Multi-product exporters:
Product churning, uncertainty and export discoveries

Leonardo Iacovone[1] Beata S. Javorcik[2]

Recent theoretical work focuses on firm-product-level heterogeneity and the role uncertainty in shaping international trade. This paper contributes to the literature by examining *product-level* dynamics *within firms* in the context of Mexican trade integration under NAFTA. The data show intense product churning within firms and confirm the existence of within-firm product heterogeneity. The data indicate that new exporters enter foreign markets with a small number of varieties, most of which were previously sold at home, and with a small export small volume. It also finds that export discoveries are relatively rare and are imitated within a short period of time.

Keywords: Multi-product firms, core competence, firm scope, product heterogeneity, export diversification, entry into exporting, Mexico, NAFTA

JEL codes: F12, F13, F14

[ATT: PRINTER]
Suggested pagehead title: Multi-product exporters in Mexico

To deepen the understanding of the complex interactions between globalization and economic development, trade economists have recently increased their interest in two related areas: the link between micro-heterogeneity and aggregate export response, and the role uncertainty in international trade. It has been recognized that progress in both areas can contribute to devising more effective policies for promoting growth (Hausmann and Rodrik, 2003; Bartelsman and Doms, 2000; Tybout, 2000).

Developments in the first area encompass groundbreaking contributions that allowed for the incorporation of firm-level heterogeneity into trade models (Melitz, 2003; Yeaple, 2005; Bernard and al., 2007), innovative empirical studies evaluating firm-level responses to trade reforms (Pavcnik, 2002; Trefler, 2004; Schor, 2004; Fernandes, 2007; Harrison, 2007), and pioneering work explaining the determinants of geographical expansion of exporters (Eaton et al., 2004a,b; Eaton et al., 2008).

More recently, the theoretical literature has moved even further by unwrapping firms and incorporating another layer of heterogeneity, namely heterogeneity at the product level, and relating it to international trade (Arkolakis and Muendler, 2009; Baldwin and Gu, 2009; Bernard et al., 2006; Eckel and Neary, forthcoming; Feenstra and Ma, 2008; Nocke and Yeaple, 2006; Mayer et al., 2009). These models capture endogenous dynamics across firms (e.g. exporting activities undertaken by some firms versus the exclusive focus on the domestic market by others) as well as within firms (e.g. some products being exported but not others). The aggregate responses to policy changes emerge as a combination of these multiple dynamics.

Progress in the literature focusing on the role uncertainty in international trade has been stimulated by the need to explain the recently documented patterns in sectoral trade: the predominance of smaller flows after establishing new trade relationships, a large number of short-lived trade relationships, and a limited number of new trade relationships that manage to survive and grow. The literature in this area, which originated with the contribution by Rauch and Watson (2003), emphasizes the role of information asymmetries and uncertainty in shaping the decisions of exporters and determining patterns of trade (see Araujo and Ornelas, 2007; Albornoz et al., 2008).

Yet due to data constraints, there is limited evidence that can corroborate or contradict the predictions emerging from the above mentioned theories. Do firms frequently adjust the number of products exported or produced? Do they do so in response to changes in trade policy? Do exporters entering export markets for the first time start with a small number of products and low export volumes? What types of products do new exporters tend to sell abroad?

In this paper, we rely on a unique dataset at the firm-product level to examine firm- and product-level dynamics in the aftermath of a profound liberalization. Our dataset is unique in that it includes information on both exports and domestic sales and covers multiple years.[3] Our focus is on the Mexican economy after the implementation of the North American Free Trade Agreement (NAFTA). The aim of our study to shed light on how well the predictions

of the theoretical literature match the patterns observed in Mexico. As many of the models produce predictions related to bilateral trade liberalization, Mexico is a very suitable setting for such an analysis. Focusing on the period after NAFTA reforms gives us a unique window, a magnifying lens, to study how multi-product firms respond to suddenly finding themselves in a more open and globalized setting. These irreversible trade reforms together with a dramatic exogenous shock, a sharp devaluation of the peso, expanded the access of Mexican firms to the US market and stimulated large responses at the firm- and product-level. In fact, the threefold increase in Mexican exports between 1993 and 2002 and growing export diversification in the post-NAFTA period have already been documented by studies relying on aggregated trade statistics (Romalis, 2007; Feenstra and Kee, 2007).

Several interesting findings, that broadly match the theoretical predictions of models of multi-product firms, emerge from our analysis. We document intense product churning at the firm level and show that it is systematically related to trade liberalization. This supports the conclusions of the recent theoretical models suggesting that product churning within the firm is another margin of adjustment taking place in response to globalization (e.g., Bernard et al., 2006; Eckel and Neary, forthcoming; Nocke and Yeaple, 2006). As predicted by the theory, we also show that firms are more likely to discontinue domestic sales of their fringe varieties than of their core ones.

Further, we document patterns consistent with the predictions of theoretical models where uncertainty and information asymmetries shape international trade flows (Rauch and Watson, 2003). We show that new exporters break into export markets with a single variety and a very small volume (relative to their total sales of the variety). According to Rauch and Watson (2003), starting small allows importers to test the credibility of their foreign partners or the suitability of their products in the export market. We also document that conditional on survival, the volume of exports grows over time.

The presence of uncertainty facing future exporters manifests itself in several ways. First, new exporters overwhelmingly enter a foreign market with a variety already sold at home. Second, we observe that export discoveries, i.e., products not previously exported from Mexico, constitute a relatively low share of new export varieties added by exporters. However, the footsteps of a producer introducing an export discovery are followed by other exporters within a short period of time. Finally, we show that a vast percentage of export varieties do not survive for more than a year in the foreign market, though the survival rate increases with the variety's tenure in the export market.

Our study is related to the small but fast growing literature documenting patterns observed at the firm-product level. It includes the pioneering work by Bernard and al. (2006 and forthcoming). The former study examines production patterns in general. The latter study is primarily a theoretical contribution but includes some empirical results on the link between the intensive and the extensive margins of exports. Both studies are based on the US data. Our study is also related to recent studies analyzing dynamics of multi-product firms from developing countries, which focus on somewhat different issues (Goldberg and al., 2009; Arkolakis and Muendler, 2009).

We believe that our findings can be informative to policy makers and researchers interested in the link between the structure of a country's exports and growth (see an emerging literature started by Hausmann and al. (2007)). Understanding the dynamics of introducing new export varieties at the firm level constitutes the first step in understanding how a country can upgrade its export structure and what policies, if any, can stimulate this process.

This paper is structured as follows. The next section describes the data. Section two documents variety churning within a firm and links it to changes in trade policies. Section three focuses on uncertainty, information asymmetries and search costs, while section four discusses export discoveries. The last section presents the conclusions.

1. Data

Our analysis is based on data from the Monthly Industrial Survey (*Encuesta Industrial Mensual* (EIM)) administered by the Instituto Nacional de Estadística Geografía e Informática (INEGI) in Mexico in order to monitor short-term trends. The survey is run in parallel with the Annual Industrial Survey (*Encuesta Industrial Anual* (EIA)) on the same sample of establishments.

The unit of observation is described as "the manufacturing establishment where the production takes place." Each establishment is classified in its respective class of activity (*clase*) based on the basis of its principal product. The *clase* or class of activity is equivalent to the 6-digit level Mexican System of Classification of Productive Activities (CMAP). Thanks to a one-time effort to identify multi-plant firms, we are able to identify establishments that belonged to the same firm in 2003.[4]

The EIM sample includes 6,291 establishments belonging to 5,493 firms operating in 205 *clases* of activity. The sampling framework is based on the 1993 industrial census. In each of the selected 205 *clases*, the survey samples the largest firms until the coverage reaches 85% of the sectoral output. In sectors with fewer than 20 plants, all entities are surveyed. Moreover, all establishments with more than 100 employees are automatically included in the sample. *Maquiladoras* are not surveyed by either EIM or EIA. Thus the surveys cover about 85% of Mexican industrial output produced by non-*maquiladora* establishments. The size of the sample decreases over time due to some establishments exiting the market. No systematic effort is made to replace exiting producers. This means that we observe exit but no entry in our data. The sample covers on average over 50% of total Mexican exports with the percentage covered increasing in the later years.

We use the EIM panel covering the period 1994-2003 which contains information on the value of total production, net sales and export sales. Particularly valuable for our purpose is the fact that the EIM collects information at the establishment-product level. Each *clase* contains a list of possible products, which was developed in 1993 and remained unchanged during the entire period under observation. The list includes 4,085 products of which 3,183 are actually

produced during the period under study. For instance, the *clase* Uniforms (identified by the CMAP code 322006) lists 18 products: sports uniforms, school uniforms, military uniforms, uniforms for doctors and nurses, uniforms for members of other organizations, generic uniforms for workers, safety uniforms for workers, other uniforms, laboratory coats, camisoles and shirts, headgear, uniforms for chefs, aprons, jackets, other work clothing, other sports clothing, other products not elsewhere classified, other subproducts not elsewhere classified. The *clase* of small electrical appliances (CMAP code 383304) contains 29 products, including vacuum cleaners, coffee makers, toasters, toaster ovens, 110 volt heaters and 220 volt heaters (within each group of heaters the classification distinguishes between heaters of different sizes: less than 25 litres, 25-60 litres, 60-120 litres, more than 60 litres). These examples illustrate the narrowness of product definitions and the richness of micro-level information available in our dataset.

As we are not interested in short-run trends, we aggregate monthly EIM data into annual observations. We also aggregate establishment-product-level data into firm-product-level information. In the case of multi-establishment firms with different establishment producing the same product, the figures are aggregated into one firm-product observation per year.[5]

We supplement the EIM data with the information on the establishment's age available from the EIA and with information on Mexican tariffs imposed on imports from NAFTA countries (obtained from Secretaría de Economía) and US MFN and NAFTA tariffs.[6] Tariff data, available originally at the 8-digit Harmonized System (HS) classification, are matched with the Mexican product-level classification.[7]

The number of firms in the sample varies between 5,493 in 1994 and 3,871 in 2003 (see Table 1). Between 1,402 and 1,889 firms are engaged in exporting. As indicated in Table 1, the number of varieties produced (hereafter, we will refer to each firm-product combination as a product variety) ranges from 18,079 in 1994 to 12,495 in 2003, while the number of exported varieties expands from 2,730 in 1994 to 3,160 in 2003, reaching the peak of 4,025 in 1998.

2. Is There Evidence of Variety Churning Being Another Margin of Adjustment?

Recent models of multi-product firms predict that product churning within the firm is another margin of adjustment taking place in response to globalization. In the model proposed by Bernard et al. (2006), product churning is due to firm-level productivity interacting with firm-product-specific competencies. A symmetric reduction in countries' fixed or variable trade costs will cause all firms to drop their lowest-competency varieties due to the general equilibrium influence of growing export opportunities on labour markets. At the same time, declining trade costs will result in an increase in both the proportion of varieties exporters sell abroad as well as their level of exports of each variety.

In Eckel and Neary (forthcoming), multi-product firms are characterized by core competence in the production of a particular variety and are less efficient in the production of varieties outside their core competence. Firms internalize demand linkages between varieties they produce. The presence of the cannibalization effect and core competencies leads to an adjustment in the range of varieties produced (firm scope). Opening of a country to international trade, which increases both the market size and the level of competition, will lead to a reduction in firm scope as firms drop their fringe varieties.

In the model of Nocke and Yeaple (2006), where firms differ in terms of productivity but all varieties produced within a firm are symmetric, multilateral trade liberalization will result in large firms decreasing their scope and small firms doing the opposite.

In this section, we provide support for the theoretical prediction of firms adjusting their scope in response to globalization, by documenting product churning at the firm-level taking place in the aftermath of trade liberalization under NAFTA. We begin by showing that just considering the average number of exported varieties per firm may be misleading because the relatively stable average hides a lot of action taking place at the variety level. The figures in Table 2 show a remarkable stability in the average number of exported varieties per firm, even in a period of profound changes as the one under analysis. In 1994, an average exporter sold 1.95 varieties abroad. During the period studied, this figure increased to 2.2 and remained around this level for about six years. The pattern appears to be even more stable for exporters in their second or later year of supplying foreign markets. During the period considered, the average firm in this group sent abroad between 2.18 and 2.26 varieties.

However, as depicted in Figure 1, these averages hide a lot of churching at the variety level, as many firms introduce new export varieties, drop existing ones or do both simultaneously. Each year about 250 to 700 producers introduce a new export variety. Between 250 and 400 firms drop an existing export variety.[8] A much smaller number, 30 and 90 firms simultaneously introduce a new export variety and drop an existing one.

To shed light on the magnitude of the churning relative to the total number of exported varieties, we apply the measure proposed by Davis and Haltiwanger (1992) to our context. More specifically, we define *export variety creation* as the number of new export varieties introduced at time t divided by the total number of varieties exported at t. Similarly, we define *export variety destruction* as the number of varieties ceasing to be exported at time t divided by the total number of exported varieties at t. We refer to the sum of the two as *gross churning* and to the difference as *net churning*.

As illustrated at the bottom of Table 3, *net churning* of 7.4% observed in the whole economy (this is the average over all years) is much lower that the 30% figure found for *gross churning*, the 19% figure for *export variety creation* and 11% for *export variety destruction.* High gross churning rates are observed in all 2-digit sectors ranging from the low of 20% in mineral based industries to 38% in textiles, garments and leather and 43% in wood products. *Export variety creation* ranges from about 13% in mineral based industries to 28% in wood products.

Export variety destruction (which accounts for exiting plants) varies between a low of 8% in other industries to a high of 16% in textiles, garments and leather.[9]

To check to what extent variety churning is related to trade reforms, in Figure 2 we plot the change in the number of exported varieties against the change in the 6-digit industry-level tariff imposed by the US on imports from Mexico. We find that industries experiencing a larger tariff decline saw a larger increase in the number of exported varieties, which is consistent with the theoretical prediction that a lower cost of sending goods abroad will encourage firms to export more varieties.[10]

Churning is not limited to just exported varieties. According to the theory, a lower cost of importing goods from abroad will lead to a decline in firm scope as firms drop their marginal varieties sold on the domestic market. However, this prediction is not corroborated by the industry-level data, as Figure 3 depicts a positive relationship between the decline in Mexican tariffs and the change in the number of varieties sold domestically. The observed pattern may due to the fact that sector-specific tariffs also include tariffs on inputs.[11] Thus the figure captures two opposing effects: increased competition facing domestically-produced varieties and access to a higher number of intermediate input varieties.

The theoretical prediction that in the aftermath of trade liberalization firms will drop their lowest-competency varieties pertains to firm behaviour (Bernard et al., 2006; Eckel and Neary, forthcoming), so next we turn to the firm-variety-level data. And indeed the prediction finds empirical support at the micro level. In Table 4, we regress an indicator variable equal to one if firm f will discontinue its sales of variety i at time t+1, and zero otherwise, on the importance of the variety i to firm f at time t. The importance is measured by the share of the variety i in the firm's f total sales at time t (variety relevance), the value of firm f's sales of variety i at t (variety sales volume) and firm f's share in the national sales of the product p to which variety i belongs (variety market share).[12] We also control for the firm's age (in the case of multi-establishment firms we use the age of the oldest establishment), the Mexican NAFTA tariff and the US NAFTA tariff specific to the product p at time t. The regression is estimated as a linear probability model and includes year and 6-digit industry fixed effects.[13]

The data indicate that fringe varieties are more likely to be discontinued than core varieties. The results are statistically significant at the 1% level for all three measures of variety importance. The data also suggest that older producers are less likely to discontinue production of a variety.[14] Further, we find a positive relationship between tariff protection (Mexican NAFTA tariff) and the probability of the variety's survival. The estimates on the interaction terms suggest that the effect of protection is stronger for core varieties. The last two findings are statistically significant in two of four specifications.[15]

Although the international trade literature has examined the patterns of introduction and discontinuation of export products and contrasted changes in the number of products exported with the changes in the volume of exports at the product level using national trade statistics (Hummels and Klenow, 2005; Besedes and Prusa, 2006 and 2007; Evenett and Venables, 2002), churning of export products at the firm level has not been extensively

documented before.[16] As we have shown in this section, relying on firm-product level data uncovers a lot of variation and patterns that are missed when more aggregated information is used.

3. Importance of Uncertainty, Information Asymmetries and Search Costs

Recent theoretical (Rauch and Watson, 2003) and empirical contributions (Besedes and Prusa, 2006) point towards the importance of information asymmetries, trust and search costs as crucial determinants of trade patterns. The existence of these factors is plausible explanation for why new entrants into export markets may make a relatively small contribution to their country's overall export growth.

In Rauch and Watson's (2003) model, search costs and information asymmetries lead importers from developed countries to start with small orders to test the credibility of an exporter located in a developing country. In an environment where potential trading partners are heterogeneous and there is incomplete information about their reliability, the buyer will need to gain confidence in the seller before awarding a large order. For this reason, in a newly established trading relationship the buyer may start with some trial orders in order to assess the reliability and quality of a new trading partner.[17]

These theoretical predictions find support in the Mexican data. We find that firms entering foreign markets for the first time start small in terms of the number of exported varieties and the export volume. This is illustrated in Figure 4 which relates the average number of export varieties to the firm's experience in export markets. The year when a firm begins to export is identified by zero on the horizontal axis. As illustrated in the figure, new exporters begin their sales in foreign markets with one or two export varieties (1.5 varieties on average). Two years later the average number of exported varieties increases to almost 2. The total number of varieties sold by the firm increases slightly in the year the firm enters foreign markets and remains stable afterwards.[18] New exporters also start small in terms of the export volume. Figure 5 indicates that first-year exports account for only a small fraction of a firm's total sales (about 12%). The volume of exports increases in subsequent years, getting close to 20% in the fifth year of exporting.

Rauch and Watson's (2003) model does not predict that all new trading relationships will start small but rather it postulates that there will be a whole distribution of starting volumes. A large extent of uncertainty will be associated with a distribution of starting volumes skewed to the left (i.e., more small orders). This appears to be the case in Mexico, as illustrated in Figure 6, which depicts the distribution of the export values of varieties in their first year of being exported, normalized by the total sales of the variety by a given firm. The distribution is skewed to the left indicating that most trading relationships start with small volumes.

A further piece of evidence supporting the importance of uncertainty comes from the observation that new exporters not only start small but also start by exporting varieties they have previously been selling on the domestic market. As evident from Table 5, in 79% of cases, firms enter foreign markets with a variety they sold domestically in at least one of the previous three years. In 75% of cases the variety was sold domestically within the past two years. Over two-thirds of firm sold the newly exported variety at home in the year before.

Starting with the variety already sold in the domestic market limits the risk faced by firms entering foreign markets for the first time. Should the export operation become unsuccessful they can divert the unsold goods to the Mexican market. While future exporters may need to upgrade the quality of their future export products (for evidence see Iacovone and Javorcik 2008), the cost of doing so is probably lower than the cost of starting production of a new product from scratch.

The risks faced by existing exporters are likely to be lower. They are familiar with the export markets and thus better positioned to predict how well a new variety will sell there. Moreover, thanks to their long-standing relationships with foreign buyers they may be able to obtain much more information on the sales prospects of a new variety. Past interactions with the foreign buyer may make it easier to assess how much their judgment may be trusted. It is also plausible that foreign customers request their Mexican partners to widen the assortment of exported goods or that active exporters introduce new export items in response to new business opportunities they have spotted while being active in foreign markets.

Thus it is not surprising that new exporters are more likely than established exporters to enter foreign markets with varieties previously sold at home. While on average 85% of new export varieties sold abroad by firms entering export markets for the first time were previously sold at home, the corresponding figure for established exporters is only 69% (see Table 6).[19]

The uncertainty about opportunities in export markets is also reflected in the fact that foreign sales of many varieties are discontinued quite quickly. This is illustrated in Table 7, which follows Brooks (2006) and presents export market survival rates of varieties introduced in a given year. Only about two-thirds of new export varieties are exported for more than one year. Between 46 and 60% of varieties (depending on the cohort) survive for at least three years in foreign markets. Only 37% of export varieties introduced into foreign markets in 1995 are still exported in 2003. Interestingly, as illustrated in Table 8, which presents annual survival rates, the survival rates are the lowest in the initial period. While only between half and two-third of varieties survive between the entry year and the subsequent period, between 76 and 88% survive between the second and third year after entry. Broadly speaking, the probability of continued presence in export markets, conditional on being exported at time t-1, increases with the time elapsed from the year of entry. These findings are consistent with the model of Araujo and Ornelas (2007) and the recent results based on product-level trade statistics or transaction-level data (Besedes and Prusa, 2006 and 2007; Eaton et al., 2008; and others).

4. Discovery

A theoretical model incorporating uncertainty and opportunities for imitation (Hausmann and Rodrik, 2003) predicts that we should witness a limited amount of export discovery, i.e., introducing into export markets a product that has not been exported from Mexico before. The theory predicts that firms potentially capable of producing a certain good will hold off until someone else introduces the product first and, having witnessed their success, they will imitate quickly.

Consistent with these predictions, we show in Table 9 that export discovery is a relatively rare phenomenon. We find that most firms introduce in export markets a product that others have already been exporting. Furthermore, we find that once a firm has introduced an export product previously not exported by any other firm, other firms follow quickly (though, admittedly, we do not have a benchmark to which we can compare the speed of imitation). On average, a discovery is simultaneously introduced by more then one firm (that is, between one and two firms introduce a variety that is an export discovery). For approximately half of the new discoveries, an additional firm starts exporting the same product in the following year. The same happens one year later. However, three years after the discovery takes place the rate of diffusion slows down but continues until at least the eighth year which is the longest time period our sample allows us to consider (see Table 10).

5. Conclusions

In the past few years, the international trade literature has made a lot of progress in understanding the link between micro-heterogeneity and aggregate export response as well as in modelling the role uncertainty in international trade. In this paper, we contribute to the literature by examining within-firm product-level dynamics in the aftermath of a profound liberalization. Our objective is to shed light on how well the predictions of the theoretical literature match the patterns observed in Mexico after it joined NAFTA.

Our results are consistent with the theoretical predictions emerging from the recent models of multi-product firms. We uncover the existence of intense variety churning at the firm level and show that it is systematically related to exogenous trade reforms. This supports the predictions of the recent theoretical models emphasizing that changes in firm product scope are another margin of adjustment taking place in response to changes in trade costs.

We also document micro-level patterns consistent with the predictions of models that emphasize the role of uncertainty and information asymmetries in shaping trade patterns. We show that new exporters break into export markets with between one and two varieties and a small volume. We document a large dispersion in the distribution of variety-level export volumes normalized by variety-level total sales. As expected, we find that the distribution is skewed to the left, which is suggestive of the presence of uncertainty in new trade relationships. We also find that new exporters usually enter foreign markets with a product

already sold at home. These findings are consistent with a model in which starting small allows producers to test the credibility of the foreign partner or the suitability of their products abroad. Finally, we show that many newly introduced export products do not survive for more than a year.

The interplay between uncertainty and possibility of imitation, as found in the model of self-discovery of Hausmann and Rodrik (2003), suggests that new export discoveries will be undersupplied. Our results indeed show that export discoveries constitute a limited share of new export varieties and that the footsteps of a producers introducing an export discovery are quickly followed by other exporters.

It is important to stress that by emphasizing the role of uncertainty in shaping patterns of trade and exports dynamics we do not intend to conclude that this is the only factor preventing diversification in developing countries. In fact, we think that the existence of substantial fixed costs and the need for quality upgrading prior to supplying export markets are certainly equally, if not more, important factors, as showed by various studies (Roberts and Tybout, 1997; Das and al., 2007; Iacovone and Javorcik, 2008).

We believe our findings are informative for both policy makers and researchers concerned with the structure and determinants of a country's exports patterns. Understanding the dynamics of introducing new export varieties at the firm level constitutes the first step in understanding how a country can upgrade its export structure and what policies, if any, can stimulate this process.

References

Albornoz, F., Calvo Pardo, H., Corcos, G. and Ornelas, E. (2008). 'Sequential exporting', Mimeo, London School of Economics.

Alvarez, R., Faruq H. and Lopez, R. (2007). 'New products in export markets: Learning form experience and learning from others', Mimeo, Indiana University, Bloomington.

Araujo, L. and Ornelas, E. (2007). 'Trust-based trade', CEP Discussion Paper 820, Center for Economic Performance, LSE.

Arkolakis, C. and Muendler, M.-A. (2009). 'The extensive margin of exporting goods: A firm-level analysis', Mimeo, University of California, San Diego.

Baldwin, J. and Gu, W. (2004). 'Trade liberalization and export-market participation, productivity growth, and innovation', *Oxford Review of Economic Policy*, vol. 20(3) (Autumn), pp. 372-92.

Baldwin, J. and Gu, W. (2009). 'The impact of trade on plant scale, production-run length and diversification', in (T. Dunne, B. Jensen and M. Roberts, eds.), *Producer Dynamics: New Evidence from Micro Data*. Vol. 68 of Studies in Income and Wealth, pp. 557-592, Chicago: University of Chicago Press.

Baldwin, J., Caves, R., and Gu, W. (2005). 'Responses to trade liberalization: Changes in product diversification in foreign- and domestic-controlled plants', in (L. Eden and W. Dobson, eds.), *Governance, Multinationals and Growth: New Horizons in International Business*, pp. 209-46, Cheltenham, UK and Northampton, MA: Elgar.

Bartelsman, E. J. and Doms, M. (2000). 'Understanding productivity: Lessons from longitudinal microdata', *Journal of Economic Literature*, vol. 38(3) (September), pp. 569–594.

Bernard, A. B., Redding, S. J. and Schott, P. K. (2006). 'Multi–product firms and trade liberalization', CEP Discussion Papers dp0769, Centre for Economic Performance, LSE.

Bernard, A. B., Redding, S. J. and Schott, P. K. (2007). 'Comparative advantage and heterogeneous firms', *Review of Economic Studies*, vol. 74(1) (January), pp. 31–66.

Bernard, A. B., Redding, S. J. and Schott, P. K. (forthcoming). 'Multi–product firms and product switching', *American Economic Review*.

Bernard, A. B., Jensen, J. B., Redding, S. and Schott, P. (2007). 'Firms in international trade', *Journal of Economic Perspectives*, vol. 21(3) (Summer), pp. 105-130.

Besedes, T. and Prusa, T. J. (2006). 'Product differentiation and duration of us import trade', *Journal of International Economics*, vol. 70(2) (December), pp. 339–358.

Besedes, T. and Prusa, T. J. (2007). 'The role of extensive and intensive margins and export growth', NBER Working Paper 13628, National Bureau of Economic Research.

Brooks, E. (2006). 'Why don't firms export more? Product quality and Colombian plants', *Journal of Development Economics*, vol. 80(1) (June), pp. 160-178.

Das, S., Roberts, M. and Tybout, J. (2007). 'Market entry costs, producer heterogeneity and export dynamics', *Econometrica*, vol. 75(3) (May), pp. 837–873.

Davis, S. and Haltiwanger, J. (1992). 'Gross job creation, gross job destruction, and employment reallocation', *Quarterly Journal of Economics*, vol. 107(3) (August), pp. 819-863.

Eaton, J., Eslava, M., Kugler M. and Tybout, J. (2008). 'Export dynamics in Colombia: Transaction-level evidence', in (E. Helpman, D. Marin and T. Verdier, eds.), *The Organization of Firms in a Global Economy,* pp. 231-272, Cambridge, MA: Harvard University Press.

Eaton, J., Kortum, S. and Kramarz, F. (2004a). 'An anatomy of international trade: Evidence from French firms', Mimeo, New York University.

Eaton, J., Kortum, S. and Kramarz, F. (2004b). 'Dissecting trade: Firms, industries, and export destinations', *American Economic Review: Papers and Proceedings*, vol. 94(2) (May), pp. 150–154.

Eckel, C. and Neary, J. P. (forthcoming). 'Multi–product firms and flexible manufacturing in the global economy', *Review of Economic Studies*.

Evenett, S. J., & Venables, A. (2002). 'Export growth by developing economies: Market entry and bilateral trade', Mimeo, London School of Economics.

Feenstra, R. and Kee, H. L. (2007). 'Trade liberalization and export variety: A comparison of Mexico and China', *The World Economy*, vol. 30(1) (January), pp. 5–21.

Feenstra, R. and H. Ma. (2008). 'Optimal choice of product scope for multiproduct firms under monopolistic competition', in (E. Helpman, D. Marin and T. Verdier, eds.), *The Organization of Firms in the Global Economy*, pp. 173-199, Cambridge, MA: Harvard University Press.

Fernandes, A. M. (2007). 'Trade policy, trade volumes and plant–level productivity in Colombian manufacturing industries', *Journal of International Economics*, vol. 71(1) (March), pp. 52–71.

Goldberg, P. K., Khandelwal, A., Pavcnik, N. and Topalova, P. (2008). 'Imported intermediate inputs and domestic product growth: Evidence from India', Princeton University, mimeo.

Goldberg, P. K., Khandelwal, A., Pavcnik, N. and Topalova, P. (forthcoming). 'Multi-product firms and product turnover in the developing world: Evidence from India', *Review of Economics and Statistics*.

Harrison, A. (ed.) (2007). *Globalization and Poverty*, Chicago: University of Chicago Press.

Hausmann, R., Hwang, J. and Rodrik, D. (2007). 'What you export matters', *Journal of Economic Growth*, vol. 12(1) (March), pp. 1–25.

Hausmann, R. and Rodrik, D. (2003). 'Economic development as self-discovery', *Journal of Development Economics*, vol. 72(2) (December), pp. 603–633.

Hummels, D. and Klenow, P. J. (2005). 'The variety and quality of a nation's exports', *American Economic Review*, vol. 95(3) (June), pp. 704–723.

Iacovone, L. and Javorcik, B. S. (2008). 'Shipping the good tequila out: Investment, domestic unit values and entry of multi-product plants into export markets', Mimeo, University of Oxford.

Manova, K. and Zhang, Z. (2009). 'Export prices and heterogeneous firm models', Stanford University, Mimeo.

Mayer, T., Melitz M. and Ottaviano G. (2009). 'Market size, competition and the product mix of exporters', Princeton University, mimeo.

Melitz, M. J. (2003). 'The impact of trade on intra–industry reallocations and aggregate industry productivity', *Econometrica*, vol. 71(6) (November), pp. 1695–1725.

Nocke, V. and Yeaple, S. (2006). 'Globalization and endogenous firm scope', PIER Working Paper Archive 06–015, Penn Institute for Economic Research, Department of Economics, University of Pennsylvania.

Pavcnik, N. (2002). 'Trade liberalization, exit, and productivity improvement: Evidence from chilean plants', *Review of Economic Studies*, vol. 69(1) (January), pp. 245–76.

Rauch, J. and Watson, J. (2003) 'Starting small in an unfamiliar environment', *International Journal of Industrial Organization*, vol. 21 (September), pp. 1021–1042.

Roberts, M. J. and Tybout, J. R. (1997). 'The decision to export in Colombia: An empirical model of entry with sunk costs', *American Economic Review*, vol. 87(4) (September), pp. 545–64.

Romalis, J. (2007). 'NAFTA's and CUSFTA's impact on international trade', *Review of Economics and Statistics*, vol. 89(3) (August), pp. 416–435.

Schor, A. (2004). 'Heterogeneous productivity response to tariff reduction. evidence from Brazilian manufacturing firms', *Journal of Development Economics* , vol. 75(2) (December), pp. 373–396.

Trefler, D. (2004). 'The long and short of the Canada-U.S. Free Trade Agreement', *American Economic Review*, vol. 94(4) (September), pp. 870–895.

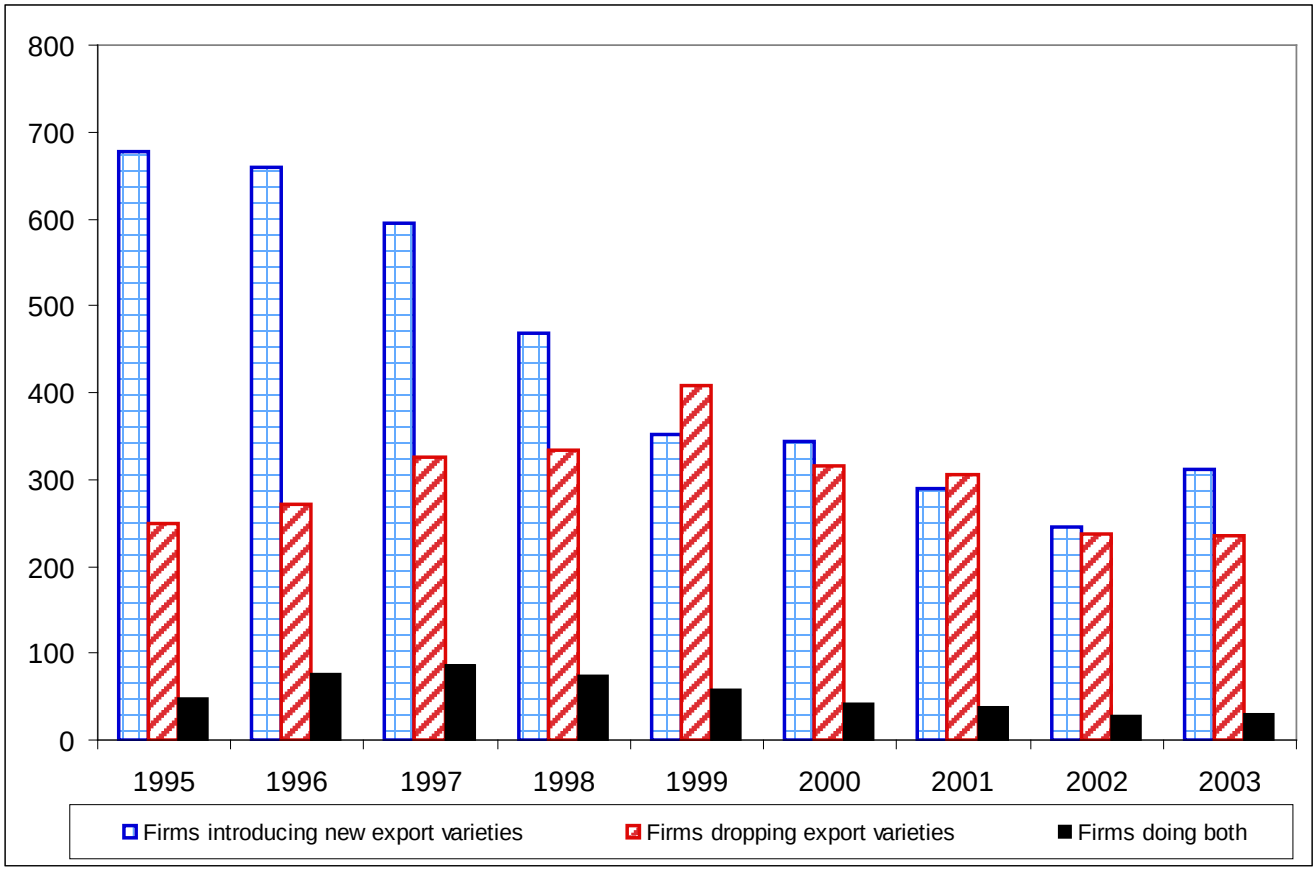
Tybout, J. (2000). 'Manufacturing firms in developing countries: How well do they do, and why?', *Journal of Economic Literature*, vol. 38(1) (March), pp. 11–44.

Venables, A. and Evenett, S. (2002). 'Export growth in developing countries: Market entry and bilateral trade flows', Mimeo, University of Bern.

Yeaple, S. R. (2005). 'A simple model of firm heterogeneity, international trade, and wages', *Journal of International Economics*, vol. 65(1) (January), pp. 1–20.

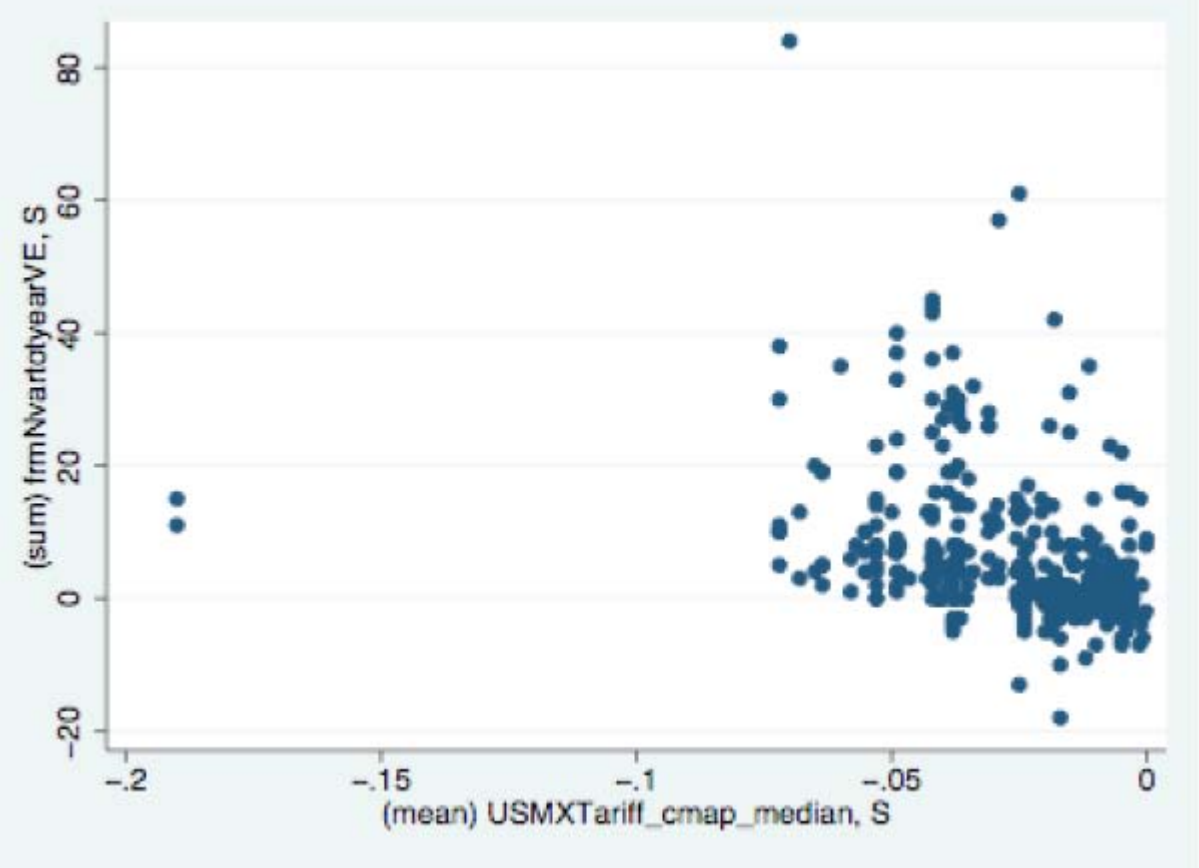
Figures

Fig. 1: Variety churning at the firm level



Note: exiting firms are included among those dropping export products.

Fig. 2: Variety churning and tariff changes under NAFTA:
Exported varieties and US tariffs



[NOTE TO TYPESETTER:
PLEASE REPLACE THE AXIS TITLES AS FOLLOWS:
HORIZONTAL AXIS: Change in US tariff under NAFTA
VERTICAL AXIS: Change in the number of exported varieties]

Fig. 3: Variety churning and tariff changes under NAFTA:
Domestic varieties and Mexican tariffs

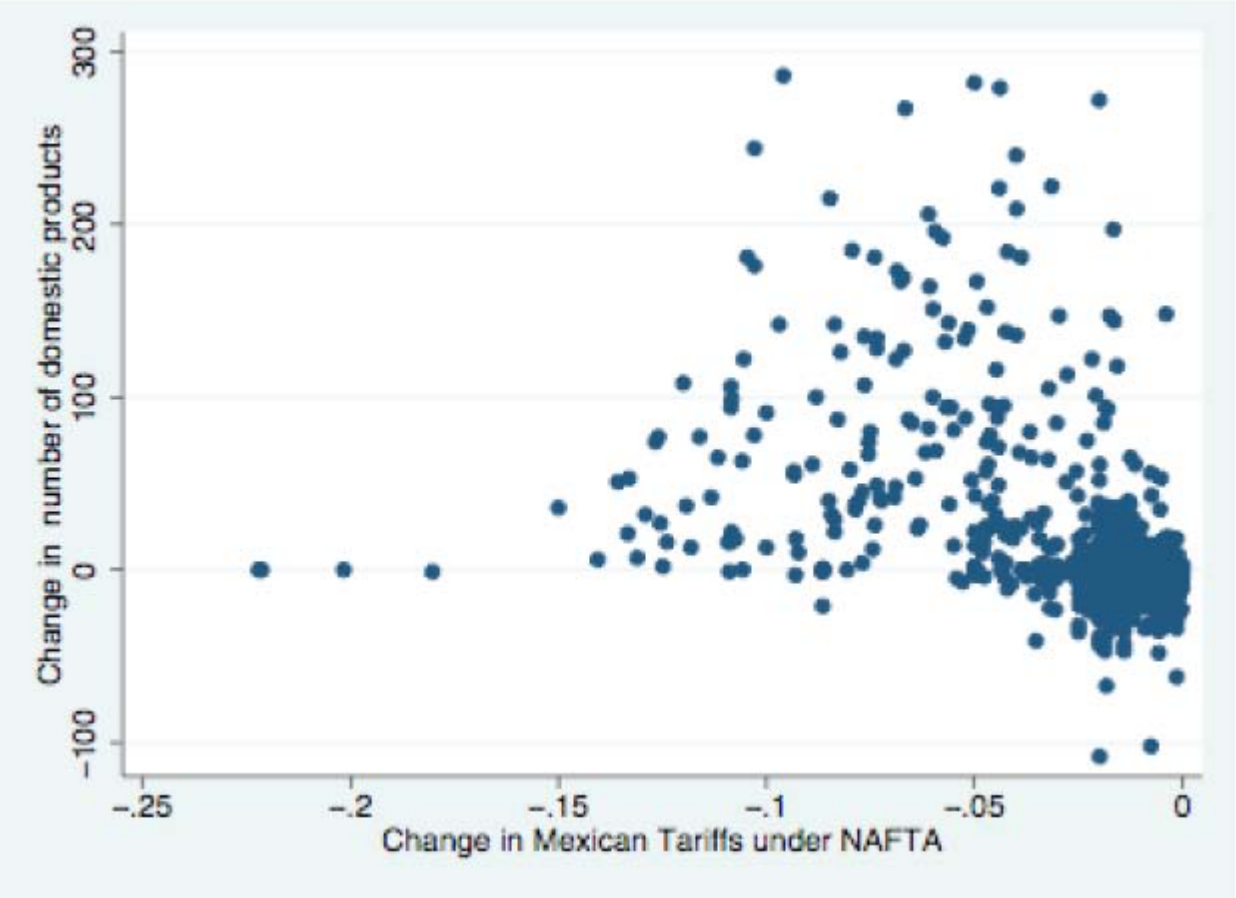
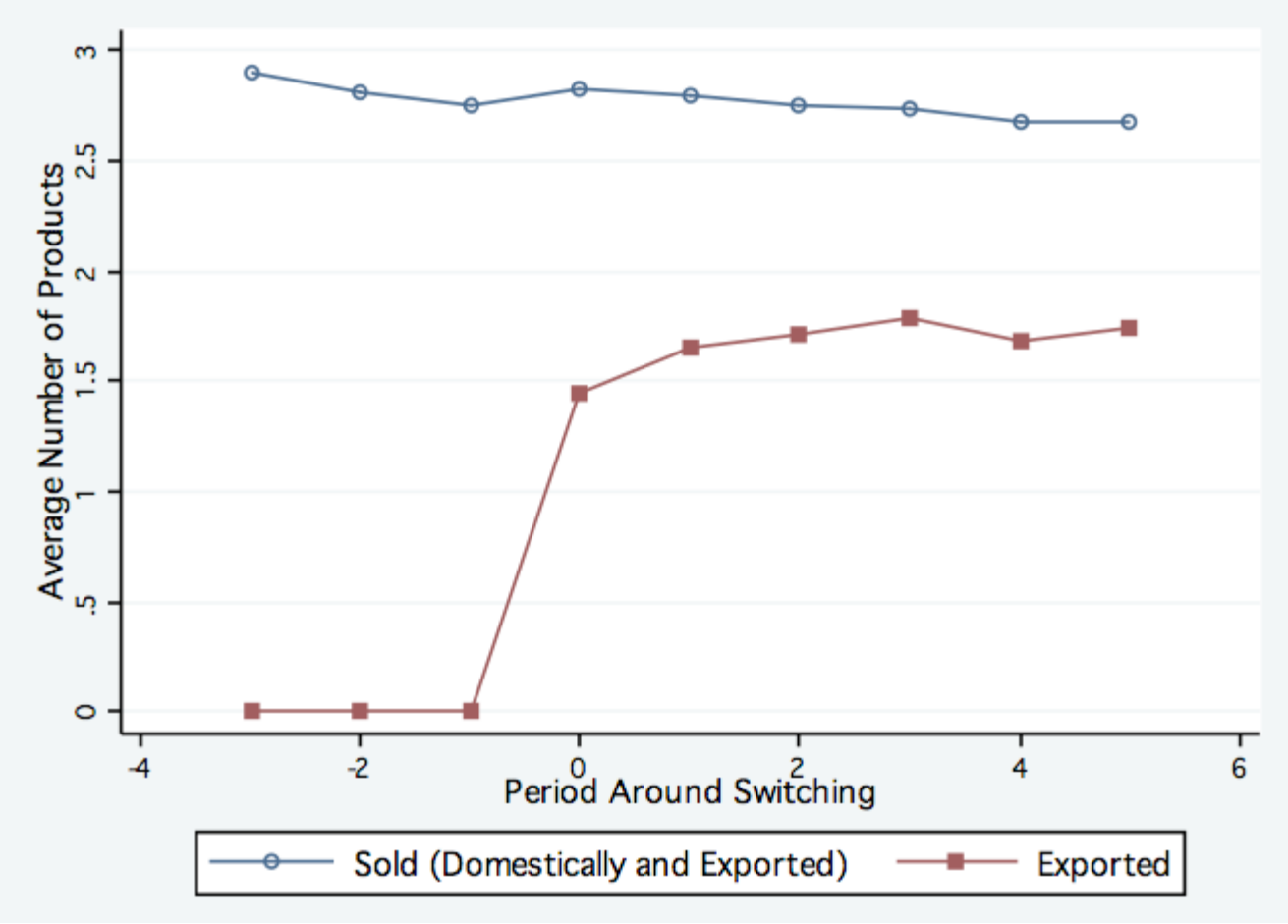
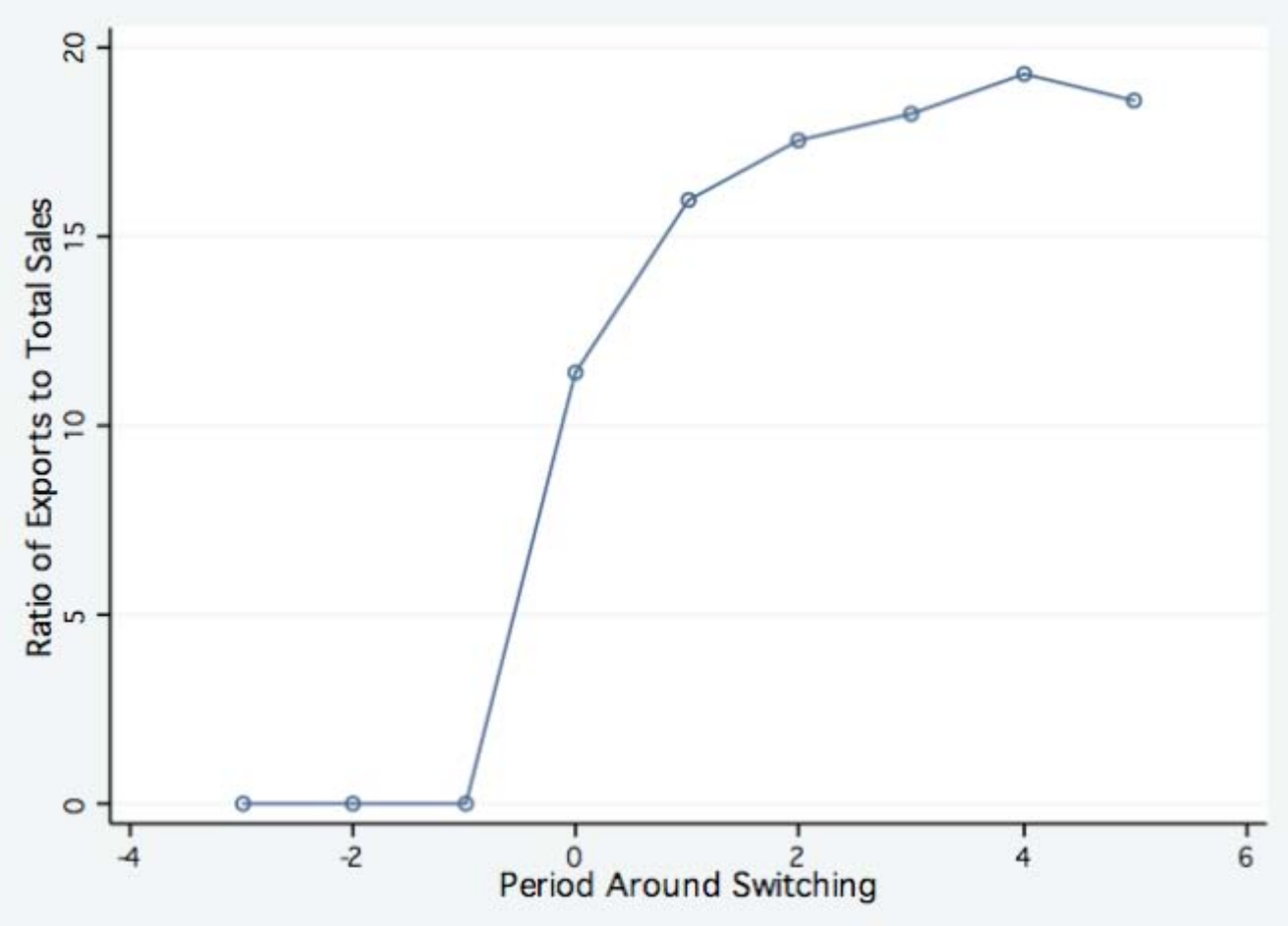


Fig. 4: New exporters start small: Number of exported varieties



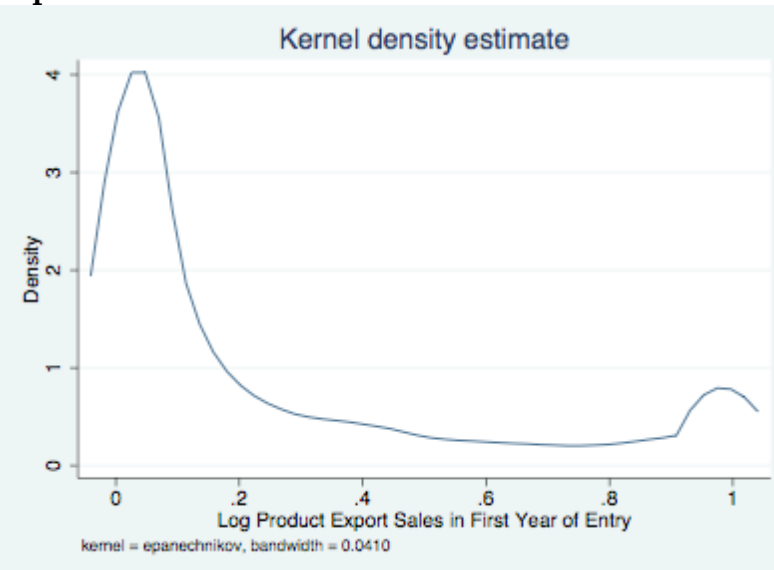
Note: Period 0 corresponds to the year of entry into export markets.

Fig. 5: New exporters start small: Export revenue relative to total sales of the variety



Note: The graph depicts the value of exports of a variety newly introduced in export markets relative to the firm's total sales of the variety (expressed in %). Period 0 corresponds to the year when the variety is first introduced into export markets.

Fig. 6: New exporters start small:
Distribution of export revenue relative to total sales of the variety in the first year of being exported



Note: The figure depicts the export value of a variety in its first year of being exported normalized by the total sales of the variety by a given firm.

[NOTE TO TYPESETTER:
PLEASE DROP THE SECONDARY TITLE OF THE HORIZONTAL AXIS WHICH STARTS WITH THE WORDS: kernel – epanechnikov . . .]

Tables

Table 1: Number of firms and varieties

	No. of firms		No. of varieties	
Year	All	Exporting	All	Exported
1994	5,493	1,402	18,079	2,730
1995	5,238	1,631	17,576	3,269
1996	4,965	1,795	16,581	3,728
1997	4,752	1,889	15,804	3,934
1998	4,579	1,849	15,295	4,025
1999	4,420	1,708	14,808	3,753
2000	4,292	1,660	14,181	3,593
2001	4,138	1,541	13,619	3,386
2002	3,987	1,469	13,150	3,209
2003	3,871	1,457	12,495	3,160
Total	49,451	17,792	163,470	37,778

Table 2: The average number of exported varieties per firm is quite stable

	The average number of varieties exported by		
Year	All exporting firms	Existing exporters	New exporters
1994	1.95	n.a.	n.a.
1995	2.00	2.18	1.47
1996	2.08	2.19	1.54
1997	2.08	2.20	1.41
1998	2.18	2.23	1.58
1999	2.20	2.26	1.40
2000	2.16	2.24	1.35
2001	2.20	2.26	1.20
2002	2.18	2.23	1.40
2003	2.17	2.25	1.54

Note: Existing exporters are defined as those in their second or later year of exporting.

Table 3: Export variety churning by sector

	Export variety creation (1)	Export variety destruction (2)	Gross churning (1)+(2)	Net churning (1)-(2)
Food, beverages and tobacco	0.203	0.113	0.316	0.090
Textiles, garments, leather	0.219	0.161	0.380	0.057
Wood products	0.277	0.151	0.428	0.126
Pulp and paper	0.169	0.104	0.273	0.065
Chemical products	0.167	0.109	0.276	0.058
Mineral based industries	0.132	0.066	0.198	0.066
Basic metals	0.152	0.094	0.246	0.058
Machinery and transport equipment	0.185	0.097	0.282	0.088
Other industries	0.160	0.076	0.236	0.084
All sectors	0.188	0.114	0.302	0.074

Table 4: Dropping domestic varieties

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variety relevance	-0.106***				-0.102***			
	(0.003)				(0.004)			
Variety sales volume (log)		-0.049***				-0.047***		
		(0.000)				(0.001)		
Variety market share			-0.081***				-0.085***	
			(0.003)				(0.004)	
Firm age (log)				-0.010***				-0.009***
				(0.002)				(0.002)
Mexican tariff					-0.133**	-0.009	-0.085*	0.018
					(0.044)	(0.096)	(0.045)	(0.094)
Mexican tariff x Variety relevance					0.048			
					(0.047)			
Mexican tariff x Variety sales						-0.017*		
						(0.009)		
Mexican tariff s Variety market share							-0.165**	
							(0.064)	
Mexican tariff s Plant age								-0.040
								(0.026)
US tariff					-0.075**	-0.016	-0.112***	-0.088**
					(0.033)	(0.035)	(0.033)	(0.030)
R-squared	.044	.146	.036	.026	.043	.143	.038	.027
N	139,334	133,435	137,833	110,589	120,166	115,938	119,043	95,634

Note: The outcome variable is equal to 1 if product i sold domestically at time t will be discontinued in t+1, and zero otherwise.
All specifications include 6-digit industry fixed effects and year fixed effects. Robust standard errors are reported in columns (1) to (4). In columns (5) to (8) standard errors are clustered at the product-year level.

Table 5: Firms tend to enter export markets with varieties previously sold at home

year	Share of new export varieties sold in Mexico		
	at t-1	at t-1 or t-2	at t-1 or t-2 or t-3
1995	82%	n.a.	n.a.
1996	69%	77%	n.a.
1997	69%	76%	80%
1998	65%	73%	76%
1999	63%	71%	74%
2000	70%	78%	81%
2001	67%	75%	79%
2002	72%	81%	85%
2003	73%	77%	79%
Average 1997-2003	68%	75%	79%

Table 6: New exporters are more likely than existing exporters to enter foreign markets with varieties previously sold at home

Year	No. of **new exporters**	Percentage of **new exporters** starting to export with a product previously sold domestically	No. of **existing exporters** introducing a new export variety	Percentage of **existing exporters** introducing a new export variety that was previously sold domestically
1995	602	90%	470	75%
1996	460	87%	539	65%
1997	358	87%	470	67%
1998	225	80%	474	66%
1999	166	68%	315	69%
2000	163	89%	263	72%
2001	124	86%	243	69%
2002	120	83%	189	78%
2003	219	78%	207	75%
Total	2,437	85%	3,170	69%

Note: Varieties previously sold at home are defined as those sold on the domestic market at t-1.

Table 7: Export variety survival rates by cohort (relative to the year of introduction)

		1995	1996	1997	1998	1999	2000	2001	2002	2003
Year	**1995**	100%								
	1996	68%	100%							
	1997	60%	67%	100%						
	1998	57%	59%	66%	100%					
	1999	51%	51%	50%	59%	100%				
	2000	46%	48%	45%	51%	55%	100%			
	2001	42%	42%	41%	47%	48%	55%	100%		
	2002	38%	39%	40%	40%	40%	46%	60%	100%	
	2003	37%	38%	36%	36%	36%	38%	50%	53%	100%

Notes: each cell presents the percentage of varieties within a cohort that continue to be exported in year t.

Table 8: Export variety survival rates by cohort (relative to the previous period)

		1995	1996	1997	1998	1999	2000	2001	2002	2003
Year	**1995**	100%								
	1996	68%	100%							
	1997	88%	67%	100%						
	1998	94%	88%	66%	100%					
	1999	89%	87%	76%	59%	100%				
	2000	92%	93%	90%	86%	55%	100%			
	2001	90%	89%	91%	92%	87%	55%	100%		
	2002	90%	93%	97%	86%	85%	83%	60%	100%	
	2003	98%	96%	92%	90%	90%	82%	84%	53%	100%

Notes: each cell presents the percentage of varieties that were exported at t-1 and continue to be exported at t.

Table 9: New export products and export discoveries

Year	New export varieties	Export discoveries	Discoveries as a share of all new export varieties
1995	1,072	352	33%
1996	999	319	32%
1997	828	253	31%
1998	699	172	25%
1999	481	97	20%
2000	426	100	23%
2001	367	101	28%
2002	309	80	26%
2003	426	113	27%
Total	5,607	1,587	28%

Table 10: Diffusion of export discoveries

Year	Average no of firms exporting a discovery	Average value of exports (by product)	% increase in the export volume of a new discovery
1	1.4	3,835	
2	1.5	6,241	163%
3	1.7	7,831	120%
4	1.7	8,263	106%
5	1.6	6,993	85%
6	1.5	6,420	92%
7	1.3	6,315	98%
8	1.3	7,657	121%

Notes: The table includes only export discoveries introduced in 1995 and 1996. Only *clases* with more than 20 active firms are taken into account.

[1] World Bank, 1818 H Street, NW; Washington, DC, 20433, USA. Email: Liacovone@worldbank.org.
[2] Corresponding author. University of Oxford and CEPR, Department of Economics, Manor Road Building, Manor Road, Oxford OX1 3UQ, UK. Email: beata.javorcik@economics.ox.ac.uk.
The authors are grateful to Gerardo Leyva and Abigail Durán for granting us access to INEGI data at the offices of INEGI in Aguascalientes subject to complying with the confidentiality requirements set by the Mexican Law. Special thanks go to all INEGI employees who provided assistance and answered our questions, in particular to Gabriel Romero, Alejandro Cano, Araceli Martinez, Armando Arellanes, Ramon Sanchez, Otoniel Soto, Candido Aguilar, Adriana Ramirez. The author are also thankful to Roberto Alvarez, Bernard Hoekman, Wolfgang Keller, Christopher Kurz, Emanuel Ornelas, Steve Redding, Petia Topalova, Alan Winters, Adrian Wood, the participants of the World Bank Trade Seminar, the 2008 Empirical Investigations in International Trade Conference, the 2008 Midwest International Economics Conference, the 2008 LACEA Regional Integration

Network Conference, the 2008 Royal Economic Society Conference, the 2008 Northeast Universities Development Consortium Conference and four anonymous referees for their useful comments. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the view of the World Bank, its Executive Directors or the countries they represent.

[3] Although several studies documenting patterns at the establishment-product level have emerged in the past couple of years, they tend to focus either on total production or solely on exports. Moreover, unlike our study, they rely mostly on cross-sectional information (Alvarez et al., 2007; Arkolakis and Muendler, 2009; Bernard et al., 2006 and 2009; Eaton et al., 2009; Goldberg et al., 2008; Manova and Zhang, 2009; Mayer et al., 2009).

[4] This means that we are assuming that ownership structure observed in 2003 was prevailing during the whole period covered by our sample.

[5] As most Mexican firms have only a single establishment, conducting our analysis at the establishment-level would lead to very similar results. There are only 473 multi-establishment firms in our data, owning on average three establishments each.

[6] The latter set of figures was kindly provided to us by John Romalis.

[7] Note that the US tariff data include information on both ad valorem and specific tariffs. Specific tariffs were converted into ad valorem equivalents by John Romalis and were added to the ad valorem rates. In some cases, this adjustment produced a figure suggesting that combined tariffs were increasing (rather than decreasing) under NAFTA. We dropped these figures (pertaining to about 1% of the sample) from the analysis.

[8] These figures include firms exiting the market.

[9] If exiting firms were excluded from the calculation of *export variety destruction*, the measure would range from 6% in mineral based industries to 16% in textile, leather and garments industry with the economy wide measure reaching 11.5%.

[10] Though, it is important to note that the theoretical prediction is at the firm level, while the figures presented are at the industry level. In a related study, Iacovone and Javorcik (2008) show that the anticipated decline in US tariffs has led to higher investment outlays among Mexican producers, especially in sectors with high advertisement intensity, and that investment was a key determinants of introduction of new varieties on export markets.

[11] And access to more intermediate input varieties will have a positive effect on firm scope (see Goldberg et al., 2008).

[12] Recall that within the product category of widgets, varieties will be defined as widgets produced by different firms.

[13] Using a probit specification, not reported to save space, leads to the same conclusions.

[14] Ideally, we would like to use the variety age rather than firm age, but unfortunately this information is not available. The theoretical model of Bernard et al. (2009) predicts a negative relationship between the probability of a variety being dropped and the variety's tenure.

[15] Our findings are in contrast with those of Goldberg et al. (2009) who do not observe a link between variety dropping and tariff declines in India.

[16] Notable exceptions include work of Baldwin and Gu (2004 and 2009) and Baldwin et al. (2005) who examine the relationship between firm diversification and trade liberalization using Canadian data and work of Bernard et al. (2006) who document a similar pattern for products produced and sold (in general) in the US. These authors conclude that product switching is *frequent*, *widespread* and *influential* in determining both firm and aggregate outcomes.

[17] A similar mechanism is also proposed by Araujo and Ornelas (2007).

[18] New exporters are defined as firms which export at time t but were not exporting at t-1. We do not impose a condition that the firm continues exporting in all years depicted in the figure.

[19] We define experienced exporters those firms that are in their second or later year of exporting activity.