Do tariffs matter for the extensive margin of international trade? An empirical analysis

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A R T I C L E   I N F O

A B S T R A C T

With disaggregate tariff data we study the impact of changing tariffs on the range of goods countries export to the United States. Our probits with country and good effects show tariffs tend to have a statistically significant but small impact: at best 5% of the increasing extensive margin for 1989–1999 and 12% for 1996–2006 is explained by tariff reductions. This suggests the extensive margin has not amplified the impact of tariffs on trade flows to such an extent that the relatively moderate tariff reductions since WW II can explain the strong growth of world trade.

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1. Introduction

Sustained growth of international trade has characterized the world economy since World War II. Explaining this steady growth, however, presents a major quantitative challenge. While continued trade liberalizations are often credited for increasing trade, overall, tariff reductions have been relatively moderate.[1] Consequently, the elasticity of exports to tariffs that is needed to attribute aggregate trade expansion to tariff reductions is larger than our models suggest. In this lively debate, a new hypothesis has attracted considerable attention. Researchers have observed non-negligible increases in the range of goods that countries export, the extensive margin, following trade liberalizations, and have conjectured that these increases are behind the magnified impact of tariff reductions.[2] In a similar vein, Yi (2003)

has argued that significant increases in the extensive margin are linked with vertical specialization in the wake of tariff reductions. What used to be trade in final goods often becomes, after a tariff reduction, an internationally fragmented production process in which a product crosses borders multiple times at different stages of its making. This phenomenon suggests that even moderate tariff reductions, which give way to increased vertical specialization, result in pronounced trade expansion by way of the extensive margin. In this paper, we attempt to quantify the exact contribution of tariff liberalizations to the changing range of goods that countries export.

We investigate with disaggregate bilateral U.S. trade and tariff data the link between tariffs and the changing range of goods that countries export to the United States. Different from Kehoe and Ruhl (2003) or Hilberry and McDaniel (2002), we do not restrict ourselves to only countries that become directly involved in formal trade agreements, but consider all countries that export to the United States. We focus on changes in the extensive margin occurring from 1989 to 1999; however, for all statistical and econometric analysis we alternatively consider the time period from 1996 to 2006, and find largely consistent results. We first document the extent to which countries change the range of goods that they export to the United States and observe substantial extensive margin growth across most countries: For example, for around 85% of the countries that export to the United States, over 40% of all goods categories that these countries exported in 1999 were not exported in 1989. In terms of trade volumes, for around 50% of these countries, over 40% of the volume of 1999 trade was from goods that were not exported in 1989. At the

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[1] Yi (2003) notes that the world average manufacturing tariff dropped by only 11% between 1962 and 1999, but the share of manufacturing exports in GDP rose by a factor of 3.4.

[2] Helpman et al. (2004), Hummels and Klenow (2005), Evenett and Venables (2002), Besedes and Prusa (2003), Kang (2004), Feenstra and Kee (2004) and Felbemayr and Kohler (2006) show that countries differ in the varieties they trade, in the range of countries they trade with, and that these patterns change over time. Kehoe and Ruhl (2003), Ruhl (2005), and Hilberry and McDaniel (2002) show evidence of an increase in the extensive margin after the North American Free Trade Agreement (NAFTA). See also Klenow and Rodriquez-Clare (1997) for an analysis of changing varieties in Costa Rica.

same time, however, U.S. tariff liberalization was relatively moderate, on average around 1% between 1989 and 1999. We provide econometric evidence that investigates the extensive margin changes by modeling the probability that a good is exported to the United States controlling for various other factors that are thought to influence trade volumes. We find that tariff changes in the United States tend to affect the extensive margin in a statistically significant but quantitatively moderate way. We consider different levels of commodity aggregation, different time periods, and different samples of the data, but find that tariff changes can only account for at most 12% of the extensive margin growth observed in the data.

Our findings are in line with recent research that has, to some extent, challenged the quantitative importance of the impact of trade liberalization on the volume of trade. Early on, in a careful study of the Canada–U.S. free trade agreement that was implemented in 1989, Trefler (2001, 2004) argued that most of Canadian import growth was not due to tariff cuts. In particular, for the 213 industries studied, only 5% of the import growth was due to tariff reductions; the results for intra-firm trade were even smaller. There is also a large literature of demand elasticity estimates for international trade models of countries that trade differentiated products with varying degrees of substitutability. However, the estimates tend to be much smaller than the ones needed to rationalize the trade growth observed in the data.[3] Our findings of a limited response to tariffs specifically along the extensive margin of trade can also be linked to recent plant-level studies. Bernard and Jensen (2004a,b) and Das, Roberts and Tybout (2007) find that there are large fixed costs for firms that begin to export. These fixed costs rationalize why moderate tariff reductions primarily induce an increase in exports at the intensive rather than the extensive margin. Econometric and anecdotal evidence, from Feinberg and Keane (2006, 2009) and Keane and Feinberg (2007), points in the same direction. In particular, Feinberg and Keane (2009) find that firms' decisions to engage in either intra-firm trade in intermediates or arm's-length trade are unrelated to reductions in tariffs, so that tariff reductions do not matter at all for the increase of trade along the extensive margin. Instead, Keane and Feinberg (2007) argue that technical change in the form of better logistics management, such as just-in-time management, is primarily driving the increase in intra-firm trade. Also Lileeva and Trefler (forthcoming) argue that tariff cuts can be effective especially in conjunction with new technologies such as just-in-time delivery.

The remainder of this paper is organized as follows. Section 2 discusses the data and descriptive statistics. Section 3 provides the theoretical setting and econometric model. Section 4 contains the empirical results and alternative specifications. Section 5 concludes.

2. Data and descriptive statistics

2.1. Data sources

We study bilateral U.S. imports using the United States International Trade Commission's *U.S. Imports/Exports (Dataweb)* which records bilateral trade flows for the U.S. at the 10-digit Harmonized Tariff Schedule (HTS) level. We primarily focus on the decade between 1989 and 1999, but also check the robustness of our findings with data from 1996 to 2006. Our objective is to consider changes in the range of manufacturing goods that countries export to the United

States and to quantify the importance in U.S. tariff changes. As Pierce and Schott (2009) have documented, there is significant instability in both the U.S. import and export code classifications, which poses a particular challenge when attempting to define a distinct set of goods over time. In our preferred specification, we therefore focus on manufacturing categories that were consistently defined over the time period between 1989 and 2007, thus omitting goods that have been redefined or reclassified.[4] We work at the 6-digit level since distinctions of goods at the 10-digit level are in many instances too fine to be meaningful with respect to a country's ability to export a particular commodity.[5] To ensure omitting reclassified goods does not drive our results, we alternatively employ the methodology of Pierce and Schott (2009) and concord 10-digit goods over time. We find quantitatively and qualitatively similar results for samples at the 10-digit level that include all goods (properly concorded) versus samples that only consider the consistently defined goods. Appendix B shows all alternative specifications. We drop all categories that were redefined when aggregating to the 6-digit level since including redefined goods would necessitate a higher level of aggregation. This is because the redefined classification for many 10-digit goods belongs to different 6-digit categories, thereby requiring the aggregation of multiple 6-digit categories. Note that the 10-digit level econometric results are statistically somewhat less significant than the 6-digit level estimates. We are left with 3328 HTS 6-digit goods categories. We include all countries for which the United States maintained normal trade relations, and which did not undergo any type of restructuring over the sample period. We are left with 177 countries.[6]

Our tariff data are taken from the United States Trade Commission's *Tariff Database.* They are available for commodity descriptions at the HTS 8-digit level and we also aggregate them to the 6-digit level. The database includes the *ad valorem*, specific, and estimated *ad valorem* equivalent tariffs based on the Most Favored Nation (MFN) status. In addition, the file indicates commodities that are eligible for tariff preference programs and the applicable tariffs under these programs. As a measure for trade barriers, we use the estimated *ad valorem* equivalent tariff for a particular country applicable under the relevant preference program. If a country/good qualifies for more than one preference program, we use the minimum tariff of all qualifying programs.

In our descriptive statistics and econometric analysis, we use several variables from the *Penn World Tables* 6.3, and data from the World Bank on average manufacturing tariffs of countries that export to the United States. Because we may lack data in one or both of these sources, our econometric estimates and statistics that involve these data are limited to a smaller sample of countries.[7]

2.2. Evolution of U.S. tariffs

Over our sample period, U.S. tariff variation for a given good across countries can be attributed to several preferential arrangements and bilateral free trade agreements (FTAs). The United States–Israel FTA took effect in 1985 and provided for the elimination of duties for merchandise entering the United States from Israel. While the Canada–U.S. Free Trade Agreement (CUSFTA) entered into force in 1989, it was supplanted by the North American Free Trade Agreement (NAFTA) in 1994. In addition to these, the Caribbean Basin Initiative (CBI) offered preferential and sometimes duty-free treatment for a

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[3] Yi (2003) for example argues a demand elasticity of 10 or more is needed to rationalize the world trade growth in recent decades; Anderson et al. (2005), argue that only an elasticity of 17 can match world bilateral trade patterns, and Feinberg and Keane (2009) need an elasticity in the range of 25 to 30 to explain the increase of intra-firm trade as a fraction of total sales for Canadian Multinationals between 1983 and 1996. However, actual estimates of these elasticities are much smaller. For example, Broda and Weinstein's (2006) median estimate of the elasticity of substitution is in the order of 3.1; Romalis's (2007) demand elasticities range between 6.2 and 10.9. For a good discussion, see Ruhl (2005).

[4] Our focus differs from Xiang (2005), who exploits changes in goods classifications to identify new goods.

[5] For example, the only difference between HTS10 category 6405100030 (OTH FTWEAR W UPPERS LEATHER/COMPOSITION LEATHER MN) and 6405100060 is whether the item is for women or men.

[6] The only exceptions are East and West Germany whose trade volumes were aggregated for 1989.

[7] See Appendix A1 for a list of countries included in the analysis.

Table 1
Manufacturing exports to the US at the HTS 6 digit level: 3328 goods.

Exporting country/group	All exported goods[a]	Newly traded goods[b]	Disappearing goods[c]	Continuously traded goods[d]	Disappearing goods' share of 1989 trade volume	Newly traded goods' share of 1999 trade volume
Panel A: 1989–1999						
Canada	3100	0.08	0.08	0.84	3.6%	4.4%
Mexico	2572	0.26	0.10	0.63	6.7%	9.6%
China	2504	0.34	0.06	0.60	2.3%	5.1%
Rest of the World	74,480	0.30	0.19	0.51	6.8%	9.9%
Exporting country/group	All exported goods[a]	Newly traded goods[b]	Disappearing goods[c]	Continuously traded goods[d]	Disappearing goods' share of 1996 trade volume	Newly traded goods' share of 2006 trade volume
Panel B: 1996–2006						
Canada	3045	0.07	0.07	0.86	1.4%	3.7%
Mexico	2641	0.14	0.13	0.73	1.5%	4.8%
China	2958	0.29	0.02	0.69	0.6%	3.5%
Rest of the World	81545	0.30	0.16	0.54	3.6%	12.1%

[a] Number of goods exported either at the beginning or end of the time frame.
[b] Number of goods exported at the end of the time frame but not the beginning.
[c] Number of goods exported at the beginning but not the end of the time frame.
[d] Number of goods exported both in the beginning and end of the time frame.

range of products to qualifying nations and territories. The Andean Trade Promotion Act (ATPA), which entered into force in 1993, applied to qualified goods exported by Bolivia, Columbia, Ecuador, and Peru. In addition, the United States offered duty-free treatment for a range of goods to qualifying less-developed countries under the Generalized System of Preferences (GSP); furthermore, a wider range of goods are offered duty-free treatment to the least developed of these countries (GSPLDC). Note that access to GSP and GSPLDC preferences, changes over time, with some countries gaining access and others graduating from the preference program. For all other countries that are granted normal trade relations (NTR) status, the United States charges the MFN rate.

In order to study the changes in U.S. tariffs between 1989 and 1999, we look at the changes in tariffs by countries or groups of countries based on the relevant preference program. We find that actual tariff decreases have been small. The most pronounced average manufacturing tariff decreases within a given preference program occurs for Canada, which experienced a 4.78 percentage point decrease (from 4.8 1989 to 0.02 in 1999) and Mexico, which experienced a 3.12 percentage point decrease (from 3.51 in 1989 to 0.39 in 1999). Average tariff rates for those countries who received the MFN tariff experienced an average decrease of 1.42 percentage points (from 5.65 in 1989 to 4.23 in 1999). GSPLDC countries experienced a decrease on average of 1.11 percentage point (from 3.42 in 1989 to 2.32 in 1999). Since all the ATPA countries qualified for GSP status for years prior to 1993, their decrease is about 1.27 percentage points (from 3.42 in 1989 to 2.15 in 1999). Israel (from .63 in 1989 to .02 in 1989), GSP countries (from 3.42 to 2.92), and CBI countries (from 2.09 in 1989 to 2.05 in 1999) experienced changes of less than 1 percentage point.

In sum, the largest changes in tariffs occur for the NAFTA countries. The rapid increase of Mexico's and Canada's trade with the United States in the wake of NAFTA has been well documented by Romalis (2007) and others. In addition, Kehoe and Ruhl (2003) and Hilberry and McDaniel (2002) have emphasized the importance of changes in the extensive margin of trade after NAFTA and other trade liberalizations. Less effort, however, has gone into comparing countries that have benefited from trade liberalizations to those that have not, and specifically into assessing across the board the extent to which countries export goods (to the United States) that they did not previously trade. In what follows, we compare the number of newly

traded goods by countries that experienced substantial decreases in U.S. tariffs to that of other U.S. trading partners that for the most part did not experience the same sweeping tariff reductions.

2.3. Newly traded goods across countries

We compare trade patterns between 1989 and 1999. A commodity is considered traded in a particular year if there are positive exports to the United States in that HTS 6-digit category. Table 1 summarizes a few key statistics. We first focus on Mexico and Canada, the NAFTA countries. This focus is warranted since earlier literature, especially Kehoe and Ruhl (2003) and Hilberry and McDaniel (2002), has reported significant changes in the extensive margin in the wake of NAFTA. Panel A of Table 1 focuses on the 1989 to 1999 time frame. As can be seen, there is, especially for Mexico, a significant increase in the extensive margin. We see that Mexico exports 2572 of the 3328 goods categories in 1989, 1999, or both. Yet 26% of those goods were newly traded post-NAFTA, and 10% of those goods stopped being traded post-NAFTA. Note that the share of newly traded goods for Canada is less at 8%. In itself, this lower number is not so surprising, since Hummels and Klenow (2005) have shown that the range of goods that are exported is larger for bigger and more developed countries. Moreover, given the finite number of goods, extensive margin *growth* should be more manifest for less-developed countries. The last two lines of Panel A contain the most striking finding. For many other countries whose tariffs with the United States did not decrease dramatically, one finds comparably large shares of newly traded goods. For example, China exports 2504 of all goods categories in 1989, 1999, or both, and 34% of these traded goods are newly traded in 1999. We also analyze the percentage of newly traded goods for the rest of the world as a whole. Treating each of the rest of the countries' goods as a separate observation, we see that 30% of the traded goods were newly traded in 1999.[8] The last two columns give the trade

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[8] In terms of the categories of goods traded, for over 80% of the sampled countries newly traded goods constitute over 40% of all the goods categories which a country exports to the US in 1999. In terms of the total value of a country's 1999 exports, newly traded goods still constitute over 40% of the value of exports for over 50% of the countries.
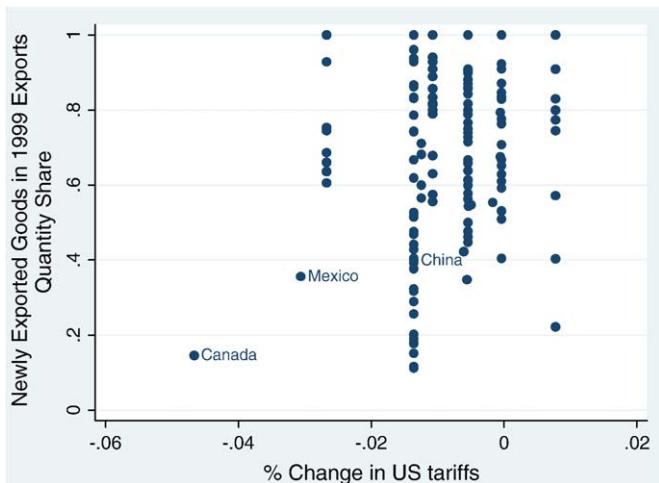
Fig. 1. Share of newly traded goods in 1999 exports. Quantity share (number of goods).

volume share of disappearing and new goods. For the disappearing goods, we calculate their share of 1989 trade volume, and for the new goods we calculate their share of 1999 trade volume.[9] In Panel B of Table 1, we report the changes in the extensive margin for the same countries for the period from 1996 to 2006. As one can see, there persists significant change in the extensive margin.

Fig. 1. plots the share of goods newly traded in 1999 in terms of the number of HTS 6-digit categories against average changes in tariffs.[10] We find that the extensive margin growth of exports to the United States is not limited to countries experiencing systematic U.S. tariff reductions. Furthermore, for a given tariff reduction, the importance of newly traded goods varies substantially across countries.[11]

3. Econometric analysis

Because our objective is to study the changing range of goods that countries export and to quantify the contribution of tariffs to those changes, our econometric model investigates the probability that a good is exported to the United States in 1999 controlling for whether or not it was exported to the United States in 1989. This specification, which exploits the cross-country sample variation by including goods-specific effects, will allow us to assess the importance of changing tariffs and other relevant variables to changing trade status.

In particular, we let y_{iz} be an indicator variable that is 1 when country i exports good z to the United States in 1999 and 0 if it does not. Specifically,

$$y_{iz} = 1[y_{iz}^* > 0] \qquad (1)$$

$$y_{iz}^* = \beta_1 + \beta_2 \Delta \ln(1 + \tau_{iz}) + \beta_3 \text{status89}_{iz} + X_i^{'}\lambda + \alpha_z + \varepsilon_{iz}, \qquad (2)$$

where y_{iz}^* is a latent variable whose value determines whether or not a good will be exported in 1999; $\Delta\ln(1+\tau_{iz})$ is the change in the natural log of the gross *ad valorem* equivalent tariff imposed by the United States on good z and country i between 1989 and 1999, and status89$_{iz}$ is an indicator variable, which is 1 if good z was exported by

i to the United States in 1989. X_i is a vector of country-specific explanatory variables, which includes the change in the natural log of GDP and GDP per capita between 1989 and 1999 to capture the effects of changing size and development level that are known to be important for the extensive margin.[12] We include the natural log of the exporting countries' average manufacturing tariffs since this may affect a country's ability to acquire intermediate goods and consequently affect its competitiveness in exporting final goods, as suggested by the vertical specialization literature. We also include in X_i several measures of bilateral trade resistance (distance from the United States, common language with the United States, whether the country is landlocked or an island, and finally, whether the country shares a border with the United States). Lastly, because GSP preferences (a zero tariff) are given to countries primarily because they are not competitive, this could be an important source of endogeneity for U.S. tariffs; therefore, we also include a dummy, which is 1 if the country is a GSP beneficiary.[13] We allow for good-specific heterogeneity in our model, since there may be good-specific variables that make it more or less likely that a good is exported from many countries.[14] Finally, we estimate the model using a probit model with a full vector of goods dummies to capture the goods-specific effects.[15] We concentrate on manufacturing industries and estimate each specification separately for 12 sectors of the economy. Since many of our explanatory variables only vary by country, we cluster robust standard errors by country in all estimations.

4. Results

Table 2 presents our results. In this table, we only report the coefficients and marginal effects of the change in the U.S. tariff variable. Note, however, that the signs on the other variables are mostly in line with our expectations.[16] The coefficient estimates for the full sample are contained in the first column of Table 2. As one can see, all the coefficients on the U.S. tariff variables are negative as expected. Also, we obtain significance at the 10% level or higher in 9 out of 12 sectors.

To better quantify the implications of these estimates, we focus on the marginal effects computed at the means of the samples. For the full sample of goods, these are reported in column 2 of Table 2. The average marginal effect across industries is around −1.10, *suggesting that a* 1-*percentage point drop in the tariff rate, say from the* 1989 *mean tariff rate of* .039 *to* .029 *in* 1999, *increases the probability of exporting a particular good by only* .0110 *percentage points*. As can be seen, the magnitudes of the marginal effects vary a great deal across industries, but are always very small.

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[9] The continuously traded goods share of trade volume for 1989 is one minus the disappearing goods' share and for 1999 one minus the new goods' share.

[10] The graph in terms of value shares is fairly similar.

[11] We also estimate the importance of net extensive margin change in real trade growth. We let the extensive margin share of real trade growth be that accounted by the net change in real trade volumes of goods whose trade status changed (the real trade of newly traded goods at the end of the sample less the value of real trade in the first period for goods that were no longer traded). We find that extensive margin growth accounts for approximately 9.3% of real trade growth for the 1989 to 1999 sample, and around 10.8% for the 1996 to 2006 sample.

[12] See Hummels and Klenow (2005).

[13] Persistent GSP beneficiaries mostly have no change in tariffs since they get zero tariffs for many goods. We expect a negative coefficient on the GSP dummy because GSP preferences are often given to non-competitive countries.

[14] The number of exporting countries varies a significantly across goods. One could interpret goods effects as capturing characteristics relevant for product cycles (e.g., technology diffusion for standardized production processes). Similarly, since most tariff variation is cross-sectional, the goods effect captures factors that are otherwise in the error term and potentially correlated with tariffs and other variables. The endogenous trade protection literature suggests that non-competitive industries that are susceptible to import competition lobby for tariffs. Without controlling for these factors, higher tariffs may be associated with a greater probability of exporting thus underestimating the negative effect of tariffs.

[15] Appendix B includes a linear probability, conditional logit, and random effects probit model.

[16] Increases in real GDP per capita tend to increase the extensive margin; however, controlling for changes in real GDP per capita, increases in GDP tend to decrease the probability of export. Distance and trade-friction variables decrease the probability of export, and decreases in countries' own tariffs tend to increase exports. Finally, GSP status decreases the probability of export as expected, but is insignificant in many industries. A good that is exported in 1989 is positively associated with the export status in 1999.

Table 2
Probit estimates for the effect of $\Delta \ln(1 + \text{tariff})$ on export status.

	1989–1999 Export status						Export status Alternative definition[a]	1996–2006 Export status	
	Positive exports in 1999							Positive exports in 2006	
	Full sample		Selected samples				Full sample	Full sample	
			Not traded in 1989[b]	Traded in 1989[c]	Upper income[d]	Low income[e]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Industry	Coefficient	Marginal effect	Marginal effect	Marginal effect	Marginal effect	Marginal effect	Marginal effect	Coefficient	Marginal effect
Food/bev/tobacco	−2.27***	−0.56***	−0.32***	−0.37	−1.28***	−0.16	−0.43	1.01	0.28
Text/app/other	−2.04*	−0.67*	−0.32*	−0.16	−0.84**	−0.69	−1.57***	−0.50	−0.18
Wood/paper	−5.87	−1.49	−0.53	−1.99	−2.12	0.01	−3.08*	−0.54	−0.16
Minerals	−2.32	−0.33	−0.48	1.77	−0.12	−0.65	−1.57*	−11.69*	−1.59*
Chemicals	−3.08*	−0.49*	−0.30**	−0.58	−0.87	−0.08	−0.89**	−6.51***	−1.29***
Plastics/rubber	−4.07	−1.33	−0.64	−0.35	−1.05	−0.27	−2.26**	−7.65**	−2.76**
Pottery/China	−4.85**	−1.50**	−0.49	−2.29***	−2.40*	−0.02	−2.02**	−3.52*	−1.24*
Iron/steel	−7.75***	−1.56***	−0.79***	−0.29	−3.21**	−0.15**	−1.17	−8.33**	−1.99**
Nonferrous metal	−6.65***	−1.97**	−0.83***	−1.07	−2.94***	0.25	−3.01***	−6.79***	−2.21***
Machinery	−7.29**	−2.21**	−0.77*	−2.44**	−3.00**	0.01	−3.94***	−9.97**	−3.47**
Transportation	−9.23***	−1.34***	−0.64***	−0.93	−3.59***	0.05	−2.58***	−2.99	−0.62
Other	−3.82*	−1.32*	−0.44	−1.18*	−1.30	−0.13	−1.78**	−5.11**	−1.97**
Goods fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model predictions									
Disappearing goods				7724					
Disappearing goods if $\Delta\ln(1 + \text{tariff}) = 0$				8244					
Disappearing goods due to tariffs				−520					
New goods	13,800		13,786		10,520	3286	13,931	13,844	
New goods if $\Delta\ln(1 + \text{tariff}) = 0$	13,110		13,068		9882	3230	13,184	12,632	
New goods due to tariffs	690		718		638	56	747	1212	
Tariff contribution	0.05		0.05	−0.07	0.06	0.02	0.05	0.09	

Notes: Robust standard errors clustered by country.
[a] A good is considered traded if there were positive exports in 1997, 1998, or 1999.
[b] Country/good pairs that were exported in 1989 are omitted.
[c] Country/good pairs that were not exported in 1989 are omitted.
[d] Sample includes only countries with 1989 Real GDP in 2005 dollars greater than $7600.
[e] Sample includes only countries with 1989 Real GDP in 2005 dollars less than $7600.
* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

To better quantify the magnitude of the effects of the actual tariff changes over the sample period, we calculate the net contribution of US tariff changes to extensive margin growth predicted by our model.[17] By summing the predicted number of newly traded goods due to U.S. tariff changes across all countries and dividing by the predicted number of newly traded goods, we find that the tariff reductions between 1989 and 1999 explain only a small share, about 5%, of the newly traded goods that emerge over the period. In this light, it is worth reminding ourselves that for the most part the U.S. tariff reductions have been fairly moderate. These findings are in line with the descriptive statistics in Section 2: U.S. tariff reductions are unlikely the alpha and omega for why the extensive margin changes.

Next, we break down the sample in terms of whether a good is traded in 1989 or not. This allows us to see if tariffs had larger negative effects on the probability of trade in 1999 for goods that were not exported in 1989 versus those that were. The third column of Table 2 presents the marginal effects for goods that were not traded in 1989, and the fourth column for the goods that were traded in 1989. For the goods that were not traded in 1989, the estimated marginal effects are very similar to those reported for the full sample, but with only

significant coefficients and marginal effects for 7 of the 12 industries. Here also, the actual tariff changes explain about 5% of the newly traded goods. When we look at the complementary sample of goods, those that were exported to the United States in 1989, we see that tariff changes are rarely significant determinants of trade. In fact, in only 3 of the 12 sectors are tariffs significant. As for goods that were traded in 1989, tariffs do not appear to be a primary determinant of trade in the latter period.[18] In other words, for those goods that were not traded in 1989, tariffs affect the probability that the good will be exported in a significant way across more industries.

We also consider whether or not it is reasonable to constrain the effects of tariffs and other variables to be the same for all types of countries. In columns 5 and 6 we consider separately the effects of tariffs on low-income and high-income countries.[19] For the high-income countries, accounting for around 50% of the newly traded goods in our sample, we find that the marginal effects are larger than

[17] The tariff change contribution is calculated as the expected number of new goods exported due to tariff changes as a share of the expected number of new goods exported. The exact formula is found in Appendix A2.

[18] For the formula used to calculate the expected share of disappearing goods that can be explained by tariffs, see Appendix A3. Because our tariff coefficients are negative and because for most country/good pairs tariffs decreased, we actually see that more goods would have disappeared had tariffs not changed.

[19] The lowest income group has a Real GDP per capita in 1989 (measured in 2005 dollars) that is less than $7600. This cut-off was chosen as it indicated the largest break in per capita income among sampled countries. Results are robust to changes in this cut-off.

the estimates for the whole sample of countries.[20] For the least-advanced countries we obtain very different results. From column 6, we find that in only 1 sector is the U.S. tariff term coefficient significant. This strongly suggests that tariff reductions in the United States are of little consequence for the extensive margin of trade for developing countries. The stark contrast between developed and developing countries is potentially supportive of recent studies which have argued that tariff reductions by themselves may not have too strong an impact on trade at the extensive margin. In particular, Lileeva and Trefler (forthcoming) argue that tariff reductions in combination with the availability of just-in-time technology may be effective. To the extent that the availability of this technology splits along developed- versus developing-country lines, our findings are consistent with this reading of the evidence.

As a final specification, we also consider alternative criteria for a good to be considered traded and/or newly traded. For a good to be considered traded in 1999, we only require that it is exported in at least one of the 3 years between 1997 and 1999, and for a good to be considered traded in 1989, we only require that it be exported in at least one of the years between 1989 and 1991. Column 7 contains the marginal effects for this specification. We find slightly larger significance with 10 of the 12 industries having negative and significant marginal effects and coefficients. Also, the magnitudes of the marginal effects are larger. Nevertheless, the overall contribution to the extensive margin is still relatively small at around 5%.

To ensure that our finding of a small contribution of U.S. tariff liberalization is not the result of our sample time period, we also include in Table 2 regression results for the time period between 1996 and 2006. Columns 8 and 9 report coefficient estimates and marginal effects for the full sample. As can be seen we find a somewhat larger overall contribution of tariff changes to be around 9% compared to 5% over the 1989–1999 sample. It should be noted, however, that tariff changes were on average larger for this second sample period: a 1 percentage point decrease for the 1989 to1999 time frame versus a near 3 percentage point decrease for the 1996 to 2006 time frame.[21] Focusing only on goods that were not traded in 1996, we observe a marginally larger but still small contribution of tariffs to extensive margin growth, at around 12%. Breaking up the sample into high- and low-income groups, we find little significance on U.S. tariffs for this time frame. In fact, for the high-income group, we find no sectors with a significant effect of tariffs, and for the low-income group only one.[22] For the alternative criteria for a good to be considered traded, we find the expected and negative coefficients across 6 sectors. Moreover, independent of the time frame we find consistent results of small contributions of U.S. tariff liberalization to the extensive margin.

Overall, we find that the contribution of tariff changes to the extensive margin is significant but not too large. This leaves open the question of what then is driving the changes in the extensive margin. According to our model, the single-largest contributing factor to extensive margin growth is the change in natural log of real per capita GDP. We find that for the full sample of countries in 1999, approximately 46% of the extensive margin growth was due to this term.

5. Conclusion

In this paper we use disaggregate U.S. bilateral trade data to investigate a prominent hypothesis in recent studies of trade growth. In particular, it has been argued by Yi (2003), Ruhl (2004), and Kehoe and Ruhl (2003) that changes along the extensive margin of trade may reconcile the strong post-World War II trade growth with the overall moderate tariff reductions. We confirm the importance of trade growth along the extensive margin for exports to the United States. However, we note that the extensive margin of trade has increased significantly between 1989 and 1999 across the board, and not exclusively for countries such as Mexico and Canada, which were directly involved in comprehensive trade liberalizations with the United States. Our study directly links the disaggregate variation in tariff changes to this changing extensive margin.

Our findings indicate that tariff changes are statistically significant in explaining increases in the extensive margin. At best, we find that 12% of newly traded goods can be attributed to tariff reductions. Interestingly enough, we find a strong disparity between the estimates for developed and developing countries. This indicates that other factors at both the industry and country levels play a much more significant role in explaining changes in the extensive margin. A challenge for future research will be to exactly uncover the driving factors.

Appendix A

A1. Sample of countries

Countries included in both the descriptive statistics and the regression analysis, ordered approximately by GDP per capita in 1999, are Norway, Switzerland, Singapore, the Netherlands, Australia, Canada, Denmark, Ireland, Belgium, Germany, Japan, France, Italy, the United Kingdom, Spain, Macao, New Zealand, Taiwan, Greece, Cyprus, Portugal, Saudi Arabia, South Korea, Mauritius, Chile, Malaysia, Trinidad and Tobago, Argentina, Poland, Mexico, Brazil, Jamaica, Colombia, El Salvador, Ecuador, Jordan, China, Indonesia, the Philippines, Bolivia, Ivory Coast, Pakistan, Guyana, Kenya, Senegal, Benin, Nigeria, Malawi, Tanzania, and the Democratic Republic of the Congo.

Additional Countries included in the descriptive statistics but not the regression analysis are Qatar, Luxembourg, Brunei, Bermuda, the United Arab Emirates, Kuwait, Liechtenstein, Austria, Hong Kong, Iceland, Christmas Island, Cocos Island, Norfolk Island, Greenland, Andorra, San Marino, Vatican City, Sweden, Finland, the Bahamas, Gibraltar, Aruba, the Netherlands Antilles, Barbados, Oman, French Polynesia, Israel, the Cook Islands, Niue, Tokelau, Bahrain, Malta, the British Indian Ocean Territory, Seychelles, New Caledonia, Antigua and Barbuda, Grenada, Palau, the Falkland Islands, Hungary, Uruguay, St. Lucia, Anguilla, the British Virgin Islands, Guadeloupe, Martinique, Montserrat, St. Kitts and Nevis, Venezuela, Costa Rica, Gabon, South Africa, the Cayman Islands, the Turks and Caicos Islands, Lebanon, Belize, Tunisia, the Dominican Republic, St. Pierre and Miquelon, French Guiana, Suriname, Panama, Thailand, Botswana, the Marshall Islands, Swaziland, Tonga, Turkey, Fiji, Nauru, Guatemala, Vanuatu, Cape Verde, Namibia, Algeria, Dominica, Djibouti, Peru, Paraguay, Morocco, Egypt, Western Samoa, Sri Lanka, St. Vincent and the

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[20] Our findings for OECD countries are in line with those for high-income countries.
[21] We refer readers to Appendix B for the full set of regression results for the 1996 to 2006 time frame.
[22] One possible explanation for the lack of significance in the latter samples of high- and low-income countries could be that after including goods dummies, there is simply not enough variation of tariff changes across countries when the sample of countries is split. In fact, the average tariff change by country has a coefficient of variation of −.877 for the 1989–1999 sample but only a −.344 coefficient of variation for the 1996–2006 sample.

Grenadines, Sao Tome and Principe, the Republic of the Congo, Guinea, Angola, the Maldives, Zimbabwe, Honduras, the Federated States of Micronesia, Bhutan, India, Syria, Cameroon, Papua New Guinea, Kiribati, Pitcairn Island, Mauritania, Comoros, Reunion, Bangladesh, Nepal, Lesotho, Haiti, the Solomon Islands, Chad, Sudan, the Gambia, Mozambique, Ghana, St. Helena, Sierra Leone, Mali, Burkina, Uganda, Zambia, Togo, Madagascar, Rwanda, the Central African Republic, Niger, Burundi, Guinea-Bissau, Somalia, and Liberia.

A2. Predicted net contribution of US tariff changes to extensive margin growth

We calculate $\dfrac{\sum\limits_{i}\sum\limits_{z\in Z'}\left(\Phi\left(X'_{iz}\hat{B}\right)-\Phi\left(X'_{iz}\hat{B}\,|\,\Delta\ln\text{ustar}=0\right)\right)}{\sum\limits_{i}\sum\limits_{z\in Z'}\Phi\left(X'_{iz}\hat{B}\right)}$ where Z'

comprises all goods not exported in 1989.

A3. Expected share of disappearing goods that can be explained by tariffs

To calculate the expected share of disappearing goods that can be explained by tariffs, we compute,

$\dfrac{\sum\limits_{i}\sum\limits_{z\in Z''}\left(\left(1-\Phi\left(X'_{iz}\hat{B}\right)-\left(1-\Phi\left(X'_{iz}\hat{B}\,|\,\Delta\ln\text{ustar}=0\right)\right)\right)\right)}{\sum\limits_{i}\sum\limits_{z\in Z''}\left(1-\Phi\left(X'_{iz}\hat{B}\right)\right)}$, where Z'' com-

prises all goods exported in 1989.

Appendix B. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jinteco.2010.03.005.

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