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Tariff Changes and the Margins of Trade: A Case Study of U.S. Agri-Food Imports

Mina Hejazi, Jason H. Grant, and Everett Peterson

Recent contributions to the theoretical and empirical trade literature underscore the channels by which exporting occurs, either through increasing the intensity of existing trade flows or by establishing new trade relationships. However, less is known about the extent to which trade liberalization influences the likelihood of trade along these channels. In this paper we develop a multinomial logit model to assess how tariff changes on agri-food imports affect the probability that country-commodity pairs will enter, exit, or maintain a presence in the U.S. agri-food import market. Using detailed bilateral tariff and trade data between 1996 and 2006, the results suggest that while U.S. tariff reductions provide a small but statistically significant increase on the probability of maintaining existing trade relationships, the magnitude of the impact on new exports is twice as large as the impact on continuously traded goods and the likelihood of disappearing products. The results have important policy implications regarding the channels by which imports change in conjunction with changes in U.S. agri-food import tariffs.

Key words: agricultural trade, extensive margin, intensive margin, multinomial logistic model

Introduction

Recent advances in the empirical and theoretical trade literature emphasize the role of firm-level productivity differences to explain bilateral trade patterns along the intensive and extensive margins (Melitz, 2003; Helpman, Melitz, and Rubinstein, 2008; Chaney, 2008; Bernard et al., 2009). Melitz's (2003) framework shows that only the most productive firms are able to enter export markets. Reductions in trade costs, either from lower tariffs or transportation costs, will therefore encourage firms that are currently exporting to expand their export sales (i.e., the intensive margin) and induce new firms to select into export markets (i.e., the extensive margin). Chaney (2008) shows succinctly that the degree of competition among products influences the intensive margin through its effect on variable trade costs, while the extensive margin depends more on the fixed costs of exporting and firm heterogeneity. Absent firm-level data, Helpman, Melitz, and Rubinstein (2008) consider how the decision to export is affected by trade costs at the country level using zero trade flow records. Bernard et al. (2009) find that short-term (long-term) variations in imports and exports (e.g., one-year intervals) are explained by changes in the intensive (extensive) margin.

In addition to new firms entering export markets (extensive partner margin), firms that are currently exporting may expand the number of products/varieties (extensive product margin) exported. Bernard, Redding, and Schott (2011) extends the Melitz model to multi-product and multi-destination firms and find that trade liberalization can induce firms to expand into export

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Mina Hejazi is a PhD candidate, Jason H. Grant is an associate professor and director of the Center for Agricultural Trade (CAT), and Everett Peterson is a professor in the Department of Agricultural & Applied Economics at Virginia Tech.
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markets by adding new products using U.S. manufacturing data and incorporating evidence from the Canada-U.S. Free Trade Agreement (CUSTA). Hummels and Klenow (2005) examined cross-country $d$ifferences in exported varieties defined at the six-digit level of the harmonized system (HS) and find that the extensive product margin accounts for 60% of the trade of larger economies. For U.S. trade, Broda and Weinstein (2006) estimate that 30% of the growth of imports over 1972–2001 occurred in product varieties that previously did not exist.

Other studies have reviewed the effects of Free Trade Agreements (FTAs) on the extensive margin of firm- and product-level trade (Molina, Bussolo, and Iacovone, 2010; Kehoe and Ruhl, 2013). Molina, Bussolo, and Iacovone (2010) find that FTAs exert a positive effect on the number of new exporters and new products at the firm level within the Dominican Republic-Central American Free Trade Agreement (CAFTA-DR). Kehoe and Ruhl (2013) introduce a "least-traded goods" effect after implementation of the North American Free Trade Agreement (NAFTA), whereby goods that were not exported in the past or experienced trade below a certain threshold are still potential exports along the extensive margin. Their results point to the fact that—with no significant changes in NAFTA's trade policy—trade flows along the extensive margin are negligible. However, Iacovone and Javorcik Iacovone and Javorcik (2008) provide evidence that Mexican firms increased the number of goods exported after the implementation of NAFTA in 1994, and Debaere and Mostashari (2010) find that U.S. tariff changes on industrial product imports have a small but statistically significant effect on the extensive product margin of U.S. imports.

This article assesses the extent to which trade liberalization vis-à-vis tariff changes affects the probability of entering, exiting, or maintaining a presence in the U.S. agri-food import market. Unlike previous studies, this study develops a multinomial framework to study three mutually exclusive margins of agri-food imports—existing, new, and disappearing margins of bilateral trade. More specifically, the purpose of this article is threefold. First, following Helpman, Melitz, and Rubinstein (2008) we develop a theoretical logit model at the country-product level to explain the margins of U.S. agri-food imports. Second, we develop a detailed database that matches U.S. agri-food tariff changes to corresponding bilateral imports between 1996 and 2006 along with several robustness checks on these two years. Finally, we extend the probit model developed in Helpman, Melitz, and Rubinstein (2008) to a multinomial logit setting of unordered categories of agri-food exporting status.

It should be noted that while the model in Helpman, Melitz, and Rubinstein (2008) is a two-stage heterogeneous firms model predicting entry into exporting and then the intensity of export flows at the country level using zeros in the trade flow matrix, in this paper we do not attempt to explain how tariff changes may influence the second-stage intensity of exports via a gravity-like equation. Rather, our purpose is to derive and extend the first-stage selection equation to a multinomial framework of four categories of export status: (i) goods that have the potential to be traded but remain non-traded; (ii) disappearing goods trade; (iii) new goods trade (extensive margin); and (iv) continuously traded goods (intensive margin).

Our work contributes to the new-new trade literature understanding welfare applications from aggregate productivity changes, variety changes, and heterogeneous firms. In traditional theory, trade and welfare gains come from specialization through comparative advantage or factor endowments, whereas in new trade theory the trade and welfare gains arise from a combination of economies of scale and the expansion of more varieties available to consumers. The new-new trade theory with heterogeneous firms (Melitz, 2003) identifies aggregate productivity growth as an additional source of welfare gain. This productivity growth is due to the reallocation of resources from exiting low-productivity firms to expanding or entering high-productivity firms into export markets. Thus, the selection and market share shifting to more productive firms are important features of new-new trade theory that were not predicted in the old and even the new trade theory based on monopolistic competition (Krugman, 1979).

Additional welfare gains in a heterogeneous firms setup are possible if trade liberalization increases product market competition, which leads to lower mark-ups of price over marginal cost.

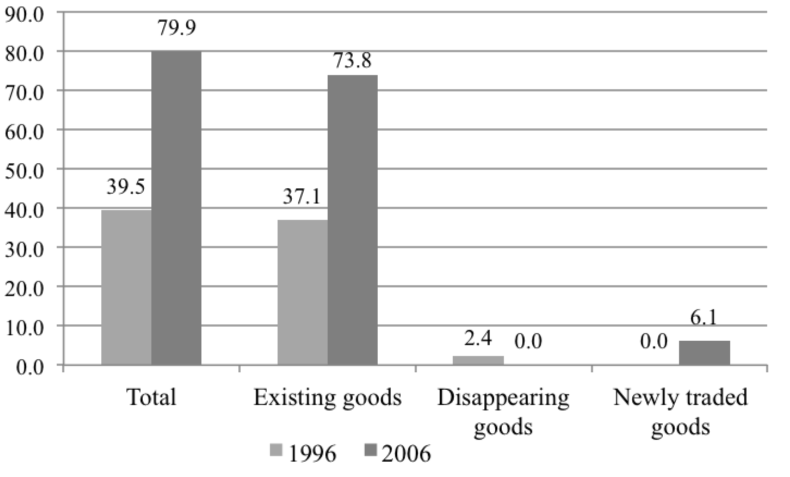

Figure 1. Decomposition of U.S. Agricultural and Food Imports ($bil.), 1996 vs. 2006

Source: U.S. International Trade Commission (USITC) at the six-digit level of the Harmonized System (HS), available at https://dataweb.usitc.gov/.

Consequently, both falling mark-ups and rising average productivity play a role in declining prices and rising real incomes (Bernard et al., 2007; Redding, 2010; Melitz and Redding, 2014, 2013; Baldwin and Ravetti, 2014). Although we do not exploit firm-level transaction data in this article, the results reflect the underlying dynamics of firms based on Melitz (2003) and the selection equation in Helpman, Melitz, and Rubinstein (2008), where we observe new products along the extensive margin of trade and disappearing products resulting from tariff changes.

We find consistent evidence that agri-food tariff liberalization enhances the entry of country-product export pairs into the U.S. market. Extending the analysis to a multinomial setting, we find that more restrictive trade policies increase the probability of disappearing goods, decrease the probability of shipping new goods (extensive margin), and have a negligible effect on the intensive margin or continuously traded goods. The results have important policy implications regarding the channels by which imports change in conjunction with changes in tariffs.

U.S. Agri-Food Imports

The value of U.S. imports of agricultural and food products doubled from $39.5 billion in 1996 to almost $80 billion in 2006. Figure 1 decomposes the growth of imports into existing (intensive margin, henceforth IM), newly traded extensive-margin goods (henceforth EM), and disappearing goods between the two time periods.[1] Existing goods, or the IM, are defined as the set of country-product observations that had non-zero trade with the United States in 1996 and 2006, whereas newly traded goods, or the EM, are defined as those country-product pairs that did not trade with the United States in 1996 but did trade in 2006. Finally, disappearing goods are defined as the set of country-product observations that had positive trade with the United States in 1996 but not in 2006.[2]

Perhaps not surprising, figure 1 illustrates that the majority of U.S. agri-food import growth is the result of increased trade with existing partner-product relationships that were active in 1996.

[1] We choose 1996–2006 because this period coincides with the implementation of market access commitments agreed to during the Uruguay Round Agreement on Agriculture (URAA) negotiations and the formal establishment of the World Trade Organization (WTO) in 1995. Since 1996, the United States has also negotiated a number of Free Trade Agreements (FTAs), which often contain some upfront tariff eliminations and some phase-in periods for sensitive products. We consider other time periods in the empirical analysis as robustness checks.

[2] Extensive margin and disappearing goods trade can also be found by subtracting existing goods trade from the total value of trade in 2006 and the value of existing goods trade from the total in 1996, respectively.

Relative to the total U.S. agri-food import growth of \$40.5 billion (\$79.9 – \$39.5) between 1996 and 2006, increased trade along the IM of \$36.7 billion (\$73.8 – \$37.4) represents almost 91% (\$36.7/\$40.5) of this growth. Smaller, new country-product relationships (EM) increased by roughly \$6.1 billion, contributing nearly 10% to U.S. agri-food import growth. Approximately 6%, or \$2.4 billion, of existing trade in 1996 was absent from the market in 2006 (disappearing trade). This interesting result is consistent with Besedeš and Prusa (2006), who find a considerable amount of churning in trade relationships as exporters test the U.S. market but later fail. Thus, while the expansion of existing trade relationships continues to dominate the growth of U.S. agri-food imports, the formation of new partner-product relationships represents an increasingly important trend.

While instructive, decomposing agri-food trade along each margin at the aggregate level masks a number of important trends at the country-product level. For example, Canada and Mexico, which are part of NAFTA (1994), have historically supplied nearly 50% of U.S. agri-food imports. More recently, however, new country-product export growth has emerged from China, Brazil, Chile, Australia, Indonesia, New Zealand, Colombia, and the EU-15 countries (treated as a single country). Whereas figure 1 decomposed the IM and EM across all partners and products, table 1 breaks down the intensive and extensive product margins for a given country as well as the share of products that have been subject to a change in the *ad valorem* equivalent duty and the median duty change between 1996 and 2006.[3]

On an absolute basis, the EU-15, Canada, and Mexico experienced the highest export growth to the U.S. market of \$7.8, \$7.7, and \$6.1 billion worth of agri-food product exports, respectively. However, these three countries differ in terms of the channels by which this import growth has occurred. Canada's profile consists of over \$1.3 billion in new goods, which accounted for over 17% of its export growth to the U.S. market. Mexican and EU-15 export growth, on the other hand, was more concentrated in existing goods, which grew by \$5.7 and \$7.5 billion, respectively, comprising over 90% of both countries' total export growth. Conversely, while Brazil's export growth along the extensive margin of \$1.1 billion is second only to Canada on an absolute scale, the contribution of the extensive margin for Brazil is 57.2% as a share of its total export growth—one of the highest EM growth rates among all countries in our sample. Similarly, China also experienced a significant contribution of newly traded goods at \$387 million, or 11.4% of its total agri-food export growth. For Chile, Australia, the EU-15, and low- and high-income countries as a group, U.S. import growth is more concentrated along the existing goods' channels.

In the remaining columns of table 1, we report the number of Harmonized System (HS) products traded, the share of overall and newly traded products that experienced tariff reductions, and the median average tariff change. Tariff changes between 1996 and 2006 occurred for several reasons. First, since the United States is a member of the World Trade Organization (WTO), any exporting partner that is also a WTO member will benefit from a reduction in tariffs resulting from U.S. market access commitments implemented under the Uruguay Round Agreement on Agriculture (URAA) that was phased in over a six-year period for developed economies.[4]

Second, tariff reductions can occur because of the implementation of FTAs. The United States has established FTAs with twenty countries, notably with Canada and Mexico (NAFTA) in 1994, the Dominican Republic (CAFTA-DR) in 2006, Chile and Morocco in 2004, and Australia in 2005. These agreements have resulted in most agricultural products facing duty-free access in the United States. Remaining, sensitive agricultural tariffs on sugar, dairy, rice, peanuts, and tobacco products are scheduled to be liberalized over a transitional period extending up to twenty years in some cases (Johnson, 2009; Adcock and Rosson, 2004; U.S. Chamber of Commerce, International Affairs, 2015).

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3 Details on the calculation of tariff changes between 1996 and 2006 are discussed in the data section.

4 However, it is important to note that URAA tariff reduction commitments were from bound rates, which can be much higher than applied rates on some products creating large gaps between the two tariff rates. Thus, the agreed overall average tariff cut of 36% for agricultural products would only change applied tariffs if the gap between bound and applied rates was less than the required percentage tariff cut.

Table 1. Growth of Intensive and Extensive Margins across Agri-Food Exporters to United States in 2006 Compared to 1996

Exporter	Total Import Growth ($ Mil.)	Continuous Traded ($ Mil.)	Newly Traded ($ Mil.)	Share of Newly Traded Goods	Disappearing Goods ($ Mil.)	No. of HS6 Products Exported	Share of Existing Products with Tariff Reduction	Median AVE Tariff Reduction	Share of New Goods with Tariff Reduction	Median AVE Tariff Reduction for New Goods
Canada	7,695	7,068	1,325	17.2%	698	650	38.9%	1.0%	2.2%	1.5%
Mexico	6,115	5,714	510	8.3%	109	494	25.5%	3.2%	2.8%	1.4%
China	3,381	3,016	387	11.4%	22	467	34.0%	1.9%	6.6%	2.3%
Brazil	1,965	902	1,123	57.2%	59	291	15.5%	2.8%	6.9%	5.3%
Chile	1,689	1,651	114	6.7%	76	264	29.9%	2.6%	6.4%	5.3%
Australia	1,751	1,707	56	3.2%	11	293	40.3%	2.8%	9.6%	4.9%
EU-15	7,838	7,544	726	9.3%	432	3,334	35.2%	1.9%	5.7%	3.5%
Low-Income	3,599	3,201	569	15.8%	171	3,122	12.8%	4.1%	3.8%	7.9%
High-Income	36,760	33,466	5,517	15.0%	2,223	12,813	25.4%	2.0%	5.0%	4.9%

Notes: Low- and high-income countries are classified according to the World Bank's list of high- and low-income economies. AVE denotes the *ad valorem* equivalent tariff duty inclusive of specific tariffs and other taxes/fees collected at the border but exclusive of transport margins. AVE tariff data are collected from the U.S. international Trade Commission's dutiable values (see http://dataweb.usitc.gov/)

Third, for some products and countries, tariff changes resulting from the formation of FTAs may not force a reduction in applied tariffs because some agricultural products already entered the U.S. duty free under preferential arrangements such as the Generalized System of Preferences (GSP) for developing countries, initiated in 2001; the African Growth and Opportunity Act (AGOA), initiated in 2000; the Caribbean Basin Initiative (CBI), initiated in 1984; and the Andean Trade Preference Act (ATPA), initiated in 1991 (Paggi et al., 137; Hornbeck, 2012).

Columns 7–11 of table 1 illustrate the total number of agri-food products exported at the six-digit level of the Harmonized System (HS) for each individual country and the total number of country-commodity pair exports to the U.S. market in the case of the EU-15 and low- and high-income groups.[5] Also reported is the share of all products and newly traded goods that experienced tariff reductions between 1996 and 2006 as well as the median reduction in the *ad valorem* equivalent (AVE) tariff rate. Perhaps due to the signing of an FTA with the United States, Australia stands out as the country with the largest shares of all and newly traded products experiencing a tariff reduction between 1996 and 2006, at 40% and nearly 10% , respectively. Canada exported the largest number of HS-6 digit agri-food lines to the United States, at 650 products and, like Australia, enjoyed tariff reductions on a relatively large share of products (38.9%). However, tariff reductions on newly traded goods originating in Canada were the lowest of all countries at around 2% and with a median tariff reduction on new goods of 1.5%. Brazil experienced the smallest share of products with tariff reductions at 15.5% but realized the largest median tariff reduction for all goods (along with Australia) at 2.8%, the second largest share of new goods facing a tariff reduction (6.9%) behind Australia, and tied for the largest median tariff reduction on new goods (along with Chile) at 5.3%. The U.S. tariff data also indicate that while the median reductions in AVE tariffs are relatively modest in magnitude (ranging from a low of 1% on Canadian goods to a high of 7.9% for new goods from low-income countries), the overall tariff distribution is skewed left, implying that the U.S. agri-food market has become more open, on average, and exporting countries have enjoyed a decrease in AVEs more often than an increase.

Thus, the data seem to suggest that the new goods margin of trade is influenced not only by tariff liberalization but also by the magnitude by which tariffs are reduced. China, Brazil, and Chile all enjoyed relatively larger median tariff reductions on the new goods margin of trade compared to traditional export sources such as Canada and Mexico. However, the preceding analysis did not control for other factors affecting the probability of exporting along each margin. The next section develops a formal model of selection into exporting.

Theoretical and Empirical Model

To identify the impact of trade liberalization on the probability of exporting, we develop a framework similar to that of Helpman, Melitz, and Rubinstein (2008). While the model is based on firm-level heterogeneity, Helpman, Melitz, and Rubinstein note that “the features of marginal exporters can be identified from the variation in the characteristics of the destination countries” (p. 4). Further, unlike Helpman, Melitz, and Rubinstein, who use aggregate export flows, we employ product-level trade data.

On the demand side, the world economy consists of R countries producing and consuming a continuum of agri-food commodities. A constant elasticity of substitution (CES) sub-utility function represents consumer preferences in each country r for agri-food commodity k. A representative consumer in country r maximizes

$$(1) \qquad u_{rk} = \left[\int_{\omega \in B_{rk}} \left(x_{rk(\omega)} \right)^{\frac{\sigma_k - 1}{\sigma_k}} d\omega \right]^{\frac{\sigma_k}{\sigma_k - 1}}$$

[5] As described in more detail in the data section, each unit of observation in the empirical analysis is a country-commodity pair.

subject to

$$(2) \qquad \int_{\omega \in B_{rk}} p_{rk(\omega)} x_{rk(\omega)} d\omega = Y_{rk},$$

where B_{rk} is the set of consumable varieties available in country r, $x_{rk(\omega)}$ is the quantity of variety ω in commodity k consumed in country r, σ_k is the elasticity of substitution across varieties of commodity k, $p_{rk(\omega)}$ is the price of variety ω in commodity k in country r, and Y_{rk} is the optimal expenditure allocated for consumption in country r. To ease notation we suppress time period subscripts.

Solving this utility maximization problem and substituting the budget constraint equation (2) in the first-order condition gives country r's demand for each variety:

$$(3) \qquad x_{rk(\omega)} = \frac{[p_{rk(\omega)}]^{-\sigma_k} Y_{rk}}{\int_{\omega \in B_{rk}} (p_{rk(\omega)})^{1-\sigma_k} d\omega}.$$

The denominator in equation (3) is the ideal CES price index, defined as follows:

$$(4) \qquad PI_{rk} = \left[\int_{\omega \in B_{rk}} (p_{rk(\omega)})^{1-\sigma_k} d\omega \right]^{\frac{1}{1-\sigma_k}}.$$

Thus, country r's demand for each variety ω in commodity k is

$$(5) \qquad x_{rk(\omega)} = \frac{[p_{rk(\omega)}]^{-\sigma_k} Y_{rk}}{(PI_{rk})^{1-\sigma_k}}.$$

On the supply side, firms are assumed to have a country- and firm-specific component of unit costs, c_{rk} and a_{rk}, respectively, where a_{rk} represents the number of the country's inputs used by the firms per unit of output and c_{rk} measures the cost of this combination of inputs. Unit costs are country specific and represent differences in factor inputs across countries, whereas $1/a_{rk}$ represents productivity differences across firms within a country, with less productive firms holding higher values of a_{rk}. Following Melitz (2003) and Helpman, Melitz, and Rubinstein (2008), we assume that the distribution of a_{rk} across firms can be described by a product-specific cumulative distribution function $G_k\ (a_{rk})$, which is symmetric across all countries with support $[a_{rk,L}, a_{rk,H}]$, $a_{rk,H} > a_{rk,L} > 0$.

Home production and distribution incur only production costs (Melitz, 2003). However, when firms in origin country o engage in export sales in destination country d,[6] two additional costs are incurred. First, sector-level fixed costs (f_{odk}) define the costs—such as information, institutions, paper work, product compliance, etc.—associated with establishing a trade relationship; these are destination specific but independent of firm productivity. Second, variable costs (τ_{odk}), which are also commodity and destination specific, define the cost—such as transportation costs, tariffs, and other surcharges—associated with shipment quantities, which are assumed to be of the "iceberg" form such that in order to ship one unit from country o to country d, τ_{odk} will be greater than 1.

The supply side is characterized by monopolistic competition in which firms have symmetric cost functions but are asymmetric with respect to productivity. Firms in country o maximize profits by charging the standard markup pricing rule $p_{ok}(a_{ok}) = c_{ok} a_{ok} / \alpha_k$, where $1/\alpha_k = \sigma_k / (\sigma_k - 1)$, $\sigma_k > 1$. Thus, if firms in country o export to destination country d, consumers in country d (foreign country) pay the delivered price

$$(6) \qquad p_{dk}(a_{ok}) = \tau_{odk} c_{ok} a_{ok} / \alpha_k,$$

[6] Note that hereafter o denotes an origin country and d denotes a destination country.

while producers in country o realize sector k profits of

$$\pi_{odk}(a_{ok}) = (\tau_{odk}c_{ok}a_{ok}/\alpha_k) \times x_{dk} - [(\tau_{odk}c_{ok}a_{ok})x_{dk} + c_{ok}f_{odk}]. \tag{7}$$

Simplifying the profit function in equation (7) using equations (5) and (6) gives us

$$\pi_{odk}(a_{ok}) = (1 - \alpha_k)\left(\frac{\tau_{odk}c_{ok}}{\alpha_k PI_{dk}}\right)^{1-\sigma_k} Y_{dk}(a_{ok})^{1-\sigma_k} - f_{odk}. \tag{8}$$

The profit function in equation (8) has a few of important properties. First, since domestic market sales do not require payment of fixed costs ($f_{ook} = 0$), countries' internal trade (where $\tau_{ook} = 1$) earn positive profits. Second, country-pair (od) export sales by firms in the origin country $d$epend on their own productivity (a_{ok}) in relation to a destination-specific cutoff value $\pi_{odk}(\overline{a}_{ok}) = 0$. Therefore, if $a_{ok} \leq \overline{a}_{ok}$, then exporting from o to d is profitable because a firm in origin country o can cover both fixed and variable costs and will have positive sales from exporting commodity k to destination country d. This leads to an important conclusion raised by Helpman, Melitz, and Rubinstein (2008): only a fraction, $G(\overline{a}_{ok})$, of country o's firms will find it profitable to export to destination market d. When firms produce differentiated products, only a subset of products (B_d) will be available to destination market consumers compared to the set of products in sector k that are produced and traded globally. Third, equation (8) allows for the explicit possibility of zero trade, disappearing trade, and extensive and intensive margin trade because of fixed and variable trade cost components. For example, if the least productive firms have a coefficient a_{ok} below the lower support of $G(a_{ok})(a_{ok} \leq a_L)$, then no firms will find it profitable to export. Conversely, if all firms have technical coefficients above the upper support of $G(a_{ok})$ ($a_{ok} \geq a_H$), then all firms in country o will find it profitable to export.

With this in mind, we can define a latent variable (Z_{odk}) for the most productive firms using the lower "cutoff" value of $a_{ok,L}$ in country o and product k (see also Debaere and Mostashari, 2010):

$$Z_{odk}(a_{ok,L}) = \frac{(1 - \alpha_k)\left(\frac{\tau_{odk}c_{ok}}{\alpha_k PI_{dk}}\right)^{1-\sigma_k} Y_{dk}(a_{ok,L})^{1-\sigma_k}}{f_{odk}}. \tag{9}$$

Thus, equation (9) is defined as the ratio of variable export profits to the fixed costs (common across all exporters) of exporting such that positive profits exist if $Z_{odk}(a_{ok,L}) > 1$. Because of the interplay of variable and fixed costs along with our interest in how tariff changes impact the four margins of trade in a multinomial setting, equation (9) forms the basis for our empirical model.

Following Helpman, Melitz, and Rubinstein (2008) and firms' selection into export markets, the fixed costs of trade are assumed to be stochastic:

$$f_{odk} = \exp(\gamma_k \varphi_{od} - e_{odk}), \tag{10}$$

where the measure of country-pair specific fixed costs is defined as φ_{od} and e_{odk} is the random component. With one importer in our sample (i.e., the United States) and because we assume fixed costs of exporting are constant across countries for a given destination market but not necessarily across products, we capture these by specifying a comprehensive set of goods-specific fixed effects. The variable component of trade costs in equation (9) is specified as

$$(1 - \sigma_k)\ln\tau_{odk} = -\mu_{k,1}d_{ok} - \mu_{k,2}t_{odk} - \mu_{k,3}v_{od} + u_{okd}, \tag{11}$$

where d_{od} is the natural logarithm of the distance between country o and country d, t_{odk} is the AVE tariff rate applied by destination country d on origin country o for commodity k, v_{od} denotes other variable costs between o and d, and u_{okd} denotes the random component of variable trade costs.[7]

[7] In equation (11) we specify the variables with negative signs because the elasticity of substitution is greater than 1, $\sigma_k > 1$.

Substituting equations (10) and (11) into the latent variable equation (9) yields

$$z_{odk}(a_{ok}) = \beta_k + \beta_{ok} + \beta_{dk} - \mu_{k,1} d_{od} - \mu_{k,2} t_{odk} - \mu_{k,3} v_{od} - \gamma_k \varphi_{od} + \eta_{odk}, \tag{12}$$

where β_{ok} is an origin-commodity fixed effect absorbing $(1-\sigma_k)\ln(c_{ok})$ and $(1-\sigma_k)\ln(a_{ok,L})$, β_{dk} is a destination-commodity fixed effect capturing $(\sigma_k - 1)\ln(PI_{dk})$ and $\ln(Y_{dk})$, and β_k is a commodity-specific fixed effect absorbing not only the remaining terms in equation (9) $(\ln(1-\alpha_k) - (1-\sigma_k)\ln\alpha_k)$ but also the sector-specific fixed costs of trading with a single importing country (the United States), and η_{odk} is a random error term of $e_{odk} + u_{okd}$.

Equation (12) is estimated for the year 2006 conditional on observed policy changes that may (or may not) have taken place relative to the base year 1996. Thus, the estimation framework is based on a comparison of two points in time (Debaere and Mostashari, 2010), with 1996 serving as our reference year and 2006 the counterfactual year. Within this framework, four (unordered) export outcomes are possible:

1. *No trade margin*: country o did not export product k to the United States in either time period;
2. *Disappearing margin*: country o exported product k in 1996 but not in 2006;
3. *Intensive margin*: country o exported product k in both 1996 and 2006;
4. *Extensive margin*: country o exported product k in 2006 but not in 1996.

Category 1 is straightforward and is our benchmark category defined as the "no trade" margin. Category 2 is referred to as "disappearing goods" since exporters had positive shipments in the initial year but zero trade in the end year. Category 3 is referred to as "continuous" or the intensive margin trade. Finally, category 4 is defined as "new goods" or trade along the extensive margin. Our analysis focuses in particular on outcomes two through four conditional on tariff rate changes in the U.S. agri-food import market. That is, we wish to evaluate the extent to which variable trade costs vis-à-vis tariff changes influence the probability of disappearing exports, maintaining a presence in the market, or establishing a new trade relationship with the United States.

Letting T_{ok} be an indicator variable equalling 1 when country o exports product k to the United States and 0 otherwise—and noting the unordered categorical nature of these four trading outcomes—a multinomial logistic model (MNL) is an appropriate empirical tool. Thus, the probability of observing any one of the four possible exporting categories (c) conditional on tariff rate changes and other explanatory variables collapsed into $x'\beta$ is specified as follows:

$$F[T_{ok} = c] = F_{ok,c} = \frac{\exp(x'_{ok,c}\beta_c)}{\sum_{n=1}^{4}\exp(x'_{ok,n}\beta_{ok})}, \tag{13}$$

where $0 < F_{odk,c} < 1$; $c = 1, \ldots, 4$ categorical outcomes; $F(Z_{odk,c}) = \Pr(Y_{odk} = x|x'\beta)$; and the main explanatory variables in $x'\beta$ are defined as follows:

- Tariff Changes (Δt_{ok}) is defined as the 2006 AVE tariff minus the 1996 AVE tariff.
- Log Distance (D_{od}) is defined as the natural logarithm of the distance between origin country (o) and the United States.
- GDP Growth is defined as the change in natural logarithm of origin country GDP in 2006 minus the natural logarithm of the origin country's GDP in 1996.
- Exports Status ($Status_{ok,1996}$) is defined as a binary variable equal to 1 if exporting country o had positive exports of product k to the United States in the base year (1996) and 0 otherwise.

Several other specification and estimation issues need to be addressed in a multinomial logit framework. First, we assume each exporting status is unique and has a singular value, allowing us to assign an ordinal number to each outcome with the independent variables held constant across each exporting category. Thus, the MNL estimates a set of c-1 coefficients for each independent variable, where c denotes the number of exporting categories. The MNL model assumes independence across choices, also known as the Independence of Irrelevant Alternatives (IIA). Therefore, the relative probability of observing a categorical outcome is unaffected if we add another outcome or drop one of the existing outcomes (Kennedy, 1998). In our sample of U.S. import data, we do not expect the IIA assumption to be an issue because we attempt to include all possible categories of exporting. However, testing the IIA hypothesis as suggested by McFadden, Train, and Tye (1977) and Small and Hsiao (1985) indicates that the IIA assumption has not been violated (Long and Freese, 2006). Further, in the empirical analysis we conduct a specification that drops one of the categorical outcomes and the estimation results are consistent, which is supportive of the IIA assumption.

Second, we conducted two additional tests that are suggested for a Multinomial Logit Model (Long and Freese, 2006). First, to examine the validity of the independent variables we used the Likelihood Ratio test, which showed that all explanatory variables are significant in the model. Second, we conducted a Wald test to check whether we can combine outcome categories. Both tests confirm that the independent variables are significantly different between each pair of categorical outcomes.

Third, a recent article by Santos Silva and Tenreyro (2015) provides an important critique of the Helpman, Melitz, and Rubinstein (2008) selection into exporting equation.[8] Their critique rests on the normality assumption of the distribution of the error term in the first-stage probit equation. However, in this paper we focus on the first-stage selection equation in a logit-based framework where normality is not a maintained assumption. We note however, that both models yield similar results. We report the results along with robust standard errors in estimation to partially mitigate heteroskedasticity issues raised in Santos Silva and Tenreyro (2015).

Fourth, one reviewer noted there may be some concern about the endogeneity of tariffs. It is widely established in the econometrics literature that the endogeneity of explanatory variables in non-linear categorical dependent variables is difficult to handle. As Wooldridge (2014) notes, methods where fitted values obtained in first-stage regressions are plugged in for endogenous explanatory variables in a second-stage equation are generally inconsistent for both the parameters and marginal effects. Thus, to the best of our knowledge in a multinomial logit setting there are few methodological advances to handle instrumental variables (IV). As a (partial) solution to this problem, however, most of the tariff variation in U.S. agri-food imports is cross-sectional in nature (i.e., tariffs vary considerably more across countries and products than over time for a given country-product pair) and thus sector-specific fixed effects can capture unobserved factors that may otherwise be in the error term but potentially correlated with tariffs (Debaere and Mostashari, 2010).

Fifth, we estimate the multinomial logit model in equation (13) with commodity-specific intercept shifters. Because the United States is the only importing country in our sample, sector-specific dummy variables are common to all exporting countries and thus can absorb the influence of U.S. domestic production and supply availability as well as changes in demand or tastes and preferences for specific products.[9] However, as a robustness check we discuss briefly the results from adding an additional variable to the model measuring changes in import expenditure shares for each HS6-digit product in an HS2-digit industry. We also present a more demanding specification that includes grouped exporter-by-commodity fixed effects to control for changes in preferences for goods that are differentiated by country of origin.[10]

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[8] We thank a reviewer for bringing this to our attention.

[9] While changes in U.S. domestic production levels can impact import quantity demanded, retrieving production data that matches the detailed HS6-digit trade data was not feasible, as discussed in the data section.

[10] We thank an anonymous reviewer for pointing this out.

Finally, while the focus of this article is to determine the degree to which tariff changes explain existing, disappearing, and newly introduced trade goods, non-tariff measures (NTMs) such as sanitary and phyto-sanitary (SPS) measures or technical barriers to trade (TBT) could also impact the various margins of U.S. agri-food imports. Because of recognized NTM data limitations precluding a comprehensive assessment of NTMs (see Grant, Peterson, and Ramniceanu, 2015), we adopt two approaches to address this issue. First, to the extent that SPS and TBT measures are time-invariant, we can control for their influence through the use of commodity-specific fixed effects, which will help control for those agri-food sectors that tend to be plagued by non-tariff issues related to animal disease, plant health, and food safety.

Second, with the exception of a some well-known pest-specific SPS issues related to plant health between the United States and its trading partners (Japanese apple dispute; Argentine lemons), a relatively large share of SPS trade disruptions since 1995 are because of issues related to animal disease (i.e., foot and mouth disease (FMD), Bovine Spongiform Encephalopathy, Blue Tongue, Avian Influenza (AI), Porcine Epidemic Diarrhea (PED) virus, Schmallenberg virus, etc.) (see Grant and Arita, 2016). Thus, to determine whether our tariff change coefficients are sensitive to animal disease-related SPS measures, we discuss in the results section an additional multinomial logit scenario in which all six-digit product lines in the Harmonized System (HS6) representing beef, pork, poultry, and dairy product codes are dropped from estimation.

Data

Bilateral U.S. agri-food import data over the period of 1996–2008 are collected from the U.S. International Trade Commission (USITC) at the 6-digit level of the Harmonized System (HS). Agri-food products are classified according to the World Trade Organization's (WTO) Multilateral Trade Negotiating (MTN) categories and include products from two-digit chapters 01–24 (excluding Chapter 03 – Fish and seafood products) as well as select codes in higher chapters, such as cotton (Chapters 51–53).[11]

As described in the previous section, we use GDP data from the World Bank Development Indicators (in U.S. dollars) and the United Nations National Accounts as a measure of origin country economic size and level of development.[12] While GDP data are available for a much wider set of countries and time periods, an important shortcoming is that this series does not have a commodity dimension. Thus, in an alternative specification we also control for origin production using country-commodity specific fixed effects where commodities are grouped according to their 4-digit chapter of the harmonized system (β_{ok}) (equations 12 and 13). Bilateral distance between the United States and its partner countries is retrieved from the *Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII) geo-distance dataset (Mayer and Zignago, 2006).[13]

Bilateral tariffs at the HS6-digit level are computed using the comprehensive customs import values contained in the USITC's Tariff and Trade Data web.[14] The customs data available are the Free on Board (FOB) customs value of shipments; the Cost, Insurance and Freight (CIF) value; the

[11] WTO's MTN categories can be found here (p. 24): https://www.wto.org/english/tratop_e/tariffs_e/tariff_profiles_2006_e/tariff_profiles_2006_e.pdf

[12] Production data were initially retrieved from the Food and Agricultural Organization Productions Statistics database (PROD-STAT). However, FAO production codes do not map well to HS6-digit products. Further, FAO production values are incomplete for many countries and time periods due to incomplete data on producer prices. In some cases (i.e., Taiwan), we use GDP data from the Penn World Tables (6.3) to supplement WB and UN data when it is incomplete or missing. WB Development Indicators Data can be accessed (with subscription) at: http://ddp-ext.worldbank.org/ext/DDPQQ/member.do?method=getMembers&userid=1&queryId=135, and UN GDP data can be retrieved at: http://unstats.un.org/unsd/snaama/dnllist.asp. Penn World Tables can be accessed at the Center for International Comparisons at the University of Pennsylvania's website: http://pwt.econ.upenn.edu/

[13] CEPII is a Paris-based independent European research institute on the international economy. CEPII's research program and datasets can be accessed at www.cepii.com. CEPII uses the great circle formula to calculate the geographic distance between countries, referenced by latitudes and longitudes of the largest urban agglomerations in terms of population.

[14] Available at: https://dataweb.usitc.gov/

dutiable value of imports; the values of the duties collected; and the CIF charges to export a particular product from a given country to the U.S. market. One of the key advantages of using customs values is that they report the value of duties collected for the year (independent of transport, insurance, and freight costs), making it possible to calculate a true measure of the AVE. This is important given the paucity of reliable tariff data over our timeframe (2006 relative to 1996) and the pervasive use of specific, seasonal, and compound tariffs in U.S. agri-food imports.

To provide some context, cucumber imports (fresh or chilled) face a tariff of \$0.0042/kg if imported during between December 1 and the last day of February in the following year, compared to a \$0.0056/kg tariff if imported in any other month.[15] Tariffs on fresh or chilled grapes (HS 080610) are (i) tariff-free between April 1 and June 30, (ii) levied as a specific tariff of \$1.13/m^3 between February 15 and March 31, and (iii) levied at \$1.80/m^3 at any other time of the year. U.S. tariffs on mushrooms (HS 070951) are applied as a compound policy with combinations of specific and *ad valorem* rates consisting of 0.08/kg plus 20% for non-preferential countries and duty free for most free trade agreement partners with the exception of Korea (\$0.017/kg + 4%), Oman (\$0.026/kg + 6%), and Australia (\$0.033/kg + 7.6%). Conversely, tariffs on non-preferential asparagus imports are purely *ad valorem*, with the United States applying a 5% duty on imports entering between September 15 and November 15 and a 21.3% duty on imports entering in any other month.

A limitation of the USITC customs values is that the calculation of the AVE tariff is limited to products with non-zero import values. If Argentine grapes were exported in 1996 but disappeared in 2006 (category 2), then calculation of the AVE tariff change absent data on duties collected in 2006 is not feasible. Similarly, missing tariff data also occur for extensive margin trade (category 4) in the initial year (1996) and the no trade margin (category 1) in both years (1996 and 2006).

To overcome this issue we develop a two-step approach. First, we search for any two data points with observable tariff information between the beginning and ending years in our sample (1996 and 2006). When trade occurs in at least two or more years between 1996 and 2006 for a given country-HS6 commodity pair, tariff changes are computed as the difference between the last and first year that trade occurs. Second, we replace the missing observations of tariff changes with zero when there is potential for trade.[16] That is, if an exporting country has the potential to export commodity k but there are no observations to calculate an AVE tariff change, we assume there is no change in tariff for that country-product pair. However, because of the sensitivity of this assumption, we also report estimation results that do not include observations when missing tariff changes are replaced with zeros.

Table 2 reports summary statistics for U.S. tariff changes defined as the ending year (2006) tariff minus the beginning year (1996) tariff and other variables used in the model. There were 5,039 AVE tariff reductions that occurred at the 6-digit HS country-commodity level over 1996–2006, 2,573 tariff increases, and 11,571 observations where the AVE tariff remained unchanged. Thus, nearly 40% of country-commodity pairs experienced a different *ad valorem* tariff equivalent in 2006 compared to 1996, and 66% of this share (5,039) were in the form of tariff reductions. Important examples of tariff liberalization in our sample include raspberries from Turkey, cherries from China, grape wines from Belgium, sunflower seeds/oil from Turkey, cocoa powder from the United Kingdom, olives and fresh cheese from Brazil, and grape juice and margarine from Argentina. These products experienced the highest absolute reduction in the AVE between 1996 and 2006, and some of these products experienced relatively high growth rates along the extensive margin. For example, Argentinian grape juice comprises 3.6% of the share of all newly traded goods on a value basis.

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[15] Other provisions include zero duties on most (but not all) products for countries with preferential trading programs with the United States, including Bahrain, Canada, Mexico, Australia, Peru, Columbia, Morocco, Korea, and Oman.

[16] In our sample, if an origin country o exports a commodity k at least once over ten years, we consider country o to have the potential to trade commodity k.

Table 2. Summary Statistics by Exporting Category

	Trade Category			
Variable	**Category 1: No-Trade Margin**	**Category 2: Disappearing Margin**	**Category 3: Intensive Margin**	**Category 4: Extensive Margin**
Log Distance				
Mean	8.89	8.81	8.88	8.73
Stdev	0.51	0.64	0.54	0.78
Min	6.31	6.31	6.31	6.31
Max	9.69	9.69	9.69	9.69
Tariff Change ($t^{2006} - t^{1996}$)				
Mean	−0.003	−0.001	−0.012	−0.005
Stdev	0.073	0.119	0.110	0.094
Min	−2.556	−1.000	−1.857	−1.009
Max	2.320	2.623	0.674	1.250
GDP Growth ($t^{2006} - t^{1996}$)				
Mean ($ Bil.)	$138	$197	$198	$299
Stdev ($ Bil.)	$278	$333	$357	$427
Min ($ Bil.)	−$349	−$349	−$349	−$349
Max ($ Bil.)	$1,857	$1,857	$1,857	$1,857
N (per trade category)	9,144	1,990	3,401	4,648

Notes: Category 1 is defined as U.S agri-food imports with zero trade in both 1996 and 2006. Category 2 is defined as U.S. agri-food imports with positive trade in 1996 but zero trade in 2006. Category 3 is the set of U.S. agri-food imports with positive trade in 1996 and 2006. Category 4 is the set of U.S. agri-food imports with zero trade in 1996 and positive trade in 2006.
Source: Authors' calculations from USITC trade data.

Results

The econometric results are organized in two sections. Section one presents the results from estimating a logit model conditional on tariff changes to understand better the intensive and extensive margins of U.S. agri-food imports.

Section two estimates the extended multinomial logit model (equation 13) with all four unordered potential categories of exporting as well as the aforementioned scenario that drops the no-trade category because of data limitations and replaces the benchmark category with the more stable continuously traded product category. Finally, as pointed out by a reviewer, it is problematic to refer to the continuously traded category as the intensive margin because initially we do not distinguish whether continuous trade was higher or lower in 2006 compared to 1996. In the final scenario we attempt to shed light on this point by splitting the continuously traded category into two outcomes: (i) continuously traded goods where the level of trade was higher in 2006 compared to 1996 (higher trade intensity) and (ii) continuously traded goods where the level of trade was lower in 2006 compared to 1996.

In both sections we examine the robustness of our findings to alternative beginning and ending year periods and our assumption regarding missing AVE tariff values. All regressions include grouped country and/or commodity dummy variables.[17]

[17] Grouped commodity and country *d*ummies are based on the frequencies with which they are exported to the United States at the HS4-digit level.

Logit Model of Exporting Status

We begin by investigating the effect of tariff changes on the probability of exporting. Columns (1)–(3) of table 3 report the marginal effects along with robust standard errors in parentheses. The marginal effects of the difference in the log of exporters' GDP are statistically significant with the correct sign, as expected. A higher percentage growth in GDP of exporting countries leads to the higher probability of exporting by 0.08 using our preferred specifications in columns 2 and 3 (table 3). The marginal effect of the logarithm of distance has the correct negative sign and is statistically significant. As expected, distance—as a proxy for shipping costs—decreases the probability of exporting. The indicator variable *Status* has the largest positive and statistically significant impact on the probability of exporting agri-food products to the U.S. market. This demonstrates that if good k was exported by country *o* in 1996, the probability of exporting the same product in 2006 increases by approximately 0.40 (columns 1–3).

For each scenario in table 3, the marginal effects of U.S. agri-food tariff changes are reported separately for the intensive and extensive margins by interacting the AVE tariff change variable with the status variable. Two interesting results emerge. First, tariff reductions increase the probability of exporting along both the intensive (*Status*= 1) and extensive (*Status*= 0) margins.[18] Put another way, a one-unit increase in AVE tariffs reduces the likelihood of exporting by 0.163 to 0.187 for newly traded products (i.e., varieties that were traded in 2006 but not in 1996) and by 0.086 to 0.099 for continuously traded products (i.e., varieties that were traded in both 1996 and 2006). Second, while the marginal effects conditional on each exporting status are statistically significant, their magnitudes are quite different. For newly traded goods, the magnitude of the marginal effect on the probability of exporting is twice as large as continuously traded products. Thus, tariff reforms appear to have a significant positive effect on the probability of exporting, but the effects are more pronounced for newly traded products.

Even though the initial results are encouraging, it could be argued that the estimates may be sensitive to the selection of the beginning (1996) and ending year (2006) from which to define continuously and newly traded goods (columns 4 and 5). Further, it is also of interest to see whether the results vary systematically with exporters' development status (columns 6 and 7). The results for the extensive margin of exports are robust and statistically significant for each begin-and-end year combination and level of exporter development. Moreover, for the alternate begin and/or end year combinations, the extensive margin marginal effects are nearly 1.5 times larger than the 1996/2006 sample. While the marginal effects of tariff changes have the correct sign for continuously traded goods (*Status*= 1), they are statistically significant only in the case of exports from high-income economies, which matches our earlier description based on table 2. In summary, it appears that U.S. agri-food trade liberalization in the form of tariff changes has more of an effect on whether a country trades at all than on whether a country continues to trade.

Results of Multinomial Logit Model (MNL)

While the logit framework was useful in determining how tariff changes affect the intensive and extensive margins of U.S. agri-food imports, it did not consider two other margins of trade: the disappearing and no-trade margins. Conceptually, an increase in tariffs or tariffs that witnessed no change but remain at high levels could lead to products disappearing from or never entering the U.S. agri-food market. In this subsection we discuss the results from estimation of a multinomial logit model with four unordered export categories: Category 1 – no trade margin; Category 2 – disappearing margin; Category 3 – new goods margin; and Category 4 – continuously traded margin. For identification purposes, category 1 defines the base outcome.

[18] Because the tariff change variable is defined as the 2006 tariff minus the 1996 tariff a reduction in tariffs over this time period yields a negative tariff change. If more negative tariff changes (a smaller number) are associated with a higher likelihood of exporting, we therefore expect the coefficient on tariff changes to be negative.

Table 3. Logit Model Results of U.S. Agricultural and Food Product Imports, 1996–2006

	Full Sample					Sub-Sample	
						High-Income Countries	**Low-Income Countries**
Estimation Method	**Logit Model Marginal Effect**			**Logit Model Marginal Effect**		**Logit Model Marginal Effect**	
	1	**2**	**3**	**4**	**5**	**6**	**7**
Fixed Effects[a]	Grouped Commodity	Grouped Country	Grouped Commodity and Country	Grouped Commodity and Country		Grouped Commodity and Country	
Initial Year	1996	1996	1996	1998	1996	1996	1996
End Year	2006	2006	2006	2008	2008	2006	2006
Variable							
Status	0.428***	0.401***	0.391***	0.396***	0.382***	0.423***	0.430***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.000)	(0.000)
Δ*Tariff* (*Status* = 0)	−0.187***	−0.175***	−0.163***	−0.237***	−0.214***	−0.180***	−0.194**
	(0.048)	(0.048)	(0.047)	(0.053)	(0.047)	(0.001)	(0.041)
Δ*Tariff* (*Status* = 1)	−0.099*	−0.086	−0.090*	−0.049	−0.07	−0.096*	−0.115
	(0.055)	(0.056)	(0.057)	(0.055)	(0.059)	(0.100)	(0.514)
log *Dist*	−0.024***	−0.012**	−0.017***	−0.025***	−0.016***	−0.026***	0.003
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.000)	(0.802)
Δlog *GDP*	0.016*	0.081***	0.078***	0.045***	0.059***	0.011	0.053**
	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.337)	(0.015)
N	19,183	19,183	19,183	19,545	19,183	14,662	4,521
Pseudo-R^2	0.139	0.147	0.155	0.153	0.146	0.138	0.126
LR	3,588.4	3,836.1	4,029.4	4,052.9	3,801.7	2,784.1	737.5
Pr > Chi^2	0	0	0	0	0	0	0

Notes: : *Status* is an indicator variable equal to 1 if exporter *o* exported product *k* in 2006, and 0 otherwise, Δ*Tariff* denotes 2006 tariff minus 1996 tariff, log *Dist* denotes the natural logarithm of distance, and Δlog *GDP* denotes the 2006 exporter GDP minus the exporter's 1996 GDP. Single, double, and triple asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% level. Robust standard errors are in parentheses.

[a] Fixed Effects Included: Grouped commodity at hs4/ Grouped countries (based on the number of times a particular country and commodity trades with the United States).

Table 4. Multinomial Logit Results of U.S. Agricultural and Food Products, 1996–2006

Estimation Method	Alter Fixed Effects			Change Begin/End Year		Modified
	Multinomial Logit Model: Base Outcome = Category 1 (No Trade Margin)					Intensive Margins
	1	2	3	4	5	6
	Grouped Commodity	Grouped Countries	Grouped Commodity/ Grouped Countries	Grouped Commodity/ Grouped Countries		Grouped Commodity/ Grouped Countries
Initial Year	1996	1996	1996	1998	1996	1996
End Year	2006	2006	2006	2008	2008	2006
Variable	Disappearing Goods					
Δ*Tariff*	0.040*	0.038*	0.040*	0.015	0.014	0.040*
	(0.025)	(0.024)	(0.025)	(0.027)	(0.026)	(0.025)
log *Dist*	−0.015***	−0.016***	−0.016***	−0.004	−0.015***	−0.015***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Δlog *GDP*	−0.046***	−0.040***	−0.040***	−0.024***	−0.039***	−0.046***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
	Extensive Margins					
Δ*Tariff*	−0.107***	−0.104***	−0.103***	−0.121***	−0.126***	−0.110***
	(0.030)	(0.030)	(0.029)	(0.031)	(0.029)	(0.030)
log *Dist*	0.016***	0.018***	0.016***	0.009*	0.020***	0.016***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Δlog *GDP*	0.051***	0.059***	0.058***	0.043***	0.056***	0.058***
	(0.008)	(0.009)	(0.009)	(0.008)	(0.007)	(0.008)
	Intensive Margins					Trade 96 > Trade 06[a]
Δ*Tariff*	−0.051*	−0.030	−0.025	−0.027	−0.043	0.064***
	(0.034)	(0.032)	(0.031)	(0.033)	(0.031)	(0.018)
log *Dist*	−0.078***	−0.059***	−0.063***	−0.056***	−0.063***	−0.017***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)
Δlog *GDP*	−0.098***	0.009***	0.007	−0.015*	−0.023***	−0.026***
	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.006)
	Intensive Margins					Trade 96 < Trade 06[a]
Δ*Tariff*	–	–	–	–	–	−0.089***
						(0.027)
log *Dist*	–	–	–	–	–	−0.054***
						(0.004)
Δlog *GDP*	–	–	–	–	–	0.033
						(0.009)
N	19,183	19,183	19,183	19,545	19,183	19,183
Pseudo-R^2	0.014	0.040	0.049	0.044	0.049	0.045
LR	676	1,900	2,300	2,132	2,317	2,366
Pr > Chi^2	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Δ*Tariff* denotes 2006 tariff minus 1996 tariff, log *Dist* denotes the natural logarithm of distance, and Δlog *GDP* denotes the 2006 exporter GDP minus the exporter's 1996 GDP. Single, double, and triple asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% level. Robust standard errors are in parentheses. Fixed Effects Included: Grouped commodity at hs4 and Grouped countries (based on the number of times a particular country and commodity trades with the United States). [a] Trade 96 > Trade 06 (Trade 96 < Trade 06) refers to intensive margin outcome when exports by region *o* of commodity *k* are less (more) in 2006 compared to 1996.

Columns (1)–(3) of table 4 present the marginal effects of the three categories of exporting. Similar to the previous results, distance and GDP growth are generally of the correct sign and statistically significant. For example, higher GDP growth of exporting countries between 1996 and 2006 is associated with a significantly lower probability of disappearing goods (category 2) and higher probability of new (category 3) and continuously traded (category 4) goods (although the results are more fragile with respect to income growth in the latter category). While distance is statistically significant, it has the expected sign only for continuous trade along the intensive margin (category 4) (columns 1–3). For the disappearing (new goods) margin, a one-unit increase in distance between the United States and its trading partners results in a lower (higher) probability of disappearing (new) products. While somewhat counterintuitive, this result likely reflects the fact that U.S. trade with its North American neighbors, Canada and Mexico, occurs predominantly along the intensive margin and has been stable for many years. The positive and statistically significant marginal effect of distance on the extensive margin is likely because new goods trade is coming from more distant trading partners.[19]

The results for tariff changes are more illuminating. First, the marginal effects for the disappearing margin are positive and significant suggesting that more restrictive tariffs (i.e., tariff changes that are less negative or more positive) increase the probability of export failures. More specifically, a one-unit increase in the tariff change between 1996 and 2006 decreases the probability of disappearing goods by roughly 0.04 percentage points (columns 1–3). Second, tariff changes continue to exert a relatively large and statistically significant positive impact on the extensive margin. Here, a one-unit increase in the AVE tariff change between 1996 and 2006 decreases the probability of exporting new goods by 0.10 (columns 1–3) to 0.12 (columns 4–5) depending on the specification (table 4). Third, tariff reductions also seem to influence the likelihood of maintaining a presence in the market (intensive margin), although the magnitudes of the marginal effects for this category are about half those of category 3 (the extensive margin).

In columns 4 and 5 of table 4, we examine the robustness of our results to the chosen beginning and end year of our sample period. In column 4 we change both the beginning year and ending year (1998–2008) and column 5 changes only the end year (1996–2008). These changes produce consistent results although the marginal effect of tariff changes are not statistically significant for disappearing goods and marginally significant for continuously traded goods (1996–2008). For extensive margin trade, on the other hand, the results are robust and consistently point to the fact that tariff changes appear to be an important explanation for the growth of new agri-food import varieties.

An important point raised by one reviewer is that our intensive margin category of continuously traded products does not establish whether tariff changes lead to higher or lower levels of continuous trade in 2006 compared to 1996. In column 6 of table 4, we shed light on the way in which tariff changes impact the level of continuously traded products by splitting the intensive margin category into two outcomes—one in which continuous trade was lower in 2006 compared to 1996 (outcome 4, $Trade\ 96 > Trade\ 06$) and one in which continuous trade was higher (outcome 5, $Trade\ 96 < Trade\ 06$). The results are robust. Not only do tariff reductions increase the probability of higher intensive margin agri-food exports in 2006 by 0.089 percentage points (outcome 5), the tariff change coefficient has the opposite sign for lower intensive margin exports (outcome 4), suggesting that higher tariffs in 2006 compared to 1996 increase the probability of lower export values by 0.064 percentage points.

Further, the absolute values of the magnitude of the coefficients for higher and lower intensive margin categories are not equal. The tariff change coefficient (-0.89) on the probability of higher intensive margin exports is nearly 1.5 times larger in absolute value than the lower intensive margin category (0.64). Thus, tariff reductions appear to have a bigger impact in absolute terms on the probability of having higher exports of continuously traded products than tariff increases do on the probability of having lower exports. Finally, the magnitude of the tariff change coefficient for lower intensive margin exports is consistent in magnitude and significance with disappearing products (0.064 versus 0.040, respectively). That is, higher tariffs in 2006 compared to 1996 increase the likelihood of lower levels of intensive margin exports by roughly the same extent as products disappearing from the market altogether.

[19] A few studies have focused on the distance effect on the extensive and intensive margin of trade. For instance, Lin and Sim (2012) provide some evidence of increasing (decreasing) extensive (intensive) margins at longer (shorter) distances. Further evidence of this is also provided in Cheong, Kwak, and Tang (2016). The negative marginal effect for the disappearing margin is more challenging to explain but could reflect the fact that more distant trading partners export fewer products because of higher shipping costs and thus have fewer product turnovers (see also Besedeš and Prusa, 2006).

Table 5. Modified Multinomial Logit Results of U.S. Agricultural and Food Products, 1996–2006

Estimation Method	Alter Fixed Effects Multinomial Logit Model Marginal Effect			Change Begin and/or End Year Multinomial Logit Model Marginal Effect	
	1	2	3	4	5
	Grouped Commodity	Grouped Countries	Group Commodity/ Group Countries	Grouped Commodity/Grouped Countries	
Initial Year	1996	1996	1996	1998	1996
End Year	2006	2006	2006	2008	2008
Variable	**Marginal Effect**				
	Disappearing Goods				
Δ *Tariff*	0.096**	0.089**	0.095**	0.068*	0.090**
	(0.040)	(0.039)	(0.041)	(0.041)	(0.043)
log *Dist*	0.001	−0.008	−0.005	0.011*	−0.004
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Δlog *GDP*	−0.054***	−0.083***	−0.081***	−0.046***	−0.070***
	(0.013)	(0.013)	(0.013)	(0.012)	(0.012)
	Extensive Margins				
Δ*Tariff*	−0.090**	−0.101**	−0.108***	−0.113***	−0.119***
	(0.046)	(0.046)	(0.046)	(0.047)	(0.047)
log *Dist*	0.073***	0.066***	0.067***	0.044***	0.070***
	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)
Δlog *GDP*	0.161***	0.094***	0.095***	0.083***	0.113***
	(0.014)	(0.015)	(0.015)	(0.014)	(0.013)
	Base Outcome: Intensive Margins				
N	9,957	9,957	9,957	10,119	9,923
Pseudo-R^2	0.014	0.032	0.037	0.035	0.040
LR	295.5	661.9	764.5	747.9	833.8
Pr > Chi^2	0.000	0.000	0.000	0.000	0.000

Notes: Category 4—continuous or intensive margin trade—serves as the base outcome and the no trade category is omitted from estimation. Δ *Tariff* denotes 2006 tariff minus 1996 tariff, log *Dist* denotes the natural logarithm of distance, and Δlog *GDP* denotes the 2006 exporter GDP minus the exporter's 1996 GDP. Single, double, and triple asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% level. Robust standard errors are in parentheses.
[a] Fixed Effects Included: Grouped commodity at hs4/ Grouped countries (based on the number of times a particular country and commodity trades with the United States).

Removing the No-Trade Category

As a final check on the sensitivity of our results, we revisit our assumption of inserting zero tariff changes when data on AVE tariffs were missing in the USITC database. In this scenario we eliminate category 1, the "no trade" margin since this category accounts for nearly all missing AVE tariff data and replace it with category 4, continuously traded goods, which now serves as the benchmark outcome. Because the intensive margin category is the most stable and has the most complete and reliable tariff data, this modification should increase estimation efficiency. The results are contained in table 5.

Perhaps the most interesting feature of this scenario is that the marginal effects for disappearing and extensive margin trade are all of the correct sign and statistically significant. Further, on an absolute basis the magnitudes of the probability of disappearing and new goods trade are nearly identical and complement each other (0.090 and −0.119, respectively). Thus, while U.S. tariff liberalization increases the probability of exporting along the extensive margin, it simultaneously decreases the probability of disappearing goods by roughly an equal magnitude (0.068 to 0.096) (table 5).

Finally, while not reported to save space, we also estimated two additional specifications as suggested by a reviewer.[20] First, the marginal effects of new, disappearing, and continuously traded

[20] The results of which are available from the authors by request.

products could be picking up SPS and/or TBT regulatory barriers as opposed to tariff changes because of the prevalence of non-tariff SPS measures affecting agri-food trade. The extent to which our results are biased, however, depends on the degree to which SPS and TBT measures are correlated with tariff changes, for which the evidence is tenuous (see Kee, Nicita, and Olarreaga, 2009; Beverelli, Neumüller, and Teh, 2014). Moreover, the lack of high-quality NTM data with consistent time and country coverage (1996–2006) precludes explicit controls in the model.

However, in an attempt to determine whether our tariff change coefficients are impacted by SPS- and TBT-related measures, we re-estimated the multinomial logit model by dropping all HS6-digit beef, pork, poultry, and dairy live and processed animal product codes (HS2-digit chapters 01, 02, and 04). As discussed in the model section, dropping these product codes was driven by the overwhelming prevalence of animal disease related SPS concerns over our sample period (Grant and Arita, 2016).[21] The estimation results with grouped commodity and country fixed effects on this sub-sample of the data produced robust and consistent results. Tariff reductions increase the likelihood of new goods (*coeff.* $= -0.09^{***}$) and continuously traded goods (*coeff.* $= -0.07^{***}$) and reduced the likelihood of disappearing trade (*coeff.* $= 0.15$). The latter result for disappearing products was only marginally significant, suggesting that the full sample—including animal products—for this category may be driven to some extent by NTMs.

Second, a reviewer noted that the model should include controls for changing U.S. tastes and preferences between 1996 and 2006. For example, U.S. olive oil imports have grown more than threefold since 1996: from \$200 million to over \$700 million in 2006. However, with one importer (the United States), changes in the representative consumers' tastes and preferences are partially controlled for by commodity-specific fixed effects. In addition, if products are differentiated by country of origin, then specifications that include grouped commodity-by-country fixed effects will mitigate some of this concern. However, to address this comment more directly, we estimated a multinomial logit model inclusive of import expenditure shares. First, we calculated the import share of each exporter-by-HS6-digit product in each HS2-digit industry chapter for both 1996 and 2006. Second, we took the difference of the import shares over the two points in time and added this variable to the model to control for products that witnessed significant import growth (or decline).

Adding this variable changed the results very little. The probability of new goods extensive margin trade increases and the probability of disappearing goods decreases for each one-unit increase in the difference of the import expenditure share. Further, the sign and significance of our tariff change policy variable changed very little, with the addition of import expenditure shares with a coefficient of -0.09 (*p-value* $= 0.01$) and 0.03 (*p-value* $= 0.33$) for new and disappearing goods, respectively.

Conclusion

This article investigated an important question concerning international agri-food trade: how do trade policies in the form of tariff changes affect the probability of continuous, disappearing, and newly traded U.S. agri-food imports? Recent contributions to the theoretical and empirical trade literature emphasize firm-level productivity differences and the intensive and extensive margins of trade—the so called new-new trade theory (Melitz, 2003; Chaney, 2008; Helpman, Melitz, and Rubinstein, 2008). While these studies have pushed the frontier of international economics research, relatively few studies have examined how explicit trade policies impact the likelihood of trade along each margin (see Beverelli, Neumüller, and Teh, 2014, for an application of trade facilitation on the margins of trade). We extended the empirical literature by developing a multinomial logit framework

[21] There are other prominent SPS-related concerns about plant-based and other products such as apples (Japan), lemons (Argentina), and avocados (Mexico) and TBT-related concerns about labelling and certification of Genetically Modified Organisms (GMOs). However, some of these—particularly GMOs—affect U.S. agri-food exports, whereas this study focuses on U.S. agri-food imports.

to assess how detailed product-line tariff changes on U.S. agri-food imports affect the probability that country-commodity pairs will enter, exit, or maintain a presence in the U.S. import market.

The empirical results provide robust evidence that agri-food tariff liberalization enhances the entry of country-product export pairs into the U.S. agri-food market. Extending the analysis to a multinomial setting, our most important findings are as follows. First, the marginal impact of tariff reductions on new exports is two times greater than the impact on continuously traded goods, suggesting that the extensive or new goods trade margin is more sensitive to changes in trade policy than that of established products already in the market. The larger impact of tariff changes on new exports compared to existing exports indicates product variety (and availability) gains, which are an important source of consumer welfare (Broda and Weinstein, 2006; Feenstra and Kee, 2007; Bernard, Redding, and Schott, 2011). Second, by directly linking detailed country-product variation in tariff changes, we found that trade liberalization increases the product variety set vis-à-vis a higher likelihood of extensive margin trade while simultaneously reducing the probability of disappearing varieties. Thus, our findings likely reflect the underlying dynamics of heterogeneous firms, where we observe new products traded along the extensive margin, and simultaneously a lower probability of disappearing products in the wake of U.S. tariff reductions. While the Melitz (2003) model is based on firm-level data, our disaggregated country-level data, with explicit records denoting zero trade flows for specific agri-food products, suggests selection effects into (and out of) agri-food exporting along the lines of Helpman, Melitz, and Rubinstein (2008).

The policy implications of this article are threefold. First, exporters gain from tariff reductions in that they can establish new product relationships with the United States and enhance their U.S. and potentially their global supply chains. For developing countries with interests in exporting agricultural products, tariff reductions lead to enhanced market access opportunities and a reduced likelihood of disappearing products, leading to a more reliable and sustainable source of export revenues. Second, in terms of product variety and availability, consumers gain access to consistent food supplies year-round, lower prices of new and existing imported products when tariffs are reduced, and reduced probabilities of disappearing product varieties. Third, if consumers value variety in consumption as Broda and Weinstein (2006) have found, then on net we view our results as a positive welfare gain for U.S. agri-food consumers.

Finally, while we restricted our attention to the impact of tariff changes on the margins of U.S. agri-food imports, other policy instruments, such as NTMs, are likely to have a significant impact on the way in which export growth occurs. Although difficult in terms of data needs, we view the impact of NTMs on the margins of trade as a fruitful area of future research.

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