the number and percentage of HS10-Exporter observations in each group.

similar magnitude difference is evident at the median. Overall, the largest 20% of exporters are, in fact, quite large, which is consistent with similar results presented at the firm level in Bernard, Jensen, Redding, and Schott (2007). Thus, given the theory in section two, I hypothesize that the effects of MFN liberalization on this group are modest relative to groups 0-4. I now seek evidence in support of this hypothesis.

To test for any differences across quintiles, I start by estimating the following equation.

$$\begin{aligned}\log(\frac{v_{i,j,04}}{v_{i,j,92}}) &= \Big(\beta_{US\_D5}D^5_{i,j} + \cdots + \beta_{US\_D1}D^1_{i,j} + \beta_{US}\Big)\log(\frac{t_{i,00}}{t_{i,94}}) \\ &+\beta_{D5}D^5_{i,j} + \cdots + \beta_{D0}D^1_{i,j} + Fixed + \epsilon_{i,j}\end{aligned} \tag{9}$$

In (9), I allow for a differential impact of tariffs across groups, where in particular, I measure the effects of group membership and a differential effect of tariff cuts relative to group zero. Thus, in (9), β_{US} represents the long-run elasticity of imports with respect to tariffs for the group of HS10-Exporters that did not report trade in 1989-1990 (but did report trade in 1992 and 2004). Further, β_{US_Dk} represents the difference in elasticity, relative to group 0, for group k. To be clear, β_{US_D5} represents the difference in import elasticity of the largest exporters relative to the smallest exporters.

An alternate way of estimating the model in (9) is by directly estimating elasticities for each group, and not differences relative to a base group. Equation 10 does exactly this:

$$\begin{aligned}\log(\frac{v_{i,j,04}}{v_{i,j,92}}) &= \Big(\beta_{US\_D5}D^5_{i,j} + \cdots + \beta_{US\_D0}D^0_{i,j}\Big)\log(\frac{t_{i,00}}{t_{i,94}}) \\ &+\beta_{D5}D^5_{i,j} + \cdots + \beta_{D0}D^1_{i,j} + Fixed + \epsilon_{i,j}\end{aligned} \tag{10}$$

The results from estimating (9) and (10) are presented in Table 3. Each panel represents a different definition of products - HS4, HS6, and HS8 - within which quintiles are defined. Within each panel, I present the results with no tariff-quintile interaction in the first two rows, the results from estimating (9) in the second two rows, and the results from estimating (10) in the last two rows. In the first two rows of each panel, I estimate the long-run tariff elasticity of bilateral imports as negative and significantly different from zero for the group of exporters that did not trade in 1989-1990. Again, while these are quite large, the elasticities for the other groups are estimated to be much smaller as the theory predicts. In particular, the point estimates of β_{US_D1}-β_{US_D5} are all positive. Further, the effects of tariffs on group 5 - the largest 20% of HS10-Exporters within each product - is significantly different from group zero for 5 of 6 regressions. Finally, in the bottom two rows of each panel, I estimate the adjusted model in (10). Here, I separately estimate each elasticity focusing on whether I can reject the hypothesis that each is equal to zero. Indeed, I find that across most product definitions and groups of fixed effects, tariffs have a significant negative effect on imports *if market penetration is relatively small*. In contrast, for the largest 20% of HS10-Exporter observations within products, tariffs seem to have an insignificant effect on bilateral imports.

To test the robustness of the results in Table 3, I first examine whether restricting the sample to products with relatively quick tariff cuts has a qualitative effect on the results. To do so, I expand the sample as described above to include products that had a longer staging of tariff cuts. Precisely, I add to the sample any product that experienced a tariff cut over the period 1994-2004. The results from estimating (9) and (10) on this expanded sample are presented in Table 4. The effects of tariffs summarized in Table 4 are smaller and less precise than in Table 3. However, as the full effects of tariffs may not be realized by 2004, this is not unexpected. In terms of the theory in section two, the results in Table 4 are moderately supportive of the theory on a few levels. First, the group of largest exporters often have an estimated elasticity which is insignificantly different from zero, where other groups do experience a negative effect of tariffs. Further, the estimated difference in elasticities is largest for group five relative to group zero in five of six regressions. Overall, while less precise in some cases than in Table 3, the results in Table 4 are mildly supportive of the theory developed in section two.

Moving back to the original sample, note that while I am focusing on the effect of US MFN tariffs, it is possible that any differential effects of MFN tariffs reported in Table 3 are spuriously correlated with more meaningful tariff reductions undertaken in other markets.

Table 3: Effects of MFN tariffs by within-product quintile

	Group Dummies					Group-Tariff interactions							R2	Fixed
	β_{D5}	β_{D4}	β_{D3}	β_{D2}	β_{D1}	β_{US_D5}	β_{US_D4}	β_{US_D3}	β_{US_D2}	β_{US_D1}	β_{US_D0}	β_{US}		(#)
HS4 Product Definitions (N=35403)	-1.47***	-1.09***	-0.77***	-0.47***	(0.03)							-5.63***	0.057	Exp_HS2
	(0.09)	(0.07)	(0.06)	(0.07)	(0.04)							(1.90)		(2607)
	-1.37***	-0.97***	-0.65***	-0.35***	0.06							-6.63***	0.055	Exp_HS4
	(0.12)	(0.09)	(0.09)	(0.08)	(0.07)							(1.51)		(10759)
	-1.36***	-1.02***	-0.73***	-0.43***	0.02	7.14***	4.65**	3.08	1.99	3.04		-9.02***	0.058	Exp_HS2
	(0.09)	(0.08)	(0.07)	(0.08)	(0.06)	(2.45)	(2.31)	(2.29)	(2.14)	(2.07)		(2.53)		(2607)
	-1.25***	-0.91***	-0.59***	-0.29***	0.10	7.46**	4.29	3.31	3.13	2.47		-10.14***	0.056	Exp_HS4
	(0.12)	(0.10)	(0.09)	(0.10)	(0.09)	(3.39)	(3.39)	(2.80)	(2.39)	(2.90)		(2.46)		(10759)
	-1.36***	-1.02***	-0.73***	-0.43***	0.02	-1.88	-4.37*	-5.94***	-7.03***	-5.98**	-9.02***		0.058	Exp_HS2
	(0.09)	(0.08)	(0.07)	(0.08)	(0.06)	(2.60)	(2.28)	(2.03)	(1.92)	(2.42)	(2.53)			(2607)
	-1.25***	-0.91***	-0.59***	-0.29***	0.10	-2.68	-5.85**	-6.82***	-7.01***	-7.67***	-10.14***		0.056	Exp_HS4
	(0.12)	(0.10)	(0.09)	(0.10)	(0.09)	(2.42)	(2.50)	(2.15)	(1.85)	(2.46)	(2.46)			(10759)
HS6 Production Deftions (N=32925)	-1.43***	-1.11***	-0.81***	-0.51***	-0.09*							-5.89***	0.052	Exp_HS2
	(0.09)	(0.08)	(0.07)	(0.06)	(0.05)							(1.92)		(2517)
	-1.32***	-0.98***	-0.67***	-0.39***	0.01							-6.86***	0.049	Exp_HS4
	(0.12)	(0.10)	(0.09)	(0.08)	(0.08)							(1.64)		(10288)
	-1.34***	-1.07***	-0.79***	-0.47***	-0.05	5.36***	2.65	1.34	2.74	2.33		-8.37***	0.052	Exp_HS2
	(0.09)	(0.08)	(0.09)	(0.08)	(0.07)	(1.58)	(1.85)	(2.46)	(2.29)	(1.54)		(2.35)		(2517)
	-1.24***	-0.95***	-0.64***	-0.33***	0.04	4.96*	1.85	1.74	3.49*	1.62		-9.22***	0.049	Exp_HS4
	(0.12)	(0.11)	(0.10)	(0.08)	(0.09)	(2.88)	(2.90)	(3.01)	(1.92)	(2.71)		(2.58)		(10288)
	-1.34***	-1.07***	-0.79***	-0.47***	-0.05	-3.01	-5.72**	-7.03***	-5.63**	-6.04***	-8.37***		0.052	Exp_HS2
	(0.09)	(0.08)	(0.09)	(0.08)	(0.07)	(2.37)	(2.29)	(1.82)	(2.37)	(2.02)	(2.35)			(2517)
	-1.24***	-0.95***	-0.64***	-0.33***	0.04	-4.26*	-7.36***	-7.48***	-5.72**	-7.6***	-9.22***		0.049	Exp_HS4
	(0.12)	(0.11)	(0.10)	(0.08)	(0.09)	(2.20)	(1.94)	(2.30)	(2.47)	(2.29)	(2.58)			(10288)
HS8 Product Definitions (N=31319)	-1.39***	-1.11***	-0.79***	-0.53***	-0.1**							-6.48***	0.048	Exp_HS2
	(0.09)	(0.09)	(0.06)	(0.06)	(0.04)							(2.17)		(2497)
	-1.3***	-0.97***	-0.66***	-0.42***	0							-8.2***	0.045	Exp_HS4
	(0.12)	(0.11)	(0.09)	(0.09)	(0.08)							(1.63)		(10095)
	-1.32***	-1.05***	-0.76***	-0.47***	-0.08	4.32**	3.64*	1.97	3.96	1.37		-9.17***	0.048	Exp_HS2
	(0.09)	(0.09)	(0.08)	(0.08)	(0.06)	(1.90)	(2.16)	(2.33)	(2.53)	(2.11)		(2.65)		(2497)
	-1.24***	-0.94***	-0.63***	-0.35***	0.01	3.41	2.00	1.95	3.86*	0.05		-10.23***	0.045	Exp_HS4
	(0.13)	(0.11)	(0.09)	(0.10)	(0.10)	(3.48)	(3.18)	(2.82)	(2.31)	(3.03)		(2.59)		(10095)
	-1.32***	-1.05***	-0.76***	-0.47***	-0.08	-4.85*	-5.53**	-7.2***	-5.21**	-7.8***	-9.17***		0.048	Exp_HS2
	(0.09)	(0.09)	(0.08)	(0.08)	(0.06)	(2.71)	(2.44)	(2.11)	(2.50)	(2.51)	(2.65)			(2497)
	-1.24***	-0.94***	-0.63***	-0.35***	0.01	-6.82***	-8.22***	-8.28***	-6.36***	-10.17***	-10.23***		0.045	Exp_HS4
	(0.13)	(0.11)	(0.09)	(0.10)	(0.10)	(2.51)	(2.17)	(2.55)	(1.95)	(2.38)	(2.59)			(10095)

Notes: The dependent variable is the log ratio of import value in 2004 to import value in 1992 for exporter j in HS10 industry i. The excluded group is $D^0_{i,j}$, which is the dummy variable identifying whether exporter j in HS10 product i did not trade with the US during the years 1989 and 1990. Product definitions (for quintiles) are listed in the left-most column. Fixed effects are estimated using a within procedure according to the groups listed in the column "Fixed". Standard errors are heteroskedasticity robust and clustered by Exporter and Fixed effect industry (Exp_HS4 fixed effects implies Exporter and HS4 clusters used for standard errors) according to the multi-level procedure in Cameron, Gelbach, and Miller (2006). The labels *, **, and *** identify estimates which are significantly different from zero at the 10%, 5%, and 1% levels, respectively.

Table 4: Effects of MFN tariffs by within-product quintile: Tariff cuts over 1994-2004

	Group Dummies					**Group-Tariff interactions**							**R2**	**Fixed**
	β_{D5}	β_{D4}	β_{D3}	β_{D2}	β_{D1}	β_{US_D5}	β_{US_D4}	β_{US_D3}	β_{US_D2}	β_{US_D1}	β_{US_D0}	β_{US}		**(#)**
HS4 Product Definitions (N=50250)	-1.48***	-1.07***	-0.72***	-0.4***	-0.02							-2.91**	0.055	Exp_HS2
	(0.09)	(0.07)	(0.05)	(0.06)	(0.05)							(1.28)		(3014)
	-1.44***	-1.01***	-0.66***	-0.34***	0.01							-4.35***	0.056	Exp_HS4
	(0.09)	(0.08)	(0.07)	(0.08)	(0.06)							(1.07)		(13469)
	-1.44***	-1.09***	-0.75***	-0.44***	-0.03	2.04	-0.84	-1.34	-1.83	-0.43		-2.44	0.055	Exp_HS2
	(0.09)	(0.08)	(0.07)	(0.09)	(0.07)	(3.05)	(3.32)	(2.83)	(2.95)	(2.77)		(2.87)		(3014)
	-1.36***	-0.98***	-0.63***	-0.32***	0.04	4.00	1.44	1.50	0.71	1.37		-5.83**	0.056	Exp_HS4
	(0.10)	(0.09)	(0.08)	(0.10)	(0.08)	(2.75)	(2.90)	(2.18)	(2.40)	(2.28)		(2.30)		(13469)
	-1.44***	-1.09***	-0.75***	-0.44***	-0.03	-0.40	-3.28*	-3.78**	-4.27***	-2.87*	-2.44		0.055	Exp_HS2
	(0.09)	(0.08)	(0.07)	(0.09)	(0.07)	(1.71)	(1.83)	(1.67)	(1.20)	(1.73)	(2.87)			(3014)
	-1.36***	-0.98***	-0.63***	-0.32***	0.04	-1.83	-4.39**	-4.33***	-5.12***	-4.46**	-5.83**		0.056	Exp_HS4
	(0.10)	(0.09)	(0.08)	(0.10)	(0.08)	(1.76)	(1.99)	(1.62)	(1.13)	(1.77)	(2.30)			(13469)
HS6 Product Definitions (N=46922)	-1.46***	-1.1***	-0.76***	-0.47***	-0.08							-3.74***	0.051	Exp_HS2
	(0.09)	(0.07)	(0.06)	(0.05)	(0.05)							(1.34)		(2929)
	-1.39***	-1.01***	-0.65***	-0.4***	-0.03							-5.32***	0.050	Exp_HS4
	(0.10)	(0.08)	(0.08)	(0.07)	(0.07)							(1.14)		(12899)
	-1.4***	-1.11***	-0.77***	-0.45***	-0.08	3.00	-0.66	-0.87	1.37	0.22		-4.21*	0.051	Exp_HS2
	(0.10)	(0.08)	(0.08)	(0.08)	(0.07)	(2.42)	(2.51)	(2.45)	(2.46)	(2.22)		(2.39)		(2929)
	-1.34***	-1.01***	-0.65***	-0.37***	-0.01	2.62	0.07	-0.07	1.91	0.94		-6.23***	0.050	Exp_HS4
	(0.12)	(0.10)	(0.09)	(0.09)	(0.08)	(2.85)	(2.88)	(2.39)	(2.35)	(2.08)		(2.39)		(12899)
	-1.4***	-1.11***	-0.77***	-0.45***	-0.08	-1.21	-4.87***	-5.08***	-2.84*	-3.99**	-4.21*		0.051	Exp_HS2
	(0.10)	(0.08)	(0.08)	(0.08)	(0.07)	(1.56)	(1.83)	(1.37)	(1.69)	(1.70)	(2.39)			(2929)
	-1.34***	-1.01***	-0.65***	-0.37***	-0.01	-3.61**	-6.17***	-6.3***	-4.33***	-5.3***	-6.23***		0.050	Exp_HS4
	(0.12)	(0.10)	(0.09)	(0.09)	(0.08)	(1.60)	(2.07)	(1.64)	(1.59)	(1.51)	(2.39)			(12899)
HS8 Product Definitions (N=44439)	-1.46***	-1.14***	-0.79***	-0.52***	-0.12**							-4.54***	0.049	Exp_HS2
	(0.10)	(0.08)	(0.07)	(0.06)	(0.06)							(1.46)		(2901)
	-1.4***	-1.04***	-0.69***	-0.45***	-0.06							-6.09***	0.048	Exp_HS4
	(0.11)	(0.09)	(0.08)	(0.08)	(0.07)							(1.07)		(2901)
	-1.37***	-1.07***	-0.75***	-0.44***	-0.08	4.69***	3.55**	1.82	4.11**	2.05		-7.37***	0.049	Exp_HS2
	(0.11)	(0.08)	(0.08)	(0.08)	(0.07)	(1.72)	(1.46)	(1.63)	(1.74)	(1.29)		(1.70)		(2901)
	-1.33***	-0.97***	-0.66***	-0.37***	-0.03	3.46	3.68	1.82	3.94*	1.28		-8.61***	0.048	Exp_HS4
	(0.13)	(0.11)	(0.10)	(0.10)	(0.09)	(3.10)	(2.57)	(2.18)	(2.03)	(2.13)		(2.09)		(12655)
	-1.37***	-1.07***	-0.75***	-0.44***	-0.08	-2.69	-3.83**	-5.55***	-3.26*	-5.32***	-7.37***		0.049	Exp_HS2
	(0.11)	(0.08)	(0.08)	(0.08)	(0.07)	(1.70)	(1.69)	(1.57)	(1.78)	(1.96)	(1.70)			(2901)
	-1.33***	-0.97***	-0.66***	-0.37***	-0.03	-5.15***	-4.92***	-6.78***	-4.67***	-7.33***	-8.61***		0.048	Exp_HS4
	(0.13)	(0.11)	(0.10)	(0.10)	(0.09)	(1.83)	(1.67)	(1.49)	(1.26)	(1.71)	(2.09)			(12655)

Notes: The dependent variable is the log ratio of import value in 2004 to import value in 1992 for exporter j in HS10 industry i. The excluded group is $D^{0}_{i,j}$, which is the dummy variable identifying whether exporter j in HS10 product i did not trade with the US during the years 1989 and 1990. Product definitions (for quintiles) are listed in the left-most column. Fixed effects are estimated using a within procedure according to the groups listed in the column "Fixed". Standard errors are heteroskedasticity robust and clustered by Exporter and Fixed effect industry (Exp_HS4 fixed effects implies Exporter and HS4 clusters used for standard errors) according to the multi-level procedure in Cameron, Gelbach, and Miller (2006). The labels *, **, and *** identify estimates which are significantly different from zero at the 10%, 5%, and 1% levels, respectively.

For example, perhaps imported varieties which were successful in the US market during 1989 and 1990, who appear relatively unaffected by US MFN tariff reductions, are simply reallocating resources in response to Uruguay Round MFN tariff reductions by other import markets. To account for this, I will modify (9) by adding an interaction between changes to worldwide HS6 tariffs (averaged over all non-US markets, 1994-2000) and group dummies. The results from this interaction are presented in Table 5. Here, the interactions between ROW tariff cuts and group dummies are almost uniformly small and insignificant, though one exception is when using Exporter-HS2 fixed effects, where it seems that higher ROW tariffs tend to increase imports to the US.[11] In contrast, looking at the interaction between US log tariff cuts and group dummies in the right-hand side of Table 5, the import elasticity for the smallest export sources is negative and significantly different from zero, and the differential effect for higher groups is positive. Further, the differential effect for the largest export sources is significant for most assumptions of product definitions and fixed effects, and in most cases larger than the estimated differential elasticity for smaller exporters. Overall, including an interaction between ROW tariff changes and relative market penetration in the US market does little to change the differential effect of US MFN tariffs across different within-product groups.

Next, I estimate a number of specifications which include interactions between US MFN tariffs and HS10-Exporter characteristics which are more general than variety-specific market penetration. First, I estimate (9) allowing for a differential impact of tariffs as a function of exporter GDP per capita (data taken from the Penn World Tables). The coefficient on this interaction is labeled β_{US_GDP}. This interaction is sensible on a number of levels. First, less-developed countries may have poor institutions, and thus may respond slowly to changes in tariffs relative to more developed exporters. In this case, β_{US_GDP} would be negative. Or, perhaps developed countries are more likely to employ unionized labor, which may yield a laggard response to price shocks. In this case, β_{US_GDP} would be positive. The results from adding this interaction to (9) are presented in the top panel of Table 6. Here, note that the interaction between tariffs and exporter GDP per capita (last column) is insignificantly different from zero in five of six regressions. In contrast, the coefficient on β_{US_D5} is significantly different from zero and positive for the same regressions as in Table

[11] This might be explained by established exporters reallocating resources to the US in response to higher tariffs in other markets.

Table 5: Effects of MFN and ROW tariffs by within-product quintile

	Group - ROW Tariff interactions						Group - US Tariff interactions						R2	Fixed
	β_{ROW_D5}	β_{ROW_D4}	β_{ROW_D3}	β_{ROW_D2}	β_{ROW_D1}	β_{ROW}	β_{US_D5}	β_{US_D4}	β_{US_D3}	β_{US_D2}	β_{US_D1}	β_{US}		(#)
HS4	4.78*	3.42	0.76	0.39	1.36	1.61	6.76***	4.5**	3.23	2.21	3.09	-9.22***	0.059	Exp_HS2
Product	(2.46)	(2.10)	(2.31)	(2.18)	(3.01)	(1.95)	(2.35)	(2.25)	(2.25)	(2.01)	(2.10)	(2.58)		(2607)
Definitions	1.07	-0.23	-2.16	-4.4	-1.28	-1	7.31**	4.29	3.53	3.58	2.55	-10.2***	0.056	Exp_HS4
(N=35403)	(4.09)	(3.79)	(3.14)	(3.19)	(3.53)	(3.13)	(3.31)	(3.46)	(2.75)	(2.41)	(2.94)	(2.47)		(10759)
HS6	4.14*	2.98	2.84	0.42	0.56	1.48	5.02***	2.48	1.13	2.84	2.42*	-8.47***	0.053	Exp_HS2
Product	(2.29)	(2.31)	(3.17)	(2.06)	(3.04)	(1.99)	(1.44)	(1.73)	(2.31)	(2.19)	(1.39)	(2.38)		(2517)
Definitions	1.06	-0.29	1.08	-2.99	-0.46	-0.2	4.89*	1.93	1.59	3.85**	1.66	-9.24***	0.049	Exp_HS4
(N=32925)	(3.73)	(3.32)	(3.18)	(2.60)	(3.36)	(3.32)	(2.82)	(2.88)	(3.00)	(1.89)	(2.69)	(2.57)		(10288)
HS8	4.34*	2.58	2.58	-0.44	0.94	1.89	3.9**	3.44*	1.75	4.14*	1.35	-9.25***	0.049	Exp_HS2
Product	(2.47)	(2.20)	(2.54)	(2.23)	(2.75)	(1.71)	(1.69)	(2.04)	(2.11)	(2.45)	(1.93)	(2.63)		(2497)
Definitions	1.32	0.43	0.39	-2.85	0.68	0.1	3.28	1.97	1.91	4.22*	-0.05	-10.22***	0.046	Exp_HS4
(N=31319)	(4.07)	(2.93)	(2.75)	(2.86)	(3.17)	(3.33)	(3.35)	(3.10)	(2.68)	(2.19)	(2.91)	(2.51)		(10095)

Notes: The dependent variable is the log ratio of import value in 2004 to import value in 1992 for exporter j in HS10 industry i. The excluded group is $D^0_{i,j}$, which is the dummy variable identifying whether exporter j in HS10 product i did not trade with the US during the years 1989 and 1990. Product definitions (for quintiles) are listed in the left-most column. Quintile dummies are omitted, though similar to those in Table 4. Fixed effects are estimated using a within procedure according to the groups listed in the column "Fixed". Standard errors are heteroskedasticity robust and clustered by Exporter and Fixed effect industry (Exp_HS4 fixed effects implies Exporter and HS4 clusters used for standard errors) according to the multi-level procedure in Cameron, Gelbach, and Miller (2006). The labels *, **, and *** identify estimates which are significantly different from zero at the 10%, 5%, and 1% levels, respectively.

3. Further, the magnitudes are also similar. Overall, I conclude that the results in Table 3 are robust to the inclusion of an interaction between changes to US tariffs and exporter GDP per capita.

Moving beyond exporter development, I now allow for a full interaction between exporter dummy variables and the log change in US MFN tariffs. Precisely, I estimate the following:

$$\log(\frac{v_{i,j,04}}{v_{i,j,92}}) = \beta_{US\_D5}\log(\frac{t_{i,00}}{t_{i,94}})D^5_{i,j} + \cdots + \beta_{US\_D1}\log(\frac{t_{i,00}}{t_{i,94}})D^1_{i,j} + \left(\boldsymbol{\beta}_{US\_Exp}\cdot\mathbf{Exp}\right)\log(\frac{t_{i,00}}{t_{i,94}}) + \beta_{D5}D^5_{i,j} + \cdots + \beta_{D0}D^1_{i,j} + Fixed + \epsilon_{i,j} \quad (11)$$

In (11), **Exp** is a vector of exporter dummies, and $\boldsymbol{\beta}_{US\_Exp}$ represents a vector of exporter-specific import elasticities for group zero. The motivation for this interaction is as follows. In section two, when including a flexible extensive margin of trade, the relationship between quality-adjusted costs (as defined by the Pareto shape parameter) and import value was negative only if the measure of potential exporters was unresponsive to the Pareto shape parameter. Indeed, the interaction between exporter dummies and US MFN tariff changes may account for larger differences in the pool of potential exporters, or some differential effect of tariffs on this pool. Also, if financing issues vary substantially across countries (as in Manova, 2008), then the exporter-tariff interaction is warranted. Further, although imports from NAFTA countries are recorded separately from MFN imports, it is possible that concomitant reductions in preferential tariffs may yield a response to MFN tariffs which is similar to the results thus far but for reasons unrelated to quality-cost heterogeneity.[12] Overall, controlling for an exporter-specific response to tariffs which is unrelated to market penetration is sensible on a number of levels.

The results from estimating (11) are presented in the bottom panel of Table 6. Again, $\beta_{US\_1} - \beta_{US\_5}$ measures the differential effect of MFN tariffs by quintile relative to an exporter-specific effect for group zero. Relative to group zero, larger export sources fared worse with lower tariffs than smaller export-sources. Indeed, this effect is once again concentrated in the highest quintile, though also noticeable in the 20-40% group. Overall, while slightly less impressive than the results detailed in previous tables, the results in Table 6 are supportive of the theory from section two.

Next, I return to the specification in (9), evaluating the effects of potential outlier exporters on the differential import elasticities measured in Table 3. In particular, I run regressions excluding NAFTA countries, and also regressions excluding China. The motivation for the former is that despite restricting the sample to import flows which are imported under MFN (explicitly removing reported preferential trade), Canada and Mexico enter the database in relatively large amounts. While it is possible that much trade from NAFTA countries may be accounted as MFN since rule-of-origin can be onerous, it seems odd that either country (in particular Canada) would enter the database significantly. Regarding the latter, China is obviously a large and fast-growing export market, which enters the WTO during the sample and also engages in a substantial amount of vertical trade with the US. Thus, I remove both NAFTA countries and China separately to evaluate whether the results are driven by large regional trading partners and/or a massive growing exporter. The results are presented in Table 7. Using both the subsample excluding NAFTA countries and the subsample excluding China, there is a significant positive effect of trade liberalization on

[12] For example, suppose that imports from Mexico are quite large, but mostly accounted for under NAFTA. However, as rules-of-origin must be satisfied to enter the US under NAFTA, a very low MFN tariff may be a more attractive alternative than dealing with the legal adminstration required to satisfy rules-of-origin. Thus, imports from Mexico under MFN, which are small under previous MFN tariffs, may jump substantially with a reduction in MFN tariffs.

Table 6: Effects of MFN tariffs by within-product quintile: Exporter-tariff interactions

	Group Dummies					Group-Tariff interactions							R2	Fixed
	β_{D5}	β_{D4}	β_{D3}	β_{D2}	β_{D1}	β_{US_D5}	β_{US_D4}	β_{US_D3}	β_{US_D2}	β_{US_D1}	β_{US}	β_{US_GDP}		#
Tariff-GDP(Exporter) Interactions														
HS4	-1.36***	-1.02***	-0.73***	-0.44***	0.01	6.93***	4.45*	2.89	1.84	2.92	-16.93**	0.85	0.058	Exp_HS2
Product	(0.09)	(0.08)	(0.07)	(0.09)	(0.06)	(2.57)	(2.37)	(2.42)	(2.20)	(2.11)	(7.92)	(1.01)		(2591)
Definitions	-1.25***	-0.9***	-0.59***	-0.29***	0.10	7.59**	4.43	3.44	3.20	2.53	0.38	-1.12	0.056	Exp_HS4
(N=35384)	(0.12)	(0.10)	(0.09)	(0.09)	(0.09)	(3.41)	(3.40)	(2.83)	(2.39)	(2.91)	(12.43)	(1.30)		(10742)
HS6	-1.35***	-1.07***	-0.79***	-0.47***	-0.06	5.03***	2.36	1.06	2.5	2.13	-20.16**	1.26	0.052	Exp_HS2
Product	(0.09)	(0.08)	(0.09)	(0.08)	(0.07)	(1.74)	(1.97)	(2.58)	(2.34)	(1.60)	(8.43)	(1.07)		(2503)
Definitions	-1.24***	-0.95***	-0.64***	-0.33***	0.04	5.05*	1.94	1.80	3.54*	1.67	-2.82	-0.68	0.049	Exp_HS4
(N=32908)	(0.12)	(0.10)	(0.10)	(0.08)	(0.09)	(2.89)	(2.94)	(3.03)	(1.94)	(2.73)	(12.61)	(1.36)		(10273)
HS8	-1.32***	-1.05***	-0.76***	-0.47***	-0.08	3.77*	3.16	1.5	3.5	1.01	-28.08***	2.03*	0.048	Exp_HS2
Product	(0.09)	(0.09)	(0.08)	(0.09)	(0.06)	(1.95)	(2.23)	(2.40)	(2.57)	(2.09)	(8.85)	(1.04)		(2483)
Definitions	-1.24***	-0.94***	-0.63***	-0.35***	0.00	3.32	1.94	1.89	3.81	0.00	-15.69	0.58	0.045	Exp_HS4
(N=31302)	(0.13)	(0.11)	(0.09)	(0.10)	(0.10)	(3.51)	(3.22)	(2.83)	(2.33)	(3.04)	(10.79)	(1.20)		(10080)
Tariff-Exporter Interations														
HS4	-1.37***	-1.03***	-0.73***	-0.44***	0.01	6.14**	3.99	2.49	1.71	2.56			0.060	Exp_HS2
Product	(0.09)	(0.08)	(0.07)	(0.09)	(0.06)	(2.98)	(2.52)	(2.50)	(2.39)	(2.09)				(2591)
Definitions	-1.25***	-0.91***	-0.6***	-0.29***	0.11	7.1**	4.00	3.10	2.95	2.56			0.058	Exp_HS4
(N=35384)	(0.13)	(0.10)	(0.09)	(0.09)	(0.09)	(3.56)	(3.47)	(2.87)	(2.35)	(2.98)				(10742)
HS6	-1.36***	-1.08***	-0.8***	-0.47***	-0.06	3.92	1.82	0.76	2.33	2			0.055	Exp_HS2
Product	(0.09)	(0.08)	(0.09)	(0.08)	(0.07)	(2.42)	(2.12)	(2.48)	(2.34)	(1.71)				(2503)
Definitions	-1.25***	-0.96***	-0.64***	-0.33***	0.04	4.35	1.15	1.27	3.21*	1.53			0.051	Exp_HS4
(N=32425)	(0.13)	(0.11)	(0.10)	(0.08)	(0.09)	(2.96)	(3.01)	(3.04)	(1.88)	(2.73)				(10273)
HS8	-1.33***	-1.06***	-0.76***	-0.47***	-0.08	3	2.82	1.44	3.5	1.2			0.051	Exp_HS2
Product	(0.09)	(0.09)	(0.08)	(0.09)	(0.06)	(2.70)	(2.36)	(2.18)	(2.61)	(2.11)				(2483)
Definitions	-1.25***	-0.95***	-0.64***	-0.35***	0.01	2.80	1.49	1.54	3.75	(0.02)			0.047	Exp_HS4
(N=30454)	(0.13)	(0.11)	(0.09)	(0.10)	(0.10)	(3.69)	(3.33)	(2.76)	(2.29)	(3.08)				(10080)

Notes: The dependent variable is the log ratio of import value in 2004 to import value in 1992 for exporter j in HS10 industry i. The excluded group is D^0 which is the dummy variable identifying whether exporter j in HS10 product i did not trade with the US during the years 1989 and 1990. Product definitions (for quintiles) are listed in the left-most column. Fixed effects are estimated using a within procedure according to the groups listed in the column "Fixed". Standard errors are heteroskedasticity robust and clustered by Exporter and Fixed effect industry (Exp_HS4 fixed effects implies Exporter and HS4 clusters used for standard errors) according to the multi-level procedure in Cameron, Gelbach, and Miller (2006). The labels *, **, and *** identify estimates which are significantly different from zero at the 10%, 5%, and 1% levels, respectively. Standard errors labeled (NA) are not defined using the clustering procedure in Cameron, Gelbach and Miller (2006), which as noted in the paper, is a possible outcome of their particular multilevel procedure.

Table 7: Effects of MFN tariffs by within-product quintile: No NAFTA/China

	Group Dummies					Group-Tariff interactions						R2	Fixed
	β_{D5}	β_{D4}	β_{D3}	β_{D2}	β_{D1}	β_{US_D5}	β_{US_D4}	β_{US_D3}	β_{US_D2}	β_{US_D1}	β_{US}		#
HS4	-1.39***	-1.02***	-0.73***	-0.43***	-0.01	6.22***	4.23*	2.88	2.27	2.33	-8.54***	0.058	Exp_HS2
Product Definitions	(0.10)	(0.08)	(0.07)	(0.09)	(0.06)	(2.36)	(2.31)	(2.28)	(2.24)	(2.10)	(2.46)		(2481)
No NAFTA	-1.28***	-0.91***	-0.59***	-0.29***	0.09	6.69**	3.73	3.17	3.42	2.15	-9.89***	0.057	Exp_HS4
(N=33933)	(0.12)	(0.10)	(0.09)	(0.09)	(0.09)	(3.15)	(3.33)	(2.82)	(2.34)	(2.90)	(2.41)		(10287)
HS4	-1.33***	-1***	-0.72***	-0.42***	0.01	6.29**	3.99	2.43	1.37	2.19	-8.16***	0.055	Exp_HS2
Product Definitions	(0.09)	(0.08)	(0.07)	(0.09)	(0.07)	(2.62)	(2.46)	(2.49)	(2.25)	(2.18)	(2.49)		(2529)
No China	-1.23***	-0.89***	-0.61***	-0.28***	0.09	7.69**	4.54	3.01	3.47	2.03	-10.6***	0.054	Exp_HS4
(N=33175)	(0.13)	(0.10)	(0.09)	(0.10)	(0.10)	(3.72)	(3.73)	(2.94)	(2.77)	(3.07)	(2.80)		(10233)
HS6	-1.37***	-1.08***	-0.79***	-0.46***	-0.06	4.66***	2.22	1.46	2.97	2.15	-8.09***	0.053	Exp_HS2
Product Definitions	(0.09)	(0.08)	(0.09)	(0.08)	(0.07)	(1.56)	(1.92)	(2.41)	(2.49)	(1.70)	(2.30)		(2397)
No NAFTA	-1.28***	-0.97***	-0.64***	-0.31***	0.04	3.94	1.01	1.65	3.85**	1.60	-9***	0.050	Exp_HS4
(N=31768)	(0.12)	(0.10)	(0.10)	(0.08)	(0.09)	(2.47)	(2.69)	(3.04)	(1.91)	(2.74)	(2.54)		(9864)
HS6	-1.31***	-1.04***	-0.76***	-0.46***	-0.04	4.48**	1.86	1.27	1.85	1.47	-7.46***	0.049	Exp_HS2
Product Definitions	(0.08)	(0.07)	(0.09)	(0.08)	(0.07)	(1.74)	(2.08)	(2.53)	(2.38)	(1.64)	(2.24)		(2439)
No China	-1.21***	-0.92***	-0.62***	-0.33***	0.05	5.25*	2.09	2.20	3.54	1.20	-9.69***	0.047	Exp_HS4
(N=30856)	(0.12)	(0.11)	(0.10)	(0.09)	(0.10)	(3.16)	(3.23)	(3.29)	(2.25)	(2.88)	(2.90)		(9791)
HS8	-1.36***	-1.06***	-0.76***	-0.46***	-0.09	3.36*	3.16	2.03	4.14	1.08	-8.77***	0.049	Exp_HS2
Product Definitions	(0.08)	(0.09)	(0.08)	(0.09)	(0.07)	(1.84)	(2.25)	(2.33)	(2.81)	(2.28)	(2.63)		(2379)
No NAFTA	-1.29***	-0.96***	-0.63***	-0.34***	0.00	2.27	1.08	1.90	4.09*	(0.01)	-9.93***	0.047	Exp_HS4
(N=30204)	(0.11)	(0.11)	(0.09)	(0.10)	(0.10)	(3.12)	(2.98)	(2.83)	(2.31)	(3.09)	(2.53)		(9684)
HS8	-1.28***	-1.02***	-0.73***	-0.45***	-0.08	3.06*	2.26	1.44	3.09	-0.05	-7.72***	0.044	Exp_HS2
Product Definitions	(0.08)	(0.08)	(0.08)	(0.09)	(0.07)	(1.86)	(2.20)	(2.44)	(2.82)	(1.88)	(2.47)		(2420)
No China	-1.23***	-0.92***	-0.62***	-0.35***	(0.01)	2.98	1.27	2.30	3.55	(0.94)	-9.92***	0.043	Exp_HS4
(29426)	(0.13)	(0.12)	(0.10)	(0.11)	(0.11)	(3.72)	(3.41)	(3.28)	(2.59)	(3.15)	(2.95)		(9610)

Notes: The dependent variable is the log ratio of import value in 2004 to import value in 1992 for exporter j in HS10 industry i. The excluded group is $D^0_{i,j}$, which is the dummy variable identifying whether exporter j in HS10 product i did not trade with the US during the years 1989 and 1990. Product definitions (for quintiles) are listed in the left-most column. Fixed effects are estimated using a within procedure according to the groups listed in the column "Fixed". Standard errors are heteroskedasticity robust and clustered by Exporter and Fixed effect industry (Exp_HS4 fixed effects implies Exporter and HS4 clusters used for standard errors) according to the multi-level procedure in Cameron, Gelbach, and Miller (2006). The labels *, **, and *** identify estimates which are significantly different from zero at the 10%, 5%, and 1% levels, respectively.

the group of HS10-Exporters which did not export to the US in 1989 and 1990. In contrast, the top-20% of exporters experiences an effect of liberalization which was significantly less positive than exporters operating near the extensive margin. This result is slightly less robust when excluding NAFTA countries and defining product groups at the HS8 level. Overall, the largest exporters still seem to experience a muted effect of liberalization, where in contrast, the smallest exporters experience an amplified effect.

Table 8: Distribution of Price Variation in HS10-Exporter Unit Values

		Percentile										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
CV	**HS4**	0.23	1.41	1.90	2.31	2.76	3.20	3.73	4.22	5.34	6.98	11.60
	HS6	0.05	0.89	1.21	1.47	1.74	2.08	2.49	2.95	3.66	4.79	11.06
	HS8	0.02	0.73	1.02	1.26	1.50	1.74	2.10	2.57	3.08	3.97	10.60
HHI	**HS4**	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.06	0.09	0.15	0.91
	HS6	0.01	0.04	0.06	0.08	0.10	0.13	0.17	0.21	0.27	0.38	0.95
	HS8	0.01	0.07	0.10	0.13	0.17	0.21	0.24	0.30	0.36	0.49	0.99

Notes: This table reports the distribtions of CV and HHI as consructed over the reported product definitions. Not included are products for which unit values at the HS10-Exporter level are not available.

Specification #3 - Product-level Price Variation

The key to the model in section two is that quality-cost heterogeneity yields heterogeneous demand elasticities across varieties. This explicitly requires that varieties are differentiated, and naturally, some products are more likely to exhibit differentiation in varieties. In this section, I evaluate the marginal effect of tariffs separately for products based on their "likelihood" of product differentiation.

To do so, I will utilize price dispersion across varieties as a statistic for the degree of differentiation within products. While it is possible that prices are uniform but products are heterogeneous due to specific correlations between quality and production cost, observing some level of price variation is sufficient to imply heterogenous varieties. I will measure the relative degree of price variation in each industry during the 1989-1990 baseline period. Again, products will be defined at the HS4, HS6, and HS8 levels to evaluate the effect of different levels of aggregation on the estimated coefficients. To measure relative price variation, I will use free-on-board unit values in 1989 and 1990. For each year and product, I calculate the coefficient of variation in unit-values (standard deviation divided by the mean), hereafter referred to as "CV". Then, this measure is averaged for each product over 1989 and 1990. Percentiles of price variation (for product definitions at the HS4, HS6, and HS8 level) are presented in the top panel of Table 8. Clearly, broadly defined products (HS4) exhibit more price variation than narrowly defined products (HS8). In some products, the degree of price variation is incredibly small. However, as is well known, price variation is rampant when measured using FOB unit-values. In Table 8, values of CV tend to be larger than one for most products and over 10 in some products.

To measure the effects of price variation on the product-level response to MFN tariff reductions, I first define three groups of products. Products with above median (relative to the entire sample) price variation are identified as "High CV". Those products with below median price variation are labeled "Low CV". Those products with price variation that is not measurable (no quantity data available) are labeled as "No CV". Then, I interact the dummy variables identifying "No", "Low", and "High" levels of price variation with all slope coefficients in (9). In particular, I hypothesize that the differential effect of MFN tariffs will be larger in "High CV" products than "Low CV" products. The results from doing so are presented in Table 9. When defining products and calculating price variation at the HS4 level, there is no appreciable difference between Low and High CV industries. The largest 20% of export suppliers experience a mitigated effect of MFN liberalization. In "No CV" products, the effects of tariffs are insignificant across the board.

Focusing on more refined product definitions (HS6 and HS8), the results sharpen substantially. For High CV industries, the differential effect of MFN tariffs between large and small exporters is positive and larger in magnitude when compared with Low and No CV products. Often, this differential effect is significantly different from zero for High CV industries, though is never significantly different from zero for No and Low CV products. Overall, the results in Table 9 suggest that support for the model is primarily driven by products which are more likely to be differentiated.

Specification #4 - Product-level Exporter Concentration

To conclude the empirical analysis, I will examine how the level of exporter concentration within a given product influences the differential effect of tariffs within the same product. The effects of exporter concentration on bargained tariff cuts has been examined by Ludema and Mayda (2009), where they show that import markets with a higher concentration of export sources are forced to engage in larger tariff concessions. This is confirmed empirically using a US case study over a similar time-period to that in this paper. The intuition is that since tariff cuts in the GATT/WTO are determined via extensive bargaining, agents in concentrated export sectors are less likely to free-ride off of tariff concessions negotiated by other exporters (since the other exporters are small in comparison). Thus, when exporter concentration is relatively large, free-riding is minimized and bargained tariff cuts in the import market are larger. In the specifications above, the Exporter-Industry/Product

Table 9: Effects of MFN tariffs by within-product quintile: by High, Low, No CV

Product definitions	CV	CV Dummy	β_{D5}	β_{D4}	β_{D3}	β_{D2}	β_{D1}	β_{US_D5}	β_{US_D4}	β_{US_D3}	β_{US_D2}	β_{US_D1}	β_{US}	R2	Fixed (#)
			Group Dummies					Group-Tariff interactions							
HS4 Product Definitions (N=35403)	No		-1.3***	-1.11***	-1.07***	-0.55*	-0.23	-0.70	-5.81	-9.72	-2.38	-12.40	-3.99	0.059	Exp_HS2
			(0.35)	(0.33)	(0.31)	(0.33)	(0.34)	(10.62)	(9.46)	(12.63)	(10.64)	(10.40)	(8.09)		(2607)
	Low	-0.28	-1.43***	-1.09***	-0.72***	-0.42***	-0.06	8.2*	5.14	3.56	3.47	1.95	-11.49***		
		(0.28)	(0.12)	(0.11)	(0.09)	(0.11)	(0.09)	(4.72)	(4.08)	(4.49)	(2.95)	(4.54)	(4.37)		
	High	-0.30	-1.29***	-0.94***	-0.68***	-0.42***	0.12**	7.08***	5.51*	4.45	1.54	6.31**	-7.85***		
		(0.26)	(0.10)	(0.08)	(0.10)	(0.10)	(0.05)	(1.59)	(2.92)	(3.78)	(2.47)	(2.81)	(2.62)		
	No		-1.06**	-0.69	-0.66	-0.14	-0.23	-0.50	-3.73	-5.57	-1.00	-16.18	-2.53	0.057	Exp_HS4
			(0.49)	(0.43)	(0.43)	(0.55)	(0.52)	(12.64)	(7.86)	(15.15)	(14.87)	(11.88)	(7.76)		(10759)
	Low		-1.25***	-0.93***	-0.54***	-0.2*	0.04	7.84	3.74	3.58	5.18	1.62	-12.78***		
			(0.14)	(0.12)	(0.14)	(0.12)	(0.14)	(5.42)	(5.31)	(4.82)	(4.30)	(5.60)	(3.83)		
	High		-1.27***	-0.91***	-0.64***	-0.38**	0.17	7.34	5.20	3.75	1.78	4.44	-7.87**		
			(0.18)	(0.16)	(0.15)	(0.15)	(0.12)	(5.08)	(5.21)	(4.65)	(3.15)	(4.56)	(3.90)		
HS6 Product Definitions (N=32925)	No		-1.27***	-1.06***	-0.87***	-0.48**	-0.12	5.41	-0.55	0.04	3.20	-0.86	-7.50	0.053	Exp_HS2
			(0.22)	(0.22)	(0.20)	(0.21)	(0.21)	(5.06)	(6.77)	(7.43)	(6.28)	(5.18)	(6.10)		(2517)
	Low	-0.14	-1.35***	-1.1***	-0.79***	-0.5***	-0.06	3.36	1.38	-0.21	2.69	3.44	-8.47**		
		(0.23)	(0.11)	(0.11)	(0.12)	(0.10)	(0.10)	(4.30)	(4.38)	(4.04)	(4.30)	(3.27)	(3.44)		
	High	-0.12	-1.38***	-1.07***	-0.77***	-0.44***	-0.03	7.01***	5.21***	2.85	2.66	2.81*	-8.49***		
		(0.29)	(0.11)	(0.11)	(0.15)	(0.12)	(0.08)	(0.42)	(1.46)	(2.61)	(2.60)	(1.55)	(2.73)		
	No		-1.12***	-0.86***	-0.6**	-0.15	-0.02	3.09	-0.72	2.14	5.37	-2.15	-8.17	0.050	Exp_HS4
			(0.27)	(0.28)	(0.29)	(0.30)	(0.29)	(7.75)	(7.41)	(7.27)	(7.48)	(7.00)	(7.19)		(10288)
	Low	-0.01	-1.23***	-0.97***	-0.6***	-0.34***	0.09	2.35	-0.97	0.31	3.68	2.33	-7.27**		
		(0.30)	(0.15)	(0.13)	(0.15)	(0.12)	(0.15)	(3.39)	(3.78)	(4.61)	(3.40)	(4.26)	(3.35)		
	High	-0.01	-1.29***	-0.96***	-0.68***	-0.36**	0.01	8.38**	5.68	2.98	3.73	2.57	-12.02***		
		(0.29)	(0.16)	(0.15)	(0.17)	(0.14)	(0.12)	(4.20)	(4.51)	(4.36)	(2.60)	(3.43)	(3.62)		
HS8 Product Definitions (N=31319)	No		-1.3***	-0.99***	-0.77***	-0.49***	-0.14	6.76	6.75	5.44	7.03	1.27	-13.63**	0.050	Exp_HS2
			(0.19)	(0.19)	(0.19)	(0.18)	(0.14)	(4.73)	(5.03)	(5.25)	(6.44)	(3.60)	(5.39)		(2497)
	Low	-0.05	-1.38***	-1.12***	-0.68***	-0.52***	-0.11	-0.53	-0.12	2.06	2.20	0.76	-7.17***		
		(0.21)	(0.10)	(0.11)	(0.12)	(0.12)	(0.11)	(3.51)	(4.60)	(3.68)	(4.66)	(3.16)	(2.47)		
	High	-0.06	-1.26***	-1***	-0.83***	-0.38***	-0.01	7.22***	5.74**	-0.44	4.34	2.70	-8.44***		
		(0.20)	(0.11)	(0.12)	(0.13)	(0.13)	(0.09)	(1.48)	(2.49)	(3.26)	(4.27)	(2.87)	(2.75)		
	No		-1.25***	-0.87***	-0.69***	-0.31	-0.13	6.13	5.87	2.36	9.75	-0.88	-14.17*	0.047	Exp_HS4
			(0.20)	(0.23)	(0.24)	(0.24)	(0.19)	(7.16)	(7.40)	(7.13)	(7.26)	(6.88)	(7.40)		(10095)
	Low	-0.03	-1.26***	-1.03***	-0.52***	-0.42***	0.03	-1.69	-3.08	0.68	0.55	-1.23	-5.47		
		(0.24)	(0.17)	(0.16)	(0.15)	(0.14)	(0.18)	(4.62)	(5.10)	(5.77)	(5.34)	(5.16)	(4.41)		
	High	-0.13	-1.22***	-0.87***	-0.72***	-0.29**	0.05	6.84	5.67	2.51	4.76	1.91	-13.18***		
		(0.19)	(0.16)	(0.13)	(0.13)	(0.13)	(0.10)	(4.93)	(4.42)	(4.34)	(2.99)	(3.92)	(3.75)		

Notes: The dependent variable in Tables 10 and 11 is the log ratio of import value in 2004 to import value in 1992 for exporter j in HS10 industry i. The excluded groups are $D^0_{i,j}$, which is the dummy variable identifying whether exporter j in HS10 product i did not trade with the US during the years 1989 and 1990, and "No CV", the dummy variable identifying the products with no quantity data. Product definitions (for quintiles) are listed in the left-most column. Fixed effects are estimated using a within procedure according to the groups listed in the column "Fixed". Standard errors are heteroskedasticity robust and clustered by Exporter and Fixed effect industry (Exp_HS4 fixed effects implies Exporter and HS4 clusters used for standard errors) according to the multi-level procedure in Cameron, Gelbach, and Miller (2006). The labels *, **, and *** identify estimates which are significantly different from zero at the 10%, 5%, and 1% levels, respectively.

fixed effects should control of mean differences exporter concentration. However, if exporter concentration has unmodeled and unobserved effects on the differential response to tariffs, the above estimates may be contaminated.

To examine these issues, within a given product, I first aggregate trade from the HS10-Exporter level to the Exporter level over the period 1989-1990. Then, I construct a Hirschman-Herfindahl index (HHI) for each product based on the market share of exporters. The distribution of HHI for different product definitions is presented in the bottom panel of Table 8. For the most part, the median values of HHI are around the breaking point for the level at which industries are labeled as concentrated.[13] After identifying the median value of HHI across the entire sample (for a given product definition), I group each product into "Low" and "High" measures of HHI. To examine the effects of exporter concentration, I interact dummy variables identifying low and high HHI products with all slope coefficients in (9). The results are presented in Table 10. Again, for HS4 product definitions, there are no systematic differences between the estimates for low and high HHI products. However, when defining products at the HS6 and HS8 levels, only those products with below median HHI (low concentration) yield estimates which are consistent with the results thus far. In particular, for low HHI products, the estimated effect of tariffs is smallest for the top 20% of export sources in all regressions, and significantly different from group zero in many cases. In contrast, for products with high HHI, there is rarely a differential effect of tariffs which is significant across groups. As high HHI products do not seem to support the model developed in section two, this suggests that high HHI products may have different underlying demand characteristics, or that supply conditions are more favorable for suppliers which are highly successful relative to their peers.

4 Discussion and Conclusion

This paper has presented a simple model of import market liberalization and bilateral trade. Theoretically, I show that when quality/cost heterogeneity yields differences in demand elasticities, trade liberalization necessarily increases imports only of varieties that are of high cost or low quality - both of which sold at relatively high demand elasticities and in relatively

[13] See http://www.justice.gov/atr/public/testimony/hhi.htm. Calculated based on shares, HHI values of 0.10 in my paper correspond to an HHI DOJ value of 1000.

Table 10: Effects of MFN tariffs by within-product quintile: by High and Low HHI

Product Definitions		HHI Dummy	Group Dummies β_{D5}	β_{D4}	β_{D3}	β_{D2}	β_{D1}	Group - Tariff interactions β_{US_D5}	β_{US_D4}	β_{US_D3}	β_{US_D2}	β_{US_D1}	β_{US}	R2	Fixed (#)
HS4 Product Definitions (N=35403)	Low		-1.3***	-0.9***	-0.6***	-0.25**	0.16*	8.21**	4.10	5.22**	3.57***	4.89*	-12.34***	0.059	Exp_HS2
			(0.13)	(0.10)	(0.08)	(0.11)	(0.09)	(3.30)	(2.67)	(2.59)	(1.29)	(2.60)	(2.63)		(2607)
	High	0.26*	-1.41***	-1.15***	-0.86***	-0.63***	-0.15	5.75	4.70	0.39	0.03	0.68	-4.93		
		(0.15)	(0.11)	(0.13)	(0.10)	(0.13)	(0.11)	(3.71)	(3.30)	(4.00)	(4.05)	(3.55)	(3.37)		
	Low		-1.3***	-0.9***	-0.6***	-0.25**	0.15	6.45	2.17	3.57	2.26	3.12	-10.43***	0.056	Exp_HS4
			(0.17)	(0.11)	(0.12)	(0.11)	(0.10)	(4.45)	(4.10)	(3.83)	(2.49)	(3.93)	(2.95)		(10759)
	High		-1.18***	-0.91***	-0.6***	-0.37**	0.03	9.01*	7.24	2.92	4.53	1.46	-9.96***		
			(0.16)	(0.17)	(0.16)	(0.16)	(0.18)	(4.67)	(5.04)	(4.84)	(4.73)	(3.78)	(3.76)		
HS6 Product Definitions (N=32925)	Low		-1.25***	-0.98***	-0.62***	-0.35***	0.08	10.07***	5.24**	5.62	5.51*	4.08*	-12.84***	0.053	Exp_HS2
			(0.10)	(0.09)	(0.10)	(0.09)	(0.07)	(1.81)	(2.31)	(3.82)	(3.23)	(2.40)	(3.79)		(2517)
	High	0.25**	-1.45***	-1.18***	-0.99***	-0.61***	-0.2*	0.44	-0.48	-3.51	-0.61	-0.02	-3.61		
		(0.12)	(0.12)	(0.11)	(0.13)	(0.10)	(0.11)	(2.74)	(3.16)	(3.23)	(3.17)	(3.02)	(2.57)		
	Low		-1.2***	-0.89***	-0.53***	-0.28**	0.13	9.87**	4.76	5.84	6.7*	3.60	-12.28***	0.049	Exp_HS4
			(0.16)	(0.13)	(0.15)	(0.12)	(0.11)	(4.14)	(3.74)	(4.48)	(3.52)	(4.48)	(3.64)		(10288)
	High	0.18	-1.29***	-1.04***	-0.8***	-0.4***	-0.09	-0.90	-2.32	-3.97	-0.88	-1.42	-4.72		
		(0.15)	(0.15)	(0.15)	(0.13)	(0.12)	(0.15)	(4.40)	(4.56)	(4.03)	(3.04)	(4.02)	(3.59)		
HS8 Product Definitions (31319)	Low		-1.11***	-0.92***	-0.61***	-0.32***	0.06	7.79***	5.09	4.24*	6.81**	2.24	-12.33***	0.049	Exp_HS2
			(0.10)	(0.10)	(0.09)	(0.09)	(0.09)	(1.85)	(3.54)	(2.53)	(2.70)	(3.64)	(3.21)		(2497)
	High	0.31**	-1.55***	-1.2***	-0.93***	-0.63***	-0.24**	0.34	1.56	-0.88	0.75	-0.38	-5.82*		
		(0.13)	(0.11)	(0.14)	(0.13)	(0.13)	(0.10)	(3.07)	(3.08)	(3.19)	(4.14)	(2.84)	(3.35)		
	Low		-1.06***	-0.82***	-0.49***	-0.24*	0.11	8.04	3.82	5.94	6.78**	1.49	-12.98***	0.046	Exp_HS4
			(0.17)	(0.14)	(0.13)	(0.13)	(0.14)	(4.90)	(4.38)	(3.73)	(2.91)	(5.02)	(3.68)		(10095)
	High	0.32*	-1.49***	-1.11***	-0.81***	-0.51***	-0.14	-1.57	-0.33	-2.13	0.64	-1.95	-7.02***		
		(0.17)	(0.15)	(0.15)	(0.14)	(0.14)	(0.12)	(3.53)	(3.30)	(3.11)	(3.16)	(2.98)	(2.47)		

Notes: The dependent variable in Tables 10 and 11 is the log ratio of import value in 2004 to import value in 1992 for exporter j in HS10 industry i. The excluded groups are $D^0_{i,j}$, which is the dummy variable identifying whether exporter j in HS10 product i did not trade with the US during the years 1989 and 1990, and "Low HHI", the dummy variable identifying the products with below median exporter concentration. Product definitions (for quintiles) are listed in the left-most column. Fixed effects are estimated using a within procedure according to the groups listed in the column "Fixed". Standard errors are heteroskedasticity robust and clustered by Exporter and Fixed effect industry (Exp_HS4 fixed effects implies Exporter and HS4 clusters used for standard errors) according to the multi-level procedure in Cameron, Gelbach, and Miller (2006). The labels *, **, and *** identify estimates which are significantly different from zero at the 10%, 5%, and 1% levels, respectively.

low amounts. In evaluating the model using a case study of US tariff reductions resulting from the Uruguay Round, I find robust support for the model. In particular, I find that within products, import elasticities are large, negative, and significantly different from zero for the smallest export sources. In contrast, for the largest export sources, the estimated import elasticities are significantly smaller in magnitude relative to the smallest sources, and often insignificantly different from zero.

As for future work, the most promising extension is a policy-equipped framework to evaluate whether, in the presence of quality-cost heterogeneity, the current rules of the WTO are sufficient to guarantee efficiency in trade negotiations. Indeed, an open question motivated by the paper is whether low cost and high quality suppliers, who may lose market access after liberalization under MFN, should receive preferential treatment for their varieties, and whether they should be forced to engage in reciprocal concessions. I plan to address both questions in a follow-up paper.

References

[1] Anderson, James E., and Eric van Wincoop (2003), "Gravity with Gravitas: A solution to the Border Puzzle", *American Economic Review*, Vol. 93-1, pp. 170-192

[2] Arkolakis, Costas, "Market Penetration Costs and the New Consumers Margin in International Trade", mimeo Yale University.

[3] Baldwin, Richard, and James Harrigan (2008), "Zeros, Quality, and Space: Trade Theory and Trade Evidence", mimeo University of Virginia

[4] Bernard, Andrew, Bradford Jenson, Stephen Redding, and Peter Schott (2007), "Firms in International Trade", *Journal of Economic Perspectives*, Vol. 21-3, pp. 105-130.

[5] Brander, James A. and Paul Krugman, (1983) "A 'Reciprocal Dumping' Model of International Trade." *Journal of International Economics,* Vol 15, pp. 313-321.

[6] Cameron, Colin, Jonah B. Gelbach, and Douglas L. Miller (2006), "Robust Inference with Multi-way Clustering", mimeo UC Davis.

[7] Feenstra, Robert C. (1994), "New Product Varieties and the Measurement of International Prices", *The American Economic Review*, Vol. 84-1, pp. 157-177.

[8] Feenstra, Robert C. and David Weinstein (2010), "Globalization, Mark-ups, and the US Price Level", NBER Working Paper No. 15749.

[9] Feenstra, Robert C., Robert E. Lipsey, Haiyan Deng, Alyson C. Ma, and Hengyong Mo (2005), "World Trade Flows: 1962-2000," NBER Working Paper No. 11040

[10] Hallak, Juan Carlos (2005), "Product Quality and the Direction of Trade", *Journal of International Economics*, 68-11, pp. 238-265.

[11] Helpman, Elhanan, Marc Melitz, and Yona Rubinstein (2008), "Estimating Trade Flows: Trading partners and Trading Volumes", *The Quarterly Journal of Economics*, Vol. 123- 2, pp. 441-487

[12] Hummels, David and Alexandre Skiba (2004), "Shipping the Good Apples Out? An Emprical Confirmation of the Alchian-Allen Conjecture", *Journal of Political Economy*, Vol. 112-6, pp. 1384-1401.

[13] Irwin, Douglas A., Petros Mavroidis and Alan O. Sykes (2007), "The Genesis of the GATT", mimeo Stanford University

[14] Jackson, John H., *The World Trading System*, MIT Press, 1997

[15] Johnson, Robert, (2009) "Trade and Prices with Heterogeneous Firms", mimeo Princeton University

[16] Kehoe, Timothy, and Kim Ruhl, (2009) "How important is the New Goods Margin in International Trade", mimeo University of Minnesota

[17] Ludema, Rodney and Anna Maria Mayda (2009), "Do Countries Free Ride on MFN", *Journal of International Economics*, Vol. 77-2, pp. 137-150.

[18] Melitz, Marc and Gianmarco I.P. Ottaviano (2008), "Market Size, Trade, and Productivity", *Review of Economic Studies*, Vol. 75-1, pp. 295-316.

[19] Manova, Kalina (2008), "Credit Constraints, Heterogeneous Firms, and International Trade", mimeo Stanford University

[20] Romalis, John (2006), "Market Access, Openness and Growth", mimeo University of Chicago

[21] Rose, Andrew (2004), "Do We Really Know that the WTO Increases Trade?," *American Economic Review*, Vol. 94-1, pp. 98-114.

[22] Saggi, Kamal (2004), "Tariffs and the most favored nation clause", *Journal of International Economics*, Vol 63, pp. 341-368.

[23] Saggi, Kamal, and Nese Sara (2008), "National Treatment at the WTO: The Role of Product and Country Heterogeneity", *International Economic Review*, Vol. 49, pp. 1367-96.

[24] Schott, Peter (2004), "Across-product Versus Within-product Specialization in International Trade", *Quarterly Journal of Economics*, Vol. 119-2, pp. 647-678

[25] Subramanian, Arvind, and Shang-Jin Wei, (2007) "The WTO Promotes Trade, Strongly but Unevenly," *Journal of International Economics*

[26] Trefler, Daniel (2004), "The Long and Short of the Canada-U.S. Free Trade Agreement", *American Economic Review*, Vol. 94, pp. 870–895.