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Essays on Firms in International Trade

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Abstract

My thesis is composed by three chapters that study the important role that firms play in mediating imports and exports between countries, and how their decisions and heterogeneity can influence the behavior of macroeconomic outcomes. The first chapter, explores the role of demand uncertainty and learning in explaining the low survival rates and sales of new exporters using a manufacturing survey for Colombian firms. In the second chapter, using a transaction-level dataset for Colombian exporters, I document novel facts about the post-entry dynamics of firm performance and prices in international markets, and study their connection with the transmission of exchange rate shocks into firm-level prices. To rationalize these facts, I propose a theory of firm dynamics emphasizing the interaction between demand accumulation and endogenous export participation. In the third chapter, using a novel administrative dataset for Canada, I explore the role of trade intermediaries in bringing foreign products into the domestic market and empirically estimate how domestic manufacturing firms are affected by being exposed to the imports of final and intermediate goods carried by wholesalers.

In Chapter 2, I develop a model featuring Bayesian demand learning and endogenous export participation in which the learning mechanism is modelled as a signal-extraction problem. The underlying assumption is that firms are uncertain about their demand in the foreign market and, for each period they export, they observe a noisy realization of it. These observed signals determine firms' posterior beliefs about their demand, on which they base their quantity and participation decisions. The parameters of the resulting dynamic discrete choice model are calibrated to match several key moments observed in Colombian firm-level data. This model is able to reproduce the dynamics of new exporters observed in the data, namely that new exporters sell only a small fraction in the foreign markets, and their survival rates are smaller than the ones of more experienced firms. Finally, the calibrated model is used to evaluate the efficiency of policies subsidizing a fraction of the fixed costs associated with exporting. The results suggest that, in terms of benefit-cost ratios, policies subsidizing exporters with less than 3 years of experience are more effective than the ones targeted to all the exporting firms.

In Chapter 3, I further explore novel features about the dynamics of new exporters, and study how these dynamics are related to the firm-level response to exchange rate shocks. Using a transaction-level data for Colombia over the period 2008 to 2018, I document that: 1) export sales and survival rates are initially small, but then consistently grow in the years following entry to a new market; 2) prices of exported goods increase with the number of years a firm has exported to the same destination; 3) the exchange rate pass-through into international prices is incomplete and new exporters exhibit a pass-through rate that is, on average, 1.8 times higher than the one of incumbent exporters. To rationalize these empirical facts, I develop a dynamic

discrete choice model of exporting introducing customer base accumulation due to *deep habits*. A key feature of this model is that pricing decisions become dynamic, and exporters have incentives to charge low prices upon entry to foster their future demand at the expense of their current profits. Moreover, this model has important predictions for the variation of the price response to exchange rate movements across firms. According to the model, young firms that are closer to the exit margin transmit a higher fraction of the exchange rate shocks into their prices, while experienced exporters partially absorb these shocks in order to keep their prices and customer base stable. I calibrate this model to match salient features of Colombian exporters, and in particular to generate new exporter dynamics that are consistent with the data. I then use the calibrated model to examine, through impulse-response analysis, the aggregate response of trade volumes to two types of trade shocks: a persistent depreciation of the Colombian peso, and a trade liberalization episode. The inclusion of deep habits and endogenous entry and exit has important aggregate implications. First, aggregate volumes are more responsive to tariffs than to exchange rates. On impact, I estimate an elasticity of trade volumes to tariffs of 1.5 and to exchange rates of 0.5. Second, for both shocks, the customer base accumulation mechanism generates a sluggish response of trade volumes, which produces discrepancies between the short-run and long-run elasticities. Particularly, in response to a permanent tariff reduction, I estimate a long-run trade elasticity that is 2.6 times higher than the short-run elasticity.

In Chapter 4, by using a unique administrative dataset containing detailed information on firm performance and import transactions for all Canadian firms, I study the role of wholesalers as international trade facilitators, and provide evidence on how their import decisions affect the performance of domestic producers through different margins. Initially, with this dataset, I document some features regarding the import behavior of wholesalers. First, I find that the share of total import value accounted by wholesalers increased from from 26.5% in 2002, to 34.3% in 2012. Second, I document that wholesalers were the dominant players on the final goods import markets, accounting for almost 50% of the total import value of final goods in 2012, up from 43% in 2002. Similarly, they earned notoriety in the import markets of intermediate inputs by increasing their import share from 16% to almost 22% ten years later. Additionally, I find substantial differences on how wholesalers and manufacturing firms engage in international trade. Specifically, I document that when compared to manufacturing firms, wholesalers imported more goods and from more countries, and over the observation period the number of importing firms grew more in the wholesale trade sector relative to the manufacturing sector. Finally, I explore how domestic producers respond to the increased import competition in the form of final and intermediate goods carried by wholesalers. To do that, I construct measures of exposure to these *indirect imports* at the local market level, and exploit the geographic variation in this exposure to empirically estimate the effect on sales, employment, productivity and exit rates of the domestic manufacturing firms located there. The empirical analysis reveals that

a higher exposure to indirect imports of final goods has a negative effect on domestic firms' employment and sales and a positive effect on exit probabilities. While a higher exposure to the imports of intermediate goods made by wholesalers has a positive effect on employment and sales, and a negative effect on exit rates. Recognizing the potential endogeneity of local market-level indirect import penetration, I also report the results obtained by specifications that instrument the indirect import penetration. Instrumental variable estimates confirm most of the previous results.

Keywords: International trade, exporter dynamics, trade intermediaries.

Summary for Lay Audience

My thesis is composed by three chapters that study the important role that firms play in mediating imports and exports between countries, and how their decisions and heterogeneity can influence the behavior of macroeconomic outcomes.

In the first chapter, using a manufacturing survey for Colombian firms I document two facts related to the growth dynamics of new exporters. I find that new exporters exhibit low export sales and low survival rates when compared to their more experienced competitors. To explain this behavior, I propose a model featuring demand uncertainty, learning and endogenous export participation, that is also used to evaluate the efficiency of policies subsidizing a fraction of the fixed costs associated with exporting.

In the second chapter, using a transaction-level dataset for Colombian exporters, I document novel facts about the post-entry dynamics of firm performance and prices in international markets, and study their connection with the transmission of exchange rate shocks into firm-level prices. To rationalize these facts, I propose a theory of firm dynamics emphasizing the interaction between demand accumulation and endogenous export participation. Then, I study how introducing realistic firm-level export transitions and grow patterns can shape the aggregate response to external shocks.

In the third chapter, using a novel administrative dataset for Canada, I explore the role of trade intermediaries in bringing foreign products into the domestic market and empirically estimate how local manufacturing firms are affected by being exposed to the imports of final and intermediate goods carried by wholesalers. The empirical analysis reveals that a higher exposure to indirect imports of final goods has a negative effect on domestic firms' employment and sales and a positive effect on exit probabilities. While a higher exposure to the imports of intermediate goods made by wholesalers has a positive effect on employment and sales, and a negative effect on exit rates.

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Chapter 1

Introduction

With the increasing availability of firm-level customs data there has been a surge in the number of studies exploring new dimensions of international trade and uncovering previously unknown features of the trading environment.[1] In particular, this research has led to a much better understanding of the important role that firms play in mediating imports and exports between countries, and how firm-level decisions and heterogeneity can influence the behavior of macroeconomic outcomes. In recent years, two intriguing phenomena have received a great deal of attention by international economists. On the one hand, a literature pioneered by Ruhl and Willis (2017), has documented that the dynamics of new exporters substantially differ from the ones of more experienced firms and has proposed that the heterogeneity in the growth dynamics of exporters could be a crucial determinant of the dynamic response of aggregate variables. On the other, as first documented by Bernard et al. (2010a), it has been observed in several countries (including Canada) that the amount of trade passing through intermediaries such as wholesalers has substantially increased, despite the falling trade costs observed in the last decades. Although an extensive literature has studied the prevalence of intermediaries in international trade, little is known about the effect of the import competition induced by these wholesalers on the performance of domestic manufacturing firms.

My thesis is composed by three chapters that aim to shed some light on the underlying mechanisms behind these two phenomena. The first chapter, explores the role of demand uncertainty and learning in explaining the low survival rates and sales of new exporters using a manufacturing survey for Colombian firms. In the second chapter, using a transaction-level dataset for Colombian exporters, I document novel facts about the post-entry dynamics of firm performance and prices in international markets, and study their connection with the transmis-

[1] For a comprehensive review of this literature see Bernard et al. (2007).

sion of exchange rate shocks into firm-level prices. To rationalize these facts, I propose a theory of firm dynamics emphasizing the interaction between endogenous demand accumulation and export participation. In the third chapter, using a novel administrative dataset for Canada, I explore the role of trade intermediaries in bringing foreign products into the domestic market and empirically estimate how local manufacturing firms are affected by being exposed to the imports of final and intermediate goods carried by wholesalers.

In Chapter 2, I develop a model featuring Bayesian demand learning and endogenous export participation in which the learning mechanism is modelled as a signal-extraction problem. The proposed mechanism is motivated by qualitative evidence collected by the World Bank during the same time period. In a survey conducted among plant managers in Colombia, the great majority identified lack of experience and information about the export market as important non-tariff barriers to entry (World-Bank 1992). I incorporate this insight into the model by making the assumption that firms are uncertain about their demand in the foreign market and, for each period they export, they observe a noisy realization of it. These observed signals determine firms' posterior beliefs about their demand, on which they base their quantity and participation decisions.

The parameters of the resulting dynamic discrete choice model are calibrated to match several key moments observed in Colombian firm-level data. The model is able to reproduce the dynamics of new exporters observed in the data, namely that new exporters sell only a small fraction in the foreign markets, and their survival rates are smaller than the ones of more experienced firms. Moreover, the calibrated model provides an ideal framework to evaluate the effect of export promotion policies. In particular, I compare the efficiency of policies subsidizing a fraction of the fixed costs associated with exporting with and without age-dependent criteria. The results suggest that, in terms of benefit-cost ratios, policies allocating resources towards young exporters (i.e. with less than 3 years of experience) are more effective than the ones targeted to all the exporting firms. Intuitively, this result could be explained by the the fact that, due to higher levels of uncertainty, new exporters are more prone to exit when facing unfavourable shocks in their foreign demand. Therefore, policies concentrating subsidies among new exporters not only could help them to counteract the demand uncertainty and allow them to survive, but also can avoid wasting resources in subsidizing mature exporters with high survival rates.

In Chapter 3, I continue the exploration of novel features about the dynamics of new exporters, and study how these dynamics are related to the firm-level response to exchange rate shocks. This chapter provides a complementary analysis of the previous one featuring *passive* learning in the sense that firms exogenously accumulate information simply by surviving in the export markets. In here, I explore a different learning mechanism in which firm's current decisions influence their future profitability. This chapter does not intend to measure which type of learning dominates, and a formal assessment of the relative contributions is left for future research.

Using a transaction-level data for Colombia over the period 2008 to 2018, I document that: 1) export sales and survival rates are initially small, but then consistently grow in the years following entry to a new market; 2) prices of exported goods increase with the number of years a firm has exported to the same destination; 3) the exchange rate pass-through into international prices is incomplete and new exporters exhibit a pass-through rate that is, on average, 1.8 times higher than the one of incumbent exporters. To rationalize these empirical facts, I develop a dynamic discrete choice model of exporting introducing customer base accumulation due to *deep habits*. The use of this mechanism is motivated by a large literature in industrial organization and marketing documenting the presence of consumer inertia and state dependence in the demand.[2] Although consumer inertia could be alternatively modelled using search costs, or imperfect information, the empirical evidence on the dynamics of export prices and exchange pass-through provided in this chapter supports the inclusion of the deep habits mechanism. Specifically, one of the key features of this model is that pricing decisions become dynamic, and thus exporters have incentives to charge low prices upon entry to foster their future demand at the expense of their current profits, producing export prices that gradually increase with age. Moreover, this model has important predictions for the variation of the price response to exchange rate movements across firms. According to the model, young firms that are closer to the exit margin transmit a higher fraction of the exchange rate shocks into their prices, while experienced exporters partially absorb these shocks in order to keep their prices and customer base stable. The parameters of the model are calibrated to match salient features of Colombian exporters, and in particular to generate new exporter dynamics that are consistent with the data. Overall, the model has a good quantitative fit, and it successfully generates increasing-with-tenure dynamics of sales, survival rates and prices, as well as incomplete and heterogeneous exchange rate pass-through over the lifecycle of exporters. I then use the calibrated model to examine, through impulse-response analysis, the aggregate response of trade volumes to two types of trade shocks: a persistent depreciation of the Colombian peso, and a trade liberalization episode. The inclusion of deep habits and endogenous entry and exit has important aggregate implications. First, aggregate volumes are more responsive to tariffs than to exchange rates. On impact, I estimate an elasticity of trade volumes to tariffs of 1.5 and to exchange rates of 0.5. Second, for both shocks, the customer base accumulation mechanism generates a sluggish response of trade volumes, which produces discrepancies between the

[2] See for example Foster et al. (2016) for supporting evidence on the domestic firms and Piveteau (2020) for exporting firms.

short-run and long-run elasticities. Particularly, in response to a permanent tariff reduction, I estimate a long-run trade elasticity that is 2.6 times higher than the short-run elasticity.

In Chapter 4, by using a unique administrative dataset containing detailed information on firm performance and import transactions for all Canadian firms, I study the role of wholesalers as international trade facilitators, and provide evidence on how their import decisions affect the performance of domestic producers through different margins. The empirical specification employed in this chapter is largely motivated by the extensive literature on import competition, however it departs from it in three aspects. First, this chapter focuses on the imports carried by wholesalers, and thus it studies indirect import penetration. Second, it differentiates the end-use of the imported products, if these are either intermediate or final goods, to study the dual role played by wholesalers as competitors and suppliers of imported inputs. And third, it measures import competition at the local market level aiming to capture how the proximity to potential competitors or suppliers of inputs can affect the outcomes of domestic manufacturing firms.

Initially, with the dataset, I document some features regarding the import behavior of wholesalers. First, I find that the share of total import value accounted by wholesalers increased from from 26.5% in 2002, to 34.3% in 2012. Second, I document that wholesalers were the dominant players on the final goods import markets, accounting for almost 50% of the total import value of final goods in 2012, up from 43% in 2002. Similarly, they earned notoriety in the import markets of intermediate inputs by increasing their import share from 16% to almost 22% ten years later. Additionally, I find substantial differences on how wholesalers and manufacturing firms engage in international trade. Specifically, I document that when compared to manufacturing firms, wholesalers imported more goods and from more countries, and over the observation period the number of importing firms grew more in the wholesale trade sector relative to the manufacturing sector. Finally, I explore how domestic producers respond to the increased import competition in the form of final and intermediate goods carried by wholesalers. To do that, I construct measures of exposure to these *indirect imports* at the local market level, and exploit the geographic variation in this exposure to empirically estimate the effect on sales, employment, productivity and exit rates of the domestic manufacturing firms located there. The empirical analysis reveals that a higher exposure to indirect imports of final goods has a negative effect on domestic firms' employment and sales and a positive effect on exit probabilities. While a higher exposure to the imports of intermediate goods made by wholesalers has a positive effect on employment and sales, and a negative effect on exit rates. Recognizing the potential endogeneity of local market-level indirect import penetration, I also report the results obtained by specifications that instrument the indirect import penetration. Instrumental variable estimates confirm most of the previous results.

Chapter 2

New Exporter Dynamics and Demand Learning

2.1 Introduction

In recent years, there has been an increasing interest in understanding the causes behind the observed heterogeneity in the performance across exporting firms. In particular, a literature pioneered by Ruhl and Willis (2017), has documented a series of empirical regularities regarding the growth and survival process of new exporters which have been observed in the data of several countries.[1] Namely, that new exporters start exporting low amounts, exit the international markets with more frequency and, among the selected group of surviving exporters, rapid growth rates are observed. Given that many of the surviving firms eventually become large exporters that account for important shares of aggregate trade volumes, a proper understanding of the sources of the heterogeneity in the post-entry dynamics is crucial to explain the aggregate dynamic response to external shocks and policy intervention.

An initial attempt to rationalize this phenomenon, were the class of models featuring sunk costs and heterogeneous productivity at the firm-level (henceforth referred as sunk-cost models). Although it is intuitive to think that the distinct dynamics of new and incumbent exporters could be attributed to differences in productivity, when contrasted with the data these models were unable to reproduce the behavior of new exporters. Following the discussion in Ruhl and Willis (2017), the failure of the sunk-cost models to replicate the new exporter dynamics lies in the fact that firms, upon entry, face no other barrier to exporting. Thus,

[1] See for example Ruhl and Willis (2017) for Colombia, Kohn et al. (2016) for Chile, Piveteau (2020), Berman et al. (2019) for France, and Cebreros (2016) for Mexico.

once firms break into the international markets they immediately adjust their export sales to the optimal level instead of doing it gradually. Additionally, since the selection mechanism is through the productivity level, only the more productive firms will be the ones exporting and, therefore, will be the least likely to exit in the following periods. Both features together imply that, under this model, new exporters start selling too much and exit too little which is a prediction that is clearly at odds with the data.

In response to that, a recent line of the literature has questioned the supply side explanation and has hinted at demand dynamics as the main driver of the observed empirical regularities.[2] Specifically, it is suggested that new exporters are initially small and exit more frequently because they are more likely to face informational, reputational, or other frictions that hinder their ability to grow. Over time and upon accumulating years of experience, much of these frictions ease allowing some firms to expand and to survive in the export markets. In line with this literature, in this chapter I study the role of foreign demand uncertainty and the extent to which informational frictions affect firms differently over their life-cycle. In order to rationalize the dynamics of new exporters I propose a model featuring Bayesian demand learning and endogenous export participation. As in Arkolakis et al. (2018), the learning mechanism is modelled as a signal-extraction problem, in which firms can not observe the underlying parameter determining their *appealing* in the foreign markets.[3] Instead, for each period they export, they can observe a noisy realization of it. It is assumed that at the beginning of each period, firms have to make production decisions before observing the realization of the signal meaning that, through a process that entails Bayesian updating, firms have to create beliefs about their appealing based on the information gathered (signals observed). The parameters of the model are calibrated to match several key moments observed in Colombian firm-level data. Finally, I use the calibrated model to analyze the efficiency of export-promotion policies targeting exporting firms. The counterfactual analysis suggests that policies subsidizing a fraction of the fixed costs of exporting generate increases in the total export revenues that outweigh the total cost of implementation, however the benefit-cost ratios are non-monotonically increasing in the subsidy rate. Additionally, I compare the benefit-cost ratios produced by policies subsidizing the fixed costs of the entire population of exporting firms and of young exporters only. The results indicate that only subsidizing young exporters is more cost-effective as it partially eliminates the uncertainty that firms face early in their life-cycle and allows high-appealing firms to be less vulnerable to observing bad shocks.

[2]See, for example, Arkolakis (2010), Drozd and Nosal (2012), Nguyen (2012), Timoshenko (2015).
[3]Appealing to be understood as how well it is received or desired the product in the foreign markets.

2.1.1 Literature Review

This chapter joins the large empirical literature motivated by the theories of export hysteresis developed in Baldwin and Krugman (1989) and Dixit (1989). Perhaps one the first attempts to empirically test this hypothesis is Roberts and Tybout (1997), in that paper the authors proposed a dynamic discrete choice model that separated the role of profit heterogeneity and sunk entry costs in order to explain the Colombian plants' exporting status. More recent examples of dynamic structural estimations include Das et al. (2007), Kasahara and Lapham (2013) and Aw et al. (2011). Also, the research in this chapter is related to a growing literature aimed to replicate the observed dynamics for new exporters. In their seminal paper, Ruhl and Willis (2017) proposed an extended model that introduces a foreign demand function that deterministically increases with the number of years a plant has been exporting. Additionally, they include a stochastic entry cost in which, with some probability the plants are exempted to pay the fixed costs. Although these mechanisms proved to be successful in replicating the behavior of new exporters, they lack of economic insight. Alternative explanations to endogenously account for these dynamics include financial frictions as in Kohn et al. (2016), market penetration costs (consumer margin) such as Arkolakis (2010) and Piveteau (2020), and learning and demand uncertainty as in Arkolakis et al. (2018) and Berman et al. (2019). Specifically, this chapter applies the learning mechanism used in Arkolakis et al. (2018) to characterize the export decisions of the firms.[4] Among all the competing explanations, the use of learning and demand uncertainty is partially justified by qualitative evidence recollected by the World-Bank (1992) during the same time period of the data employed. In there, several hundreds of plant managers interviewed, indicated that uncertainty about export markets, lack of knowledge and experience, and underdeveloped financial and transportation sectors were the main determinants of the low export market participation. All these features mentioned are consistent with the learning and foreign demand uncertainty proposed here.

2.2 Data and Stylized Facts

The data comes from the annual census of manufacturing plants in Colombia, collected by the Departamento Administrativo Nacional de Estadística (DANE) for the years 1981 to 1991. This census, that only samples plants with 10 or more employees, contains information about location, industry, age, capital stocks, expenditure on labor and intermediate inputs, value of the output sold domestically and abroad, among other topics. This time period and database have been widely used in the literature, prominent examples are Roberts and Tybout (1997), Das et al. (2007), Rivers (2013), and Ruhl and Willis (2017).

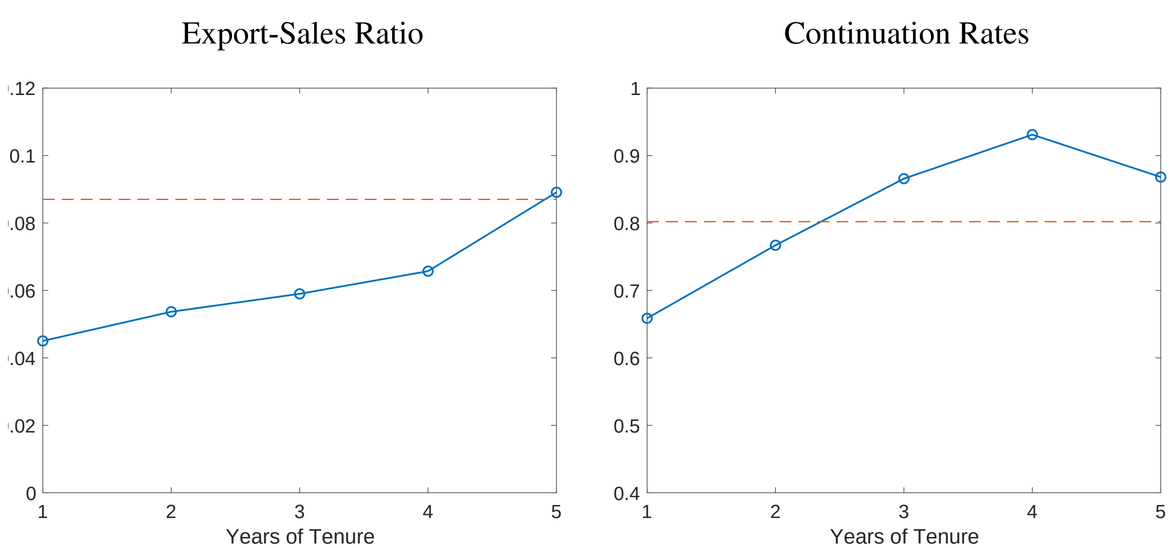
[4]The referred paper only focuses on entry/exit to the domestic market and does not consider export decisions.

I employ the same 19 industries as in Roberts and Tybout (1997), and in order to construct a balanced panel of firms I apply the same data treatment as in Ruhl and Willis (2017). First of all, I remove all the firms that entered or exit the market between 1981 and 1991. Then, I drop all firms whose employment falls bellow 15 employees in any year. Finally, I exclude firms experiencing annual changes in real production or employment greater that 150% in absolute value. I end up with a sample containing 1,780 plants with information for the years 1981 to 1991.

2.2.1 Stylized Facts

The main objective of this subsection is to describe a set of stylized facts observed in the Colombian data, which later are used to inform the theoretical model. The first fact is related to the *export intensity* of firms, which can be defined as the ratio of foreign sales to the total sales. To construct this ratio and to abstract from the effects of composition changes and exit, the sample is restricted to plants that entered the foreign markets for some year between 1982 to 1986, and continued to export for the following 4 years upon entry. The export ratio is computed for each year the firm has been exporting (tenure), and then the average export-sales ratio across firms is calculated.

Figure 2.1: New Exporters Dynamics



Source: Author's own calculations with data from DANE.
Note: The left panel only contains firms that started exporting between 1982 to 1986, and continue to export for the following 4 years. The right panel uses all the firms in the sample. Full-sample averages plotted in the dotted lines.

As depicted in the left panel of Figure 2.1, for the firms entering the foreign markets for the first time, only a small fraction of their total revenues comes from exporting. As firms gain tenure in the exporting markets, this ratio increases and after 4 years it reaches the average export-sales ratio across all firms (dotted line). The second feature documented is the evolution of the continuation rates, which measure the fraction of firms that having exported for a certain number of years continue to export in the following period. The right panel in Figure 2.1, plots the average continuation rates per years of tenure in the export markets for all the firms present in the sample. The pattern suggest that exporting is an uncertain activity with high rates of failure among new exporters, however as firms gain experience in this activity the probability of leaving the foreign markets decreases considerably. Together, these two facts postulate that tenure in the foreign markets is an important determinant of the firm dynamics of new exporters.

As a robustness check, I estimate the evolution of export-sales ratios and continuation rates by estimating the following specification:

$$y_{jt} = \phi + \sum_{a=1}^{5} \phi_a \mathbb{1}\{age_{jt} = a\} + \gamma_c + \epsilon_{jt} \tag{2.1}$$

where y_{jt} is either the export-sales ratio or a dummy equal to one if the firm still exporting the next year and zero otherwise, for firm j in year t. The age or tenure in a market, age_{jt} is denoted as the number of years that firm j has reported positive export sales. I include cohort fixed effects (γ_c) to control for the fact that some firms might enter the market in a better-than-average year.

Table 2.1: New Exporter Dynamics

	Export-sales ratio		Continuation rates	
	(1)	(2)	(3)	(4)
Age =1	0.045***	0.043***	0.659***	0.627***
	(0.011)	(0.014)	(0.028)	(0.030)
Age =2	0.054***	0.052***	0.767***	0.764***
	(0.009)	(0.014)	(0.030)	(0.030)
Age =3	0.059***	0.057***	0.866***	0.881***
	(0.009)	(0.014)	(0.028)	(0.029)
Age =4	0.066***	0.064***	0.931***	0.953***
	(0.013)	(0.014)	(0.024)	(0.025)
Age =5	0.089***	0.087***	0.868***	0.891***
	(0.017)	(0.014)	(0.036)	(0.037)
Cohort F.E.	No	Yes	No	Yes

Note: I report the linear combination of $\phi + \phi_a$ for $a = 1, 2, ...5$. Columns (2) and (4) are estimated using fixed effects at the cohort level. Clustered standard errors at the industry-level are included in parenthesis.

The sample used for the regression of export-sales is restricted to firms that continued to export for the following 4 years upon entry, and the one for continuation rates includes all the observations. Notice that linear combinations of the intercept, ϕ, and the age coefficients, ϕ_a, allow to identify the level of the outcome of interest upon entry and its evolution with age in the export markets. The results depicted in Table 2.3, confirm the same pattern and do not exhibit substantial differences across the specifications that include cohort fixed effects and the ones that do not. Based on the set of facts documented, in the following section I construct a theoretical model that is in line with what is observed in the data.

2.3 Model

In order to capture the observed dynamics of new exporters in the Colombian data, a model that embeds learning-by-exporting and demand uncertainty is proposed. The main idea behind the learning mechanism, is that firms instead of observing their true *appealing* in the export markets, they only can observe a noisy signal of it every time they decide to export. As firms continue to export and gain tenure, firms can gather more information and more accurately updated their beliefs about their unknown parameter. This device coupled with per-period fixed costs of exporting, can reproduce the two empirical regularities documented.

Discussion: the firm dynamics studied in this chapter, can also be rationalized by alternative theories relying on different mechanisms such as costly search, financial constraints and demand accumulation. Disentangling the role of each specific mechanism is, in general, a difficult task that is beyond the scope of this chapter. Instead, the learning mechanism adopted in this model is justified by the qualitative evidence collected by World-Bank (1992), in a set of interviews made to hundred of managers of Colombian plants during the same time period. In there, most of the answers suggested that lack of knowledge and information about the export markets, is one of the major determinants of the low participation rates.

The model imposes some restrictive assumptions regarding the firm-learning process that are worth discussing. First, the learning process is restricted to each firm's export experience excluding the possibility of learning from the domestic demand, other firms or even heterogeneity in the learning rates across firms. In this regard, the tractability of the learning process adopted is very useful, as many of these extensions can be easily incorporated. In particular, the signal-extraction process can be modified to make the observed signal about the foreign demand to depend on the observed signals of the domestic demand, of other firms or to be dependent of the size of the firms. These an other interesting extensions are left for future research. Second, it assumes that only producers can learn and thus ignores the role of consumer learning or inertia in the consumption decisions. Possible extensions could be either to introduce habit formation or other sources of consumer inertia to the preferences of the consumers, or to explicitly model how exporters search and match with foreign buyers using a one or two-sided search model. Given that both alternatives require very disaggregated data, or importer-exporter datasets to calibrate the models these mechanisms are not explored in this chapter.

2.3.1 Basic Set-up

The world consists of two countries, home and foreign, and an infinite horizon of discrete time periods t. In each country, consumers spend a fixed share of their income, y_t, to consume varieties of a differentiated good produced locally and abroad. In particular, the preferences of the representative consumer from the foreign country over the J varieties produced in the home country can be represented as (where an asterisk denotes a foreign variable):

$$U_t^* = \left(\sum_{j=1}^{J} e^{\frac{a_{jt}}{\sigma}} c_{jt}^{*\,\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

where c_{jt}^* is the quantity of variety j consumed at time t, $\sigma > 1$ is the elasticity of substitution between varieties and a_{jt} is the realization of the appealing of variety j in the foreign markets. The latter is determined every period by a time invariant idiosyncratic component, θ_j, and a shock, ϵ_t. Therefore, every period, the appealing shock is given by:

$$a_{jt} = \theta_j + \epsilon_t$$

where:

$$\epsilon_t \sim N\left(0, \sigma_\epsilon^2\right)$$
$$\theta_j \sim N\left(\theta_0, \sigma_\theta^2\right)$$

Notice that the process assumed for the appealing shock constitutes a signal extraction problem, in which the parameter θ_j can be interpreted as the true underlying product appeal of the firm that is unobserved. Instead, every period the firm observes a noisy realization subject to shocks, ϵ_t, that are independent and identically distributed. Analogously, the preferences of the representative consumer in the home country over the J varieties produced at home can be written as:

$$U_t = \left(\sum_{j=1}^{J} c_{jt}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

2.3.2 Consumers

In each country, the representative consumer maximizes her utility by choosing the quantities demanded of varieties of the differentiated good produced in the home country, and taking the prices and share of income as given. The resulting demand functions faced in each market by the producer of variety j are:

$$q^*_{jt} = c^*_{jt} = \frac{e^{a_{jt}} p^{*\,-\sigma}_{jt} y^*_t}{P^{*\,1-\sigma}_t} \tag{2.2}$$

$$q_{jt} = c_{jt} = \frac{p_{jt}^{-\sigma} y_t}{P_t^{1-\sigma}} \tag{2.3}$$

where:

$$P^{*\,1-\sigma} = \sum_{k=1}^{J} e^{a_{jt}} p^{*\,1-\sigma}_{k,t} \quad \text{and} \quad P^{1-\sigma} = \sum_{k=1}^{J} p_{k,t}^{1-\sigma}$$

2.3.3 Producers

Each of the varieties is produced by a monopolistically competitive firm facing the demand functions 2.2 and 2.3. All firms have a similar technology represented by the linear production function:

$$f(z_j, l_{jt}) = z_{jt} l_{jt} \tag{2.4}$$

where z_{jt} is the firm-level idiosyncratic productivity and l_{jt} the labor demanded. The timing assumed in this model is the following. Every period each firm has to decide whether to export or not. If a firm does not export, it chooses the quantity and labor to serve the domestic market, then profits are realized and the firm moves to the next period. If the firm decides to export, it has to chose how to allocate the total production between the domestic and foreign markets, and the labor demand. In particular for the foreign market, it has to make quantity decisions before observing that period's realization of the appealing of its variety in the foreign market, a_{jt}, and pay the corresponding export fixed costs. For simplicity, in what follows I omit the firm subscript j.

Learning: As discussed in Nguyen (2012), the problem of producing estimates of an unknown variable based on a series of noisy signals observed over time, is suitable to be modelled using Bayesian updating. Before observing any signal, the prior beliefs of each firm regarding their underlying product appeal, θ, are normally distributed with mean θ_0 and variance σ^2_θ. Notice that the true product appeal is firm-specific and corresponds to a draw from the normal distribution with mean θ_0 and variance σ^2_θ. Given that for every period that a firm decides to be an exporter it observes an appealing shock, a_t, it is useful to define the tenure of firm, and hence the number of observed signals about θ_j, up to $t-1$:

$$\begin{aligned} n_{t-1} &= x_{t-1} + x_{t-1}\cdot x_{t-2} + x_{t-1}\cdot x_{t-2}\cdot x_{t-3} + ... \\ &= \sum_{s=0}^{t-1}\left(\prod_{\tau=0}^{s} x_{t-1-s}\right) \end{aligned}$$

where the indicator variable x_t takes a value of 1 if the firm decides to export in period t and 0 otherwise. Notice that according to the definition, tenure is measured as the number of consecutive periods that a firm has exported up to period $t-1$. It is assumed that every time the firm exits the export markets, it automatically gets a new draw of θ. Finally, define $\bar{a}_{t-1}$ as the mean of the observed signals by the firm up to period $t-1$:

$$\bar{a}_{t-1} = \frac{1}{n_{t-1}}\sum_{s=0}^{n_{t-1}} a_{t-1-s}$$

By means of the Bayes' rule, the firm's posterior belief about θ, after having observed n_{t-1} signals is normally distributed with mean:

$$\mu_{n_{t-1}} = \frac{\sigma^2_\epsilon}{\sigma^2_\epsilon + n_{t-1}\sigma^2_\theta}\theta_0 + \frac{\sigma^2_\theta}{\sigma^2_\epsilon + n_{t-1}\sigma^2_\theta}\cdot n_{t-1}\cdot \bar{a}_{t-1} \tag{2.5}$$

and variance:

$$v^2_{n_{t-1}} = \frac{\sigma^2_\epsilon\sigma^2_\theta}{\sigma^2_\epsilon + n_{t-1}\sigma^2_\theta} \tag{2.6}$$

where the pair $(\bar{a}_{t-1}, n_{t-1})$ summarizes all the information gathered by the firm at the time of making their decisions at the beginning of period t. Additionally, it is straightforward to see that the firm's belief regarding the realization of its appealing shock, a_t, follows a $N\left(\mu_{n_{t-1}}, v^2_{n_{t-1}} + \sigma^2_\epsilon\right)$. In order to describe how new information is incorporated into the posterior belief, it is useful to reformulate the Bayesian updating process recursively.[5] Denote $\Delta\mu_{n_t} \equiv \mu_{n_t} - \mu_{n_{t-1}}$ and $\Delta v^2_{n_t} \equiv v^2_{n_t} - v^2_{n_{t-1}}$, then we have:

$$\Delta\mu_{n_t} = \frac{\sigma^2_\theta}{\sigma^2_\epsilon + n_t\sigma^2_\theta}\left(a_t - \mu_{n_{t-1}}\right) \tag{2.7}$$

$$\Delta v^2_{n_t} = -\frac{\sigma^2_\theta}{\sigma^2_\epsilon + n_t\sigma^2_\theta} v^2_{n_{t-1}} \tag{2.8}$$

[5]See the Appendix A for full details.

from (2.7) it is clear that observing a signal greater than the mean, $a_t > \mu_{n_{t-1}}$, induces an upward revision of the mean of the posterior belief in the next period and a downward revision whenever a signal lower than the mean is observed, $a_t < \mu_{n_{t-1}}$. Regardless of the direction, the magnitude of the revision is large for young exporters (with low n_t) and decreases as the firms accumulate years of experience in the export markets. Contrary to $\mu_{n_{t-1}}$, the posterior variance $v^2_{n_{t-1}}$ does not depend on the mean of the observed signals and only depends on the firms' tenure in the export markets (i.e. the number of signals observed). As described by equation (2.8), the posterior variance decreases with n_t and larger downward revisions are observed for new exporters.

Firm Optimization

Recall that it is assumed that at the beginning of period t each firm decides whether to export or not, and if they do, choose the optimal quantities sold in the home and foreign markets. All of this, without observing the realization of the appealing shock in the foreign market, a_t, in period t. Therefore, conditional on their export decision, x_t , and with an information set summarized by $(\bar{a}_{t-1}, n_{t-1})$ firms maximize the expected total profits given by:

$$\max_{\{q_t, q_t^*\}} \mathbb{E}\Big[p_t(q_t)\, q_t + x_t p_t^*(a_t, q_t^*)\, q_t - \frac{w_t}{z_t}(q_t + q_t^*) - x_t \cdot f_x \Big| \bar{a}_{t-1}, n_{t-1}\Big]$$

$$\begin{aligned} &\text{s.t} \\ p_t(q_t) &= q_t^{-\frac{1}{\sigma}} \varphi_t^{\frac{1}{\sigma}} \\ p_t^*(a_t, q_t^*) &= e^{\frac{a_t}{\sigma}} q_t^{*-\frac{1}{\sigma}} \varphi_t^{*\frac{1}{\sigma}} \end{aligned}$$

where $\varphi_t \equiv \frac{y_t}{P_t^{1-\sigma}}$ and $\varphi_t^* \equiv \frac{y_t^*}{P_t^{*1-\sigma}}$ denote the domestic and foreign market size. After substituting the inverse demand functions and taking the first order conditions, the optimal quantities produced in each market are:

$$q_t = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma} \left(\frac{z_t}{w_t}\right)^{\sigma} \varphi_t \tag{2.9}$$

$$q_t^* = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma} \left(\frac{\mathbb{E}\Big[e^{\frac{a_t}{\sigma}} \Big| \bar{a}_{t-1}, n_{t-1}\Big] z_t}{w_t}\right)^{\sigma} \varphi_t^* \tag{2.10}$$

Given that a_t, conditional on $(\bar{a}_{t-1}, n_{t-1})$, is normally distributed with mean $\mu_{n_{t-1}}$ and variance $v^2_{n_{t-1}} + \sigma^2_{\epsilon}$, the conditional expected value of the belief regarding the appealing shock in period t is given by:

$$b(\bar{a}_{t-1}, n_{t-1}) \equiv \mathbb{E}\left[e^{\frac{a_t}{\sigma}} \middle| \bar{a}_{t-1}, n_{t-1}\right] = \exp\left\{\frac{\mu_{n_{t-1}}}{\sigma} + \frac{1}{2}\left(\frac{\nu_{n_{t-1}}^2 + \sigma_\epsilon^2}{\sigma^2}\right)\right\} \tag{2.11}$$

from the optimal export quantity depicted in equation (2.10) we can infer that firms with higher beliefs, $b(\bar{a}_{t-1}, n_{t-1})$, sell more. As before, we can compute the growth rate of the beliefs about the appealing shock to understand how new signals are incorporated. Using equations (2.7) and (2.8), we obtain:

$$\begin{aligned}
\Delta \log b(\bar{a}_t, n_t) &= \frac{\Delta \mu_{n_t}}{\sigma} + \frac{1}{2}\left(\frac{\Delta \nu_{n_t}^2}{\sigma^2}\right) \\
&= \frac{\sigma_\theta^2}{\sigma_\epsilon^2 + n_t \sigma_\theta^2}\left(\frac{a_t - \mu_{n_{t-1}}}{\sigma}\right) - \frac{\sigma_\theta^2}{\sigma_\epsilon^2 + n_t \sigma_\theta^2} \frac{\nu_{n_{t-1}}^2}{2\sigma^2}
\end{aligned}$$

which suggests that firms that observe a higher-than-expected signal, $a_t > \mu_{n_{t-1}}$ update their belief upwards, and the opposite is observed for lower-than expected signals. Again, new exporters will tend to have larger adjustments in their beliefs, and hence in their export sales, and firms making upward adjustments to their beliefs will tend to be expanding firms with higher chances of survival.

Moreover, after combining the optimal quantities produced we can obtain an analogue of the export sales ratio:

$$\frac{q_t^*}{q_t + q_t^*} = \frac{\varphi_t^* b_t(\bar{a}_{t-1}, n_{t-1})^\sigma}{\varphi_t + \varphi_t^* b_t(\bar{a}_{t-1}, n_{t-1})^\sigma} \tag{2.12}$$

$$= \frac{1}{1 + \tilde{\varphi}_t^{-1} b_t(\bar{a}_{t-1}, n_{t-1})^{-\sigma}} \tag{2.13}$$

where $\tilde{\varphi}_t \equiv \varphi_t^* / \varphi_t$. Notice that, consistent with the empirical findings, the export sales ratio is increasing with the years of tenure in the export markets, as firms incorporate additional information leading to upward revisions in their belief. Finally, to close the characterization of the static profit maximization, we can derive expressions for the market clearing prices in each market:

$$\begin{aligned}
p_t &= \frac{\sigma}{\sigma - 1} \frac{w_t}{z_t} \\
p_t^* &= \frac{e^{\frac{a_t}{\sigma}}}{b_t(\bar{a}_{t-1}, n_{t-1})} \frac{\sigma}{\sigma - 1} \frac{w_t}{z_t}
\end{aligned}$$

the ex-post total profits:

$$\begin{aligned}\Pi\left(x_t,\bar{a}_{t-1},n_{t-1}\right) &= \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}\varphi_t\left(\frac{w_t}{z_t}\right)^{1-\sigma}+ \\ & x_t\frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}\varphi_t^*\left(\frac{w_t}{z_t}\right)^{1-\sigma}b_t\left(\bar{a}_{t-1},n_{t-1}\right)^{\sigma-1}\left[\sigma e^{\frac{a_t}{\sigma}}-(\sigma-1)\,b_t\left(\bar{a}_{t-1},n_{t-1}\right)\right]-x_t\cdot f_x\end{aligned}$$

and the expected total profits:

$$\Pi^e\left(x_t,\bar{a}_{t-1},n_{t-1}\right)=\frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}\left(\frac{w_t}{z_t}\right)^{1-\sigma}\left[\varphi_t+x_t\varphi_t^*b_t\left(\bar{a}_{t-1},n_{t-1}\right)^{\sigma}\right]-x_t\cdot f_x$$

2.3.4 Dynamic Programming Problem

Now, I describe the dynamic export decision in the presence of fixed costs. Notice that since the elasticity of substitution is exactly the same in the domestic and foreign markets, the participation decision in each market can be analyzed separately. That is, the tenure in the domestic market does not provide information regarding the export market nor influence the export participation decision. Thus, I focus on the part of the expected total profits that correspond to export sales:

$$\pi_x^e\left(\bar{a}_{t-1},n_{t-1}\right)=\frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}\left(\frac{w_t}{z_t}\right)^{1-\sigma}\left[\varphi_t^*b_t\left(\bar{a}_{t-1},n_{t-1}\right)^{\sigma}\right]$$

and when firms decide not to export the revenue obtained is equal to zero. To focus on the effect of demand learning and the endogenous acquisition of information I abstract from any variation in productivity and normalize the productivity, z_t, of all the firms to 1.

Recall that for every period a firm wants to participate in the export markets, it has to incur on a per-period fixed cost, f_x. At the beginning of each period, each firm observes the state vector $(\bar{a}_{t-1},n_{t-1})$, which conveys all the information required to solve the static and dynamic maximization problems. Putting all things together, the dynamic programming problem solved by the firms is described by the value function of the new exporters:

$$V^{ne}\left(\bar{\theta},0\right)=\max_{x_t\in\{0,1\}}\left\{x_t\cdot\left[\pi_x^e\left(\theta_0,0\right)-f_x\right]+\beta\left[x_t\cdot V^{in}\left(\bar{\theta},1\right)+(1-x_t)\,V^{ne}\left(\theta_0,0\right)\right]\right\} \tag{2.14}$$

and the value function of the incumbent exporters:

$$V^{in}(\bar{a}_{t-1}, n_{t-1}) = \max_{x_t \in \{0,1\}} \left\{ x_t \cdot [\pi_x^e(\bar{a}_{t-1}, n_{t-1}) - f_x] + \beta \begin{bmatrix} x_t \cdot \mathbb{E}\left[V^{in}\left(\frac{n_{t-1} \cdot \bar{a}_{t-1} + a_t}{n_{t-1} + x_t}, n_{t-1} + x_t\right) \middle| \bar{a}_{t-1}, n_{t-1} \right] \\ + (1 - x_t) V^{ne}(\theta_0, 0) \end{bmatrix} \right\} \quad (2.15)$$

From the Bellman equation for new exporters, it is clear that all firms start with the same belief regarding the unobserved appealing shock, a_t, and based on that belief they decide whether to enter to the export markets or remain as non-exporters. Incumbent exporters, on the other hand, form beliefs about current and future appealing shocks using the information gathered up to period t, which is summarized by $(\bar{a}_{t-1}, n_{t-1})$. In particular, the information set of firms at the beginning of period t is endogenously accumulated and depends on the history of export participation. Notice that every time a firm decides to exit the foreign market it will receive a new draw of θ, meaning that the set of observed signals and the tenure will reset to zero. The value functions of new and incumbent exporters are solved by means of value function iteration.

The solution of the incumbent's dynamic programming problem produces a policy function of export participation given by:

$$x_t(\bar{a}_{t-1}, n_{t-1}) = \begin{cases} 1, & \pi_x^e(\bar{a}_{t-1}, n_{t-1}) + \beta \left\{ \mathbb{E}\left[V^{in}\left(\frac{n_{t-1} \cdot \bar{a}_{t-1} + a_t}{n_{t-1} + x_t}, n_{t-1} + x_t\right) \middle| \bar{a}_{t-1}, n_{t-1} \right] - V^{ne}\left(\bar{\theta}, 0\right) \right\} - f_x \geq 0 \\ 0, & \text{otherwise.} \end{cases} \quad (2.16)$$

According to (2.16), the firm compares the expected present value of exporting with the expected present value of exiting the market. Given that the beliefs and value functions are monotonically increasing in $\bar{a}_{t-1}$, for every n_{t-1}, I can obtain an exit threshold $\tilde{a}(n_{t-1})$ which implies that $x_t(\bar{a}_{t-1}, n_{t-1}) = 1$ whenever $\bar{a}_{t-1} > \tilde{a}(n_{t-1})$. The latter considerably simplifies the characterization of the optimal export participation rule. Notice that since the beliefs, and hence the profits, of younger exporters are more volatile and subject to larger revisions, these firms will be more vulnerable to bad appealing shocks and therefore, exporters will tend to exit more frequently at the beginning of their life-cycle in the foreign markets.

2.4 Calibration

The main objective of the quantitative exercise is to see if the model successfully replicates the new exporter dynamics observed in the data. To calibrate the parameters of the model I externally fix some parameters and the rest are chosen to match a set of empirical moments. To be consistent with the data, one period in the model corresponds to one year. It is worth noting that this model does not incorporate general equilibrium effects and the domestic wage,

w_t, is normalized to 1. I choose the values of β and σ based on what has been proposed in the literature. In particular, as is standard for annual data, I assume that the inter temporal discount rate β is equal to 0.96, which implies an interest rate of 4%. Additionally, I set $\sigma = 5$ which is a common value in the literature, specially for this database.[6] Finally, given that the mean of the distribution of the true appealing cannot be separately identified from the per-period fixed cost, I set $\theta_0 = 0$.

The rest of the parameters $(f_x, \sigma_\theta, \sigma_\epsilon, \varphi, \varphi^*)$ are calibrated internally using a simulated method-of-moments approach. I choose a total of 7 moments containing information about the parameters to be identified, these are: 1) the mean of the log-export sales, 2) the average export-sales ratio in the first 3 years of tenure, and 3) the average continuation rates for the first 3 years of tenure. Although a rigorous identification argument is not possible given that the parameters jointly determine the moments, I provide and informal argument of how the different moments help me to identify each of the parameters. The mean of the log-export sales is largely affected by the per-period fixed cost, f_x and the foreign market size φ^*. The survival rates for the first 3 years of tenure, are informative of the variance of the signals, σ_ϵ, as this largely determines how fast exporters incorporate new information and learn their true appealing parameter. Lastly, as noted in equation 2.12, the average export-sales ratio for the first 3 years, can be used to identify σ_θ and the domestic market size φ. The calibrated parameters are depicted in Table 2.2.

Table 2.2: Internally Calibrated Parameters

Parameter	Symbol	Value
Per-period Fixed Costs†	f_x	0.1551
S.D. True Appealing	σ_θ	0.538
S.D. Signal Shock	σ_ϵ	1.087
Relative Foreign Market size‡	$\tilde{\varphi}$	0.041

Note: This table shows parameters chosen to match the empirical moments. † Measured as fraction of the average firm exports. The actual value of $f_x = 1,554.81$. ‡ The relative foreign market size is given as the ratio of the foreign market size $\varphi^* = 12,757.09$ and the domestic market size $\varphi = 313,726.523$

In Table 2.2, I report the per-period fixed costs associated to exporting, f_x, measured as a fraction of the mean export sales. I find that the fixed costs represent 15.51% of the mean export sales of Colombian exporters. To make them comparable to the to the estimates provided by Ruhl and Willis (2017), I also compute the fixed costs as a fraction of the median total sales

[6] See for example Cebreros (2016) and Ruhl and Willis (2017). Using the same database,Rivers (2013) finds an estimate of the elasticity of substitution of 5.55, so the choice of this parameter seems reasonable

and as fraction of the mean first-year export sales of new entrants. The values I obtain are .011 and .257, while Ruhl and Willis (2017) report values of .057 and .219 with a similar model featuring fixed and sunk costs, heterogeneous productivity and a foreign demand that exogenously grows with age. Instead of reporting separately the values of φ and φ^*, in Table 2.2, I depict the relative foreign market size $\tilde{\varphi} = \varphi^*/\varphi$. I obtain a value of .041, which implies that Colombian firms face a domestic market that is considerably larger than the foreign market. With respect to learning process of the foreign demand, I obtain $\sigma_\theta = 0.538$, which suggests a small dispersion in the distribution of the true appealing faced by the firms in the foreign markets. Finally, the precision of the variance of the signal ($\nu_\epsilon \equiv 1/\sigma_\epsilon^2$) can be interpreted as the rate at which firms are able to uncover their true appealing (i.e. learning rate). The value obtained for σ_ϵ implies a learning rate of 0.846, that indicates that Colombian firms had low learning rates.

2.4.1 Quantitative Fit

The resulting simulated and data moments are depicted in Table 2.3. The first column contains the moments obtained using the Colombian firms' data and the second column shows the estimated moments implied by simulation of the model. As can be seen the matching, although not perfect, is good enough to capture the main patterns observed in data. In particular, the model is able to generate increasing with tenure export-sales ratios and continuation rates.

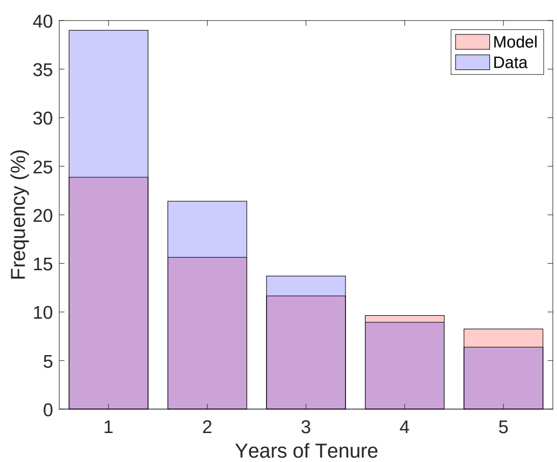
Additionally, I report the average number of years of tenure of exporting firms, although this is not a targeted moment in the calibration the resulting average in the model is remarkably close to what is observed in the data. Moreover, in Figure 2.2, I plot the distribution of the years of tenure in the data and the one implied by the model. As can be noted, the frequency of the firms with one year of tenure in the export market is disproportionately large in the data as opposed to the model. However, the model does a good job replicating the frequencies for 2 to 5 years of tenure.

Table 2.3: Simulated and Data Moments

Moment	Data	Model
Average log export sales	9.13	9.13
Export-sales ratio, $n = 1$	0.04	0.04
Export-sales ratio, $n = 2$	0.05	0.05
Export-sales ratio, $n = 3$	0.06	0.06
Continuation rates, $n = 1$	0.66	0.65
Continuation rates, $n = 2$	0.77	0.75
Continuation rates, $n = 3$	0.87	0.83
Other Moments		
Average Years of Tenure	2.64	2.64

Note: For the data moments, the sample covers a panel of 1,780 firms from 1981 to 1991. The model moments are obtained by simulating the outcomes of 40,000 firms and taking the cross-sectional averages. Variable n, denotes years of tenure.

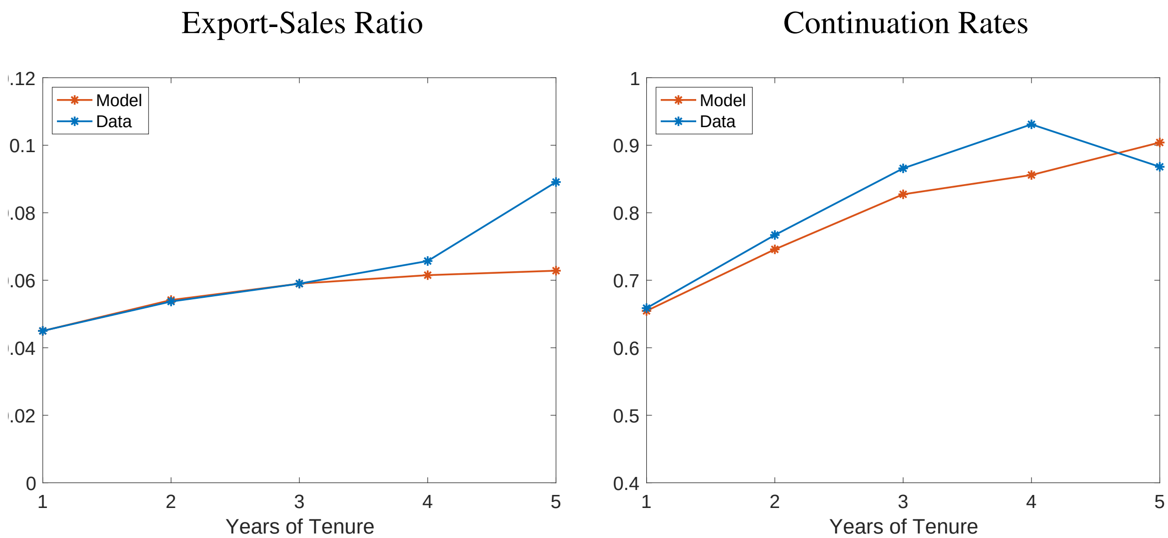
Figure 2.2: Distribution of Years of Export Tenure



Source: Author's own calculations with data from DANE.

Finally, in Figure 2.3 I compare the new exporter dynamics computed from the data with the ones produced by the model. Important to notice that export-sales ratio and the continuation rates for the first three years of tenure, are targeted moments in the calibration. In general, the calibrated model generates new exporter dynamics that are consistent with the data.

Figure 2.3: Quantitative Fit



Source: Author's own calculations with data from DANE.
Note: The left panel only contains firms that started exporting between 1982 to 1986, and continue to export for the following 4 years. The right panel uses all the firms in the sample. Full-sample averages plotted in the dotted lines.

2.5 Counterfactual Exercises

Once armed with the model and the estimated parameters, I am able to analyze how firms respond to the introduction of policies aiming to incentivize export participation, which consist of subsidies to the fixed costs associated with exporting (f_x). These policies are commonly used by governments in order to incentivize existing exporters, as well as to encourage non-exporting firms to become exporters, and as discussed in Das et al. (2007), they mostly operate through the entry-exit margin rather than in the volume margin.

To assess the effects of these policies, I use the calibrated model to simulate the firm-level response to a subsidy to the export fixed costs. I consider two type of policies: one that is aimed to subsidize a fraction of the fixed costs of all exporting firms, and the second that is targeted to young exporters with less than 3 years of experience in the export markets. Given that these policies may have different costs of implementation, to be able to make comparisons, I compute a benefit-cost ratio by calculating the total change in export revenue induced by the subsidy and dividing it by the total cost of the subsidy (i.e. the total sum of the fixed costs subsidized). In Table 2.4, I depict the results for a 15%, 25% and 50% subsidy rate.

Table 2.4: Export Revenue/Cost Ratios for Different Subsidies

	15%	25%	50%
To all firms	9.88	7.76	4.56
To young exporters	10.26	8.82	5.73

Notice that in all the cases considered the export revenue to cost ratios are greater than 1 meaning that, based on this metric, the benefits generated by these policies outweigh the costs. Interestingly, the policies subsidizing a percentage of the fixed costs of young exporters produce larger export revenue-cost ratios than policies targeting all the exporters. Intuitively, this result could be explained by the differences in the levels of uncertainty faced by exporters during their life cycle. On the one hand, new exporters have less information about their true appealing in the export markets and as a consequence are more susceptible to exit after observing unfavourable appealing shocks. On the other, as firms accumulate years of experience in the export markets they become more certain about their true appeal index and are less likely to exit when observing occasional bad shocks. Therefore, a policy subsidizing the fixed costs of new exporters will considerably increase their survival rates, and will allow potential high-appeal firms to remain in the market leading to a considerable increase in the total export revenue. Moreover, this policy is cost-effective as it only offers subsidies to a small fraction of firms.

Another interesting remark, is that the benefit-cost ratios decline as the subsidized fraction of the fixed costs increases. As the subsidy rate increases, a larger number of firms is able to continue exporting and thus the total costs of the subsidy increase proportionally. However, as a result of the decline in the fixed costs induced by the policy the exit threshold, $\tilde{a}(n_{t-1})$, increases and thus more medium and low-appeal firms are able to survive in the international markets. Given that in the absence of subsidies to the fixed costs many of these firms would exit the market, their contribution to the growth of the total export revenue, and the total benefit of the policy, is limited.

2.6 Conclusion

This chapter introduces a demand learning mechanism into a dynamic model of export participation. The parameters of the model are calibrated to match a set of empirical moments computed from the census of manufacturing plants in Colombia for the years 1981 to 1991. The resulting model successfully generates new exporter dynamics that are consistent to what is observed in data. These dynamics can be summarized as: small export-sales ratios and continuation rates for new exporters compared to more experienced firms, as well as both variables being increasing in the number of years a firm has been exporting.

The calibrated parameters indicate that, the fixed costs associated to exporting represent around 15% of the export sales of the median exporting firm, a number that is considerably lower to what is obtained by models ignoring new exporter dynamics and heavily relying on sunk-costs. Regarding the parameters associated to the learning process, I find that the learning rate for the Colombian firms for this time period, is considerably low. These results are in line with the qualitative evidence collected by World-Bank (1992), in a set of interviews made to hundred of managers of Colombian plants during the same time period. In there, most of the answers suggested that lack of knowledge and information about the export markets, is one of the major determinants of the low participation rates.

Then, using the calibrated model, I evaluate the efficiency of policies subsidizing a fraction of the fixed costs to all and new exporters. In terms of benefit-cost ratios, policies subsidizing exporters with less than 3 years of experience are more effective than the ones targeted to all the exporting firms, given that these policies compensate for the high level of uncertainty faced by new exporters and avoid wasting resources in subsidizing mature exporters.

Chapter 3

Dynamic Pricing and Exchange Rate Pass-Through in a Model of New Exporter Dynamics

3.1 Introduction

Using data for several countries and time periods, an emerging stream of research has documented that the dynamics of exporters are characterized by a series of empirical regularities (see for example Ruhl and Willis (2017), Eaton et al. (2007), and Berman et al. (2019)). First, new exporters are smaller than established exporters; and the gap between them gradually closes as these new entrants accumulate experience in the international markets. Second, exporting entails a high degree of failure mostly for young exporters and survival rates considerably improve with tenure in the export markets.[1] These dynamic facts have prompted the emergence of several theories that rely on a wide variety of mechanisms such as productivity shocks, financial constraints, and demand learning. More recent theoretical developments have stressed the importance of demand dynamics to explain these regularities. In these models, new firms face a low demand for their products due to some frictions produced by the presence search and advertisements costs, incomplete information or sticky customer base formation. As firms gain experience, the frictions hindering their ability to grow ease, and firms are able to gradually expand into the export markets.

In this chapter, I empirically explore the importance of demand dynamics in explaining the

[1] In what follows, I use interchangeably the terms age and tenure to denote the years of experience in the export markets.

growth process of new exporters, and put particular focus on the underlying mechanisms generating these dynamics. Using detailed custom-level data for Colombia containing information on firms' export sales, quantities, destinations and ten-digit product codes for the period 2008 to 2018, I document the following stylized facts. First, I confirm that sales and survival rates increase with age in the international markets.[2] Second, I estimate the trajectory of firm-level prices and find that export prices also increase with age. Overall, these findings indicate that the observed growth of exporters is mostly explained by increases in the demand shifters, and that exporters actively influence the demand accumulation process through their pricing decisions. The latter is consistent with an endogenous demand accumulation narrative in which upon entering a market, exporters initially charge low prices to boost their future demand and then gradually increase their prices once they have sufficiently expanded their customer base.

I then study the relation between prices and exchange rates and empirically estimate the responsiveness of international prices to changes in the exchange rate. As noted by Burstein and Gopinath (2014), this type of study could be informative of the nature of the demand faced by exporting firms and contribute to our understanding of the presence of real rigidities in the economy. Formally, I estimate the elasticity of producer prices denominated in Colombian pesos with respect to the bilateral exchange rate and use this information to infer by the extent by which Colombian firms change their international prices denominated in foreign currency in response to bilateral exchange rate shocks (i.e. the exchange rate pass-through). The results suggest that the exchange rate pass-through (ERPT) is less than one, meaning that Colombian exporters incompletely transmit exchange rate shocks into their international prices. Additionally, I conjecture that the dynamic pricing behavior observed in Colombian exporters can have important implications for the firm heterogeneity in exchange rate pass-through. Specifically, I examine differences in the exchange rate pass-through rates over the life cycle of exporters. The empirical estimations reveal a robust relationship between exchange pass-through and tenure in the export markets. In particular, new exporters exhibit substantially higher pass-through rates than incumbent exporters.

To rationalize the empirical findings, I embed a model of customer base accumulation due to deep habits as in Ravn et al. (2010) into an otherwise standard dynamic discrete choice model of exporting. A key feature of this model is that pricing decisions of the exporters become dynamic, and exporters face a tradeoff between *invest* and *harvest* motives. On the one hand, exporters have incentives to lower prices to boost their future demand, at the expense of current profits. On the other, they have incentives to increase their current prices and fully exploit the customers they have accumulated. This mechanism generates increasing-with-age

[2] More precisely, I define as a market a product-destination pair, and for age, I refer to the number of consecutive years a firm has been active in a market.

dynamics of sales and prices, as observed in the data. With the inclusion of fixed and sunk costs and additional sources of firm and aggregate uncertainty, the model is well suited to reproduce the high exit rates of new exporters as these firms start with low levels of profits and are therefore less likely to cover the continuation costs of exporting. Moreover, this model has important predictions for the variation of the price response to exchange rate movements across firms. In particular, young firms that are close to the exit margin are more likely to transmit a higher fraction of these shocks into their prices, while experienced exporters partially absorb these shocks in order to keep their prices and customer base stable.

To further explore the mechanisms behind this model, I calibrate the model to match a set of static and dynamic moments obtained from Colombian exporters. The model correctly predicts that sales, survival rates, and export price increase with tenure, and it generates incomplete exchange rate pass-through that is heterogeneous across the exporter's lifecycle. Then, using the calibrated model which features realistic firm-level export transitions and grow, I study the implications on the aggregate trade response to permanent and temporary trade shocks. In response to a temporary exchange rate depreciation, the transmission into the prices faced by the foreign consumers is incomplete. In particular, older exporters that are more important for trade volumes barely adjust their prices (and hence their quantities), which results in an aggregate elasticity to changes in the exchange rate below one. When the economy is hit by a permanent decrease of tariffs, the model produces a sluggish response of aggregate trade volumes that is driven by the firm-level adjustments in the customer base. The gradual adjustment in the intensive margin coupled with the increase in importance of the extensive margin induces a discrepancy between the short run and long run trade elasticities, as has been extensively documented in the literature.

Relation to the Literature

This chapter joins an emerging body of literature on the dynamics of new exporters. In their seminal paper, Ruhl and Willis (2017) document the different dynamics of new and established exporters using data on Colombian manufacturing plants. Additionally, the authors show that models relying on sunk costs and productivity heterogeneity are unable to generate increasing-with-age export sales and continuation rates; they propose an extended model featuring a foreign demand function that increases with the number of years a plant has been exporting and stochastic entry costs. In particular, this chapter contributes to the literature stressing the importance of demand dynamics. Nguyen (2012), Timoshenko (2015) and Berman et al. (2019) have incorporated demand uncertainty and passive learning to generate exporter dynamics. In these passive learning models, firms facing an uncertain demand can learn more about it by simply accumulating experience in the international markets. In a second class of models of firm dynamics, referred to as active learning models, firms make decisions that influence their future profitability. For instance, Drozd and Nosal (2012) and Fitzgerald et al. (2016) incorporate costly market share formation and marketing and advertisement costs as the main drivers. Closely related to the research in this chapter are Foster et al. (2016) for domestic firms and Piveteau (2020) for exporters; both develop models in which the customer base accumulation process depends on past sales. In this chapter, I provide compelling evidence suggesting that firms adjust their prices to grow in the international markets, which is consistent with a narrative of using prices to foster the accumulation process, and is at odds with the predictions of models relying on non-pricing investments to accumulate demand.[3]

Additionally, my work is motivated by the literature studying the relationship between international prices and exchange rate fluctuations. Several papers have documented the coexistence of large movements in bilateral exchange rates and import prices that are stable in the local currency. In a comprehensive study for 23 OECD economies, Campa and Goldberg (2005) estimate an average pass-through elasticity of 46%. Using data for 51 countries, Bussière et al. (2020) report that exchange rate pass-through into export and import prices is incomplete for most countries, and find substantial differences between advanced economies and emerging markets. For Colombia specifically, Casas (2020) estimates the ERPT into export and import prices for manufacturing firms and explores the role of intermediate inputs to explain the variations across industries. This chapter is close to the literature stressing the importance of real rigidities to explain the gradual response of prices to exchange rate shocks. This literature has used underlying mechanisms such as firm heterogeneity (Berman et al. 2012, Burstein and Gopinath 2014 and Li et al. 2015), import intensity of intermediate inputs (Amiti et al. 2014), distribution costs (Corsetti and Dedola 2005) and strategic complementarities (Amiti et al. 2016 and Gopinath et al. 2020). Similar to Jacob and Uusküla (2019), I use a habit-formation model to explain incomplete exchange rate pass-through into international prices. At the core of this mechanism is the effect of the sales smoothing incentive in which firms find optimal to adjust their profit margins in order to limit the effect on future demand. This chapter contributes to the literature in two ways. First, it provides empirical evidence suggesting that exporters have a heterogeneous response to exchange rate shocks over the lifecycle. Second, it extends the analysis of Jacob and Uusküla (2019) by allowing firm heterogeneity and endogenous entry and exit. With these two features, the model is able to generate different price responses to exchange rate fluctuations across new and incumbent exporters. In that regard, this chapter is related to papers by Gilchrist et al. (2017) and Hong (2017), which study in a closed-economy context, the implications of financial distortions and size differences on the countercyclicality of markups.

[3]These type of models will predict constant prices over time.

Finally, this chapter is akin to the literature documenting a discrepancy between the short-run and long-run aggregate trade responses to external shocks. Using a model featuring plant heterogeneity, sunk costs and aggregate fluctuations, Ruhl (2008) finds that the discrepancy between short- and long-run trade elasticity is mainly driven by the differential response of exporters to temporary and permanent shocks. On the one hand, since temporary shocks affect the expected future profits of firms very little, few firms change their export status and most of them respond by making adjustments in the intensive margin. On the other hand, when the shocks are persistent or even permanent, the expected profits of firms are affected. As a consequence, some firms are more likely to make adjustments in the extensive margin, which amplifies the aggregate trade response. Moreover, related literature has studied the transition dynamics of aggregate trade flows. For instance, Alessandria et al. (2014) employ a micro-founded general equilibrium model in which the aggregate trade dynamics depend on producer-level investments to lower their future export variable costs, while Alessandria et al. (2013) develop a model in which interest rates dampen the response of aggregate exports to shocks. In both papers, the aggregate response of trade flows is sluggish and takes several periods to fully reflect the effects of the shock. In this chapter, I use a partial equilibrium model calibrated to produce realistic firm-level export transitions and growth, which allows me to assess the response of aggregate trade flows to shocks of different natures.

The rest of the chapter is organized as follows. The next section discusses the data and documents a series of stylized facts about the dynamics of exporters and firm-level exchange rate pass-through. In Section 3.3, I develop a dynamic discrete choice model of exporting that is consistent with these facts, and in Section 3.4 I discuss the calibration and its quantitative fit. Lastly, in Section 3.5 I examine the aggregate implications of the model.

3.2 Empirical Findings

In this section, I describe the main features of the Colombian custom-level data used and provide some facts regarding the main characteristics of exporters, the prevalence of new exporters and their importance for the aggregate export flows. I then study firms' export dynamics and further investigate the underlying mechanisms generating them. In particular, I empirically estimate the post-entry trajectories of export sales, prices and survival rates across Colombian exporters. Additionally, I explore to what extent these observed dynamics are relevant in explaining the degree of response of firm-level prices to bilateral exchange rate shocks. Thus, I estimate the elasticity of producer prices (denominated in foreign currency) with respect to the bilateral exchange rate, and from this estimate, I infer the exchange pass-through into the prices faced by foreign consumers. Finally, I examine possible differences in the firm-level pass-through over the life cycle of exporters.

3.2.1 Data Description and Summary Statistics

The international data used in this chapter is from the Dirección de Impuestos y Aduanas Nacionales (DIAN) and the Departamento Administrativo Nacional de Estadística; it includes detailed information on the universe of exporters in Colombia. This data contains the firm's tax identification number, a 10-digit product code based on the Nandina classification system, country of destination, F.O.B. export value (in U.S. dollars and in Colombian pesos), and quantity (number of units). The data covers the period from 2008 to 2018 and is available on a monthly basis. Two of the major concerns when working with monthly data are seasonality and sparsity because very few firms export the same product to the same destination every month. To alleviate this issue, I aggregate the data at the annual level. Further, to improve the reliability of the data, several cleaning procedures are adopted. In order to limit the impact of changes in the classification of the products, I restrict the sample to the product codes that consistently reported a positive export value during all the quarters between 2008 and 2018. Also, as is common in the empirical trade literature, I exclude all the products related to the petroleum industry.[4] Similarly, only destination countries with positive export values in all the quarters are considered, and I exclude all the exports in which the destination is a *zona franca (free trade zone)*.

First, I document some facts about Colombian exporter's characteristics. Table 3.1 reports some moments of the distribution of export sales, number of 10-digit coded products, and number of destinations across Colombian exporters for the year 2014.[5] Consistent with what has been documented in the literature, Colombian data exhibits a substantial skewness in the distribution of all the variables considered. For instance, firms in the 25th percentile of the distribution of export value sold approximately $5,000 in 2014, while firms in the 99th percentile exported around $42 million, the average export value was $2.8 million. Colombian firms exported, on average, 3.7 different products to 2.8 destinations; firms on the 25th percentile of the distribution exported one product to one destination while firms in the 99th percentile exported 35 products to 22 different countries.

[4] Specifically, all products from the 4-digit code 2709-Petroleum Oils And Oils From Bituminous Minerals, Crude are excluded from the dataset.

[5] The choice of the year is arbitrary, and the distributions for other years share similar features.

Table 3.1: Exporter Characteristics

Distribution of Colombian exporters in 2014

	Exports (Th. $)	Products	Countries	Product×Country
25th	5	1	1	1
50th	24	1	1	2
75th	186	3	3	6
99th	42,198	35	22	109
mean	2,891	3.699	2.794	8.360
s.d.	43,482	7.217	4.178	27.338
N	7,316	7,316	7,316	7,316

Source: own calculation with data from DANE.

Additionally, I explore the distribution of export spells in the data. An export spell is defined as the number of consecutive years that a firm has exported the same product, to the same country, or the same country-product pair. Given I cannot determine the year firms already exporting in 2008 entered the market, I only focus on the observations whose first appearance in the sample was after 2009. Table 3.2 reports that on average, the export spells last 1.83, 1.60 and 1.70 years at the country, product and country-product level, respectively, and the median export spell is one year in each of these cases. Contrary to the notion that exporting is a long-lasting activity, these findings suggest that the bulk of export transactions are characterized by short duration spells.

Table 3.2: Export Spells Distribution

	mean	p5	p25	p50	p75	p95
Spells duration (in years)						
firm-country	1.83	1	1	1	2	6
firm-product	1.60	1	1	1	2	5
firm-country-product	1.70	1	1	1	2	5

Source: own calculation with data from DANE.

Finally, I study the firm turnover and the importance of new exporters in the different export destinations. Table 3.3 reports the median value across countries of the entry rate, exit rate, and revenue share of new exporters for several years.[6] The entry rate is computed as the fraction of firms selling in a country in year t and that were not exporting in year $t-1$. On average, approximately 42% of the firms active in a country were new exporters. The exit rate, defined as the fraction of firms that exported in period t and ceased to export in year $t+1$, is on average 41%. Both results indicate that firms enter and exit the export markets actively, and the firm turnover rates are high. Revenue share is computed as the sum of the export value of firms that are active in a given destination in period t, but that were inactive in period $t-1$, divided by the total export value in a given destination in period t. Reported in Table 3.3 is the median revenue share across destinations for every year. On average, over all the years considered, new exporting firms accounted for 9.9% of the total value exported.

Table 3.3: Firm Entry and Exit

	2010	2012	2014	2016	Average
Entry Rate	44.2%	40.0%	42.0%	39.6%	42.2%
Exit Rate	45.2%	40.0%	37.5%	37.4%	41.2%
Revenue Share New Exporters	10.3%	08.4%	07.7%	06.6%	09.9%

Source: own calculation with data from DANE.

To sum up, I find that an important share of exporters are new exporters in many countries; most of them export for a short period of time and eventually stop exporting after a few years.

3.2.2 Stylized Facts

To have a better understanding of the evolution of Colombian exporters, I estimate the trajectories of export sales, prices, and continuation rates over the exporter's life-cycle. As described by Berthou and Vicard (2013) and Bernard et al. (2017), when working with detailed datasets, the estimated dynamics of new entrants may be subject to an issue known as partial-year bias. This bias induces an underestimation of the variables of interest during the first years and is produced by the fact that exporters might enter into a market late in the year. To illustrate this concept, consider two identical exporters entering the market in the same year, where firm A entered in January and firm B in December. Suppose that after entry, both firms sell the same amount every month ($ 100) for the next two years. When exports are aggregated at the calendar year level, the export value in the entry year for firm A will be $1,200 and for firm B

[6] I exclude the years 2008 and 2017 because by construction the entry rate is equal to 100% in the former and the exit rate is also 100% in the latter.

only \$100, and in the subsequent year both firms will report sales for \$1,200. Although both firms behave similarly upon entry, simply comparing the annual export values across calendar years will give the false impression that firm A is selling much more than firm B in the entry year.

To correct this bias, I implement the following procedure. For every firm-product-destination triplet, I identify the year and month of entry into the sample and recompute calendar years based on 12-month periods after the observed month of entry. For instance, for a firm that entered a market in June 2009, I aggregate all the observations between June 2009 and May 2010 and consider them as if they had happened in the first year, namely 2009. Similarly, all the observations between June 2010 and May 2011 are considered to belong to 2010 and so on. Naturally, I restrict the sample to all the observations whose first appearance in the sample is after 2008, given that otherwise it is impossible to determine the true year of entry.

For the rest of the empirical analysis, I define a *market* as a product-destination pair (where the product is given as the 10-digit Nandina code). Export sales are denominated in U.S. dollars; to aggregate them at the firm-market-year level, first I deflate the monthly values using a monthly price index for exporters provided by DANE. Then, the annual value is computed as the sum of the deflated exports across the reconstructed years. The prices are approximated by the unit value, namely the deflated export value divided by the number of units shipped. The yearly value corresponds to the mean unit value across each firm-market-year. Constructing annual unit values either using the median or the revenue weighted average, produces similar results.

New Exported Dynamics

Following Piveteau (2020), I estimate the following specification to document the life-cycle of the continuation rates, log exports and log unit values:

$$y_{jpdt} = \phi + \sum_{a=2}^{9} \phi_a \mathbb{1}\{age_{jpdt} = a\} + \gamma_{dt} + \gamma_{jpt} + \epsilon_{jpdt} \tag{3.1}$$

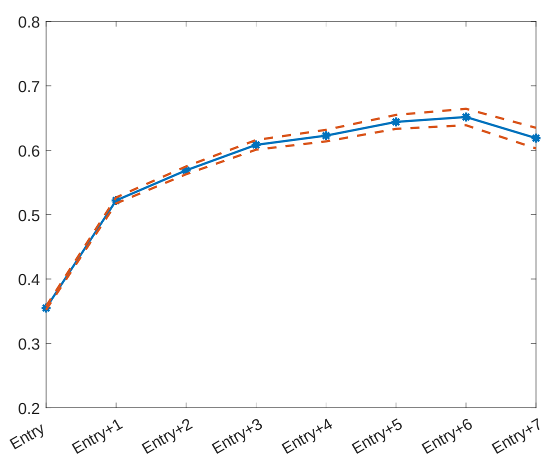
where y_{jpdt} is the either the logarithm of the real sales, unit values or a dummy equal to one if the firm still exporting the next year and zero otherwise, for firm j exporting product p to country d in year t. The age in a market, age_{jpdt} is denoted as the number of reconstructed years that firm j has consecutively exported the same product to the same destination. I include destination-year fixed effects (γ_{dt}) to control for any aggregate trends that might affect the outcome variables, and also firm-product-year fixed effects (γ_{jpt}) to control for any differences in productivity across firms. In all the specifications, the reference (excluded) category is $age = 1$ therefore the coefficients ϕ_a measure the partial effect of age relative to the the level of the variable of interest upon entry.

Fact 1: Continuation rates are low for new exporters and increase with years of tenure in the export market.

Figure 3.1 reports the estimated continuation rates for different years of tenure. As is common in trade data, the survival rates are considerably low and the data exhibits high levels of attrition. For new exporters, the probability of staying in the same market for an additional period is roughly 35%. This survival rate increases to 53% for firms that have been exporting for two consecutive years; it then plateaus around 65% for subsequent years of experience. These estimates are considerably lower than the ones reported by Ruhl and Willis (2017) for Colombian manufacturing firms. They report survival rates of 63% and 77% for firms with one and two years of tenure, respectively. One possible explanation for this discrepancy is the difference in the level of disaggregation of the data; Ruhl and Willis (2017) use data that is aggregated at the firm level and I use data at the firm-product-destination level.

These low and increasing survival rates have important implications for the modelling strategy, and stress the importance of incorporating endogenous entry and exit into the model to produce realistic transitional dynamics for new exporters.

Figure 3.1: Continuation rates

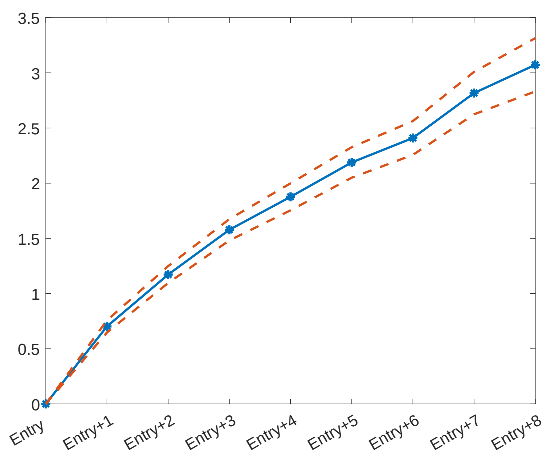


Fact 2: New exporters start selling small amounts. Export sales consistently increase with tenure, mainly during the first years.

Figure 3.2 plots the estimated age-coefficients for the regression on export sales along with the 95% confidence interval. As can be noted, exports sales consistently grow with tenure, especially during the first years. On average, the export value of a firm that has exported for three consecutive years is more than twice that of the export value upon entry. That level almost triples for firms that have exported for nine straight years. This indicates that although export sales increase with tenure, the first years are when most of this grow happens.

The first two stylized facts are in line with the patterns documented in the literature. Moreover, in this chapter I show that existing results about exporter dynamics using more aggregate data, carry over at the firm-product-destination level.

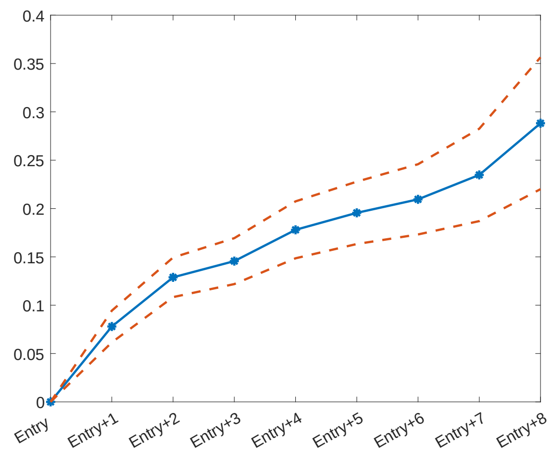
Figure 3.2: Export sales dynamics



Fact 3: Export prices, proxied by unit values, also increase with the years of experience in a market.

Now, I explore the potential mechanisms explaining the observed growth in exports. In particular, I study whether price adjustments upon entry might be an important source of growth. As described by Figure 3.3, export prices also increase with age, which is consistent with predictions made by models featuring customer base accumulation through dynamic manipulation of prices. In such models, because changes in prices have effects on the trajectory of future demand, firms have incentives to lower their prices as a way to attract more consumers. One of the implications of such behavior is that the prices charged by new exporters should be lower than those of experienced firms. Importantly, these dynamics cannot be easily generated by models relying on stochastic productivity or passive learning as the main source of heterogeneity across firms. In particular, because in these models prices reflect constant markups over the marginal costs, a constant or decreasing-with-age trend in prices should be observed. Overall, these findings provide support to the deep-habits mechanism used in the following section.

Figure 3.3: Export price dynamics



In the estimated dynamics, I include all observations from the moment they are first observed in the sample until they exit the market. Given that exporters lasting only two years may be substantially different from those exporting for nine consecutive years, one major concern is that the estimated evolution of the variables of interest over the lifecycle might be affected by selection. As a consequence, the inclusion of firms with different lengths of export spells could produce biased age coefficients that are conditional on the survival of firms in export markets. To ensure that the results are not sensitive to the inclusion of observations with short duration, I reestimate the dynamics of export sales and prices but I restrict the sample to firms that survived more than four, six, and eight years, respectively. The results are depicted in Table 3.4, along with estimations that include all the observations. As can be noted, for the different years of survival, most of the age coefficients are statistically significant and the increasing trend is preserved. These alternative specifications confirm the previous results that sales increase with age, and that exporters use their prices to accumulate demand.

Exchange Rate Pass-through

In this subsection, I study the relation between prices and exchange rates. The latter can be informative of the nature of the demand faced by exporters, and shed some light on the frictions shaping the exporter's response to exchange rate shocks. I start by estimating the responsiveness of firm-level prices to exchange rates. Influenced by the empirical literature on exchange rate pass-through, I estimate the first-difference specification given by:

$$\Delta \ln p_{jpct} = \beta_0 + \beta_e \Delta \ln e_{ct} + \gamma_c + \gamma_{jp} + \epsilon_{jpct} \tag{3.2}$$

Table 3.4: Estimation results

	Export sales				Export prices			
		Products surviving				Products surviving		
	All	4 years	6 years	8 years	All	4 years	6 years	8 years
Age = 2	0.700***	0.518***	0.602***	0.984***	0.0764***	0.0306*	0.0367	0.0375
	(0.0151)	(0.0373)	(0.0640)	(0.132)	(0.00778)	(0.0164)	(0.0261)	(0.0482)
Age = 3	1.164***	0.950***	1.204***	2.036***	0.121***	0.0523***	0.0775***	0.108*
	(0.0193)	(0.0425)	(0.0724)	(0.163)	(0.00936)	(0.0178)	(0.0289)	(0.0653)
Age = 4	1.566***	1.260***	1.621***	2.808***	0.134***	0.0502***	0.0875***	0.104
	(0.0240)	(0.0456)	(0.0773)	(0.182)	(0.0109)	(0.0191)	(0.0316)	(0.0764)
Age = 5	1.861***		1.972***	3.545***	0.162***		0.0911***	0.105
	(0.0295)		(0.0853)	(0.200)	(0.0129)		(0.0349)	(0.0858)
Age = 6	2.167***		2.173***	4.158***	0.174***		0.105***	0.171*
	(0.0364)		(0.0919)	(0.219)	(0.0153)		(0.0369)	(0.0947)
Age = 7	2.389***			4.882***	0.188***			0.229**
	(0.0442)			(0.236)	(0.0175)			(0.101)
Age = 8	2.813***			5.395***	0.230***			0.240**
	(0.0567)			(0.255)	(0.0232)			(0.112)
Age = 9	3.063***				0.278***			
	(0.0817)				(0.0349)			
Observations	215,864	47,021	28,639	15,959	215,864	47,021	28,639	15,959

Notes: All regressions include firm-product-year plus country-year fixed effects. Standard errors clustered at the firm-year.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

where p_{jpct} is the export price denominated in Colombian pesos, for firm j exporting product p to country c in year t. The bilateral exchange rate e_{ct} is expressed as Colombian pesos (COP) per unit of country c's currency, meaning that an increase in e_{ct} represents a depreciation of the Colombian peso. The regressions include fixed effects γ_c and γ_{jp} to absorb any time-invariant variation at the country and firm-product level. The coefficient of interest is β_e, which measures the elasticity of the log-change of the destination-c producer-currency price relative to the log change in the bilateral exchange rate. From it, we can easily compute the ERPT rate as $1-\hat{\beta}_e$, which measures the elasticity of the import price denominated in foreign currency to a change in the bilateral exchange rate (measured as units of foreign currency per Colombian peso). Therefore, $\hat{\beta}_e = 0$ indicates complete pass-through and $\hat{\beta}_e > 0$ incomplete pass-through.

The results are depicted in Table 3.5; at the top, I report the estimated elasticity of export prices with respect to the bilateral exchange rate, and at the bottom the implied ERPT rate into international prices. Similar to evidence for other countries and datasets, the ERPT is incomplete. The first column contains the results for the whole sample and the estimations suggest that a 1% increase in the bilateral exchange rate is associated with a .58% increase in the international prices denominated in foreign currency. The ERPT rate obtained is within the range of values reported in the literature. For instance, Bussière et al. (2020) estimates ERPT for 51 advanced and emerging countries, and in particular for Colombia. In their baseline specification the authors obtain a ERPT of 0.687 for Colombia, while for manufacturing industries, Casas (2020) estimates an ERPT rate of .466.

I include a set of robustness tests. First, I address the fact that an important number of firms export several products to the same destination; therefore, the inclusion of multi-product exporters might confound adjustments through the intensive margin, with adjustments along the extensive margin and the product scope. To partially solve this issue, I follow Berman et al. (2019) and estimate the same regressions for two alternative subsamples. The second column restricts the sample to each exporter's major product (i.e. the product representing the highest revenue share in a destination), and the third column restricts the sample to single-product firms, that is the ones that exported only one product to a single destination. The estimated ERPT for the major products is relatively close; however, the estimated ERPT for single-product firms is lower.

Another major concern in the Colombian data, documented by Gopinath et al. (2020), is that the vast majority of trade is invoiced in a small number of dominant currencies. The authors find that approximately 98% of the transactions are invoiced in U.S. dollars, thus estimating the ERPT using only bilateral exchange rates between the local currency unit (LCU) and the Colombian peso may omit the fact that the exchange rate with the dollar might be relevant. Therefore, in columns four to six, I repeat the same estimation with focus on only the firms exporting to the U.S. Naturally, the estimated degree of pass-through is reduced to .246 and the estimates for the subsamples of the major products and single-product firms yield closer estimates.

Table 3.5: ERPT results

	Δp_{COP}	Δp_{COP}	Δp_{COP}	Δp_{COP}	Δp_{COP}	Δp_{COP}
		Major product	Single product		Major product	Single product
$\Delta e_{COP/LCU}$	0.420***	0.507***	0.638***	0.754***	0.728***	0.829***
	(0.0278)	(0.0264)	(0.0584)	(0.0671)	(0.0739)	(0.171)
ERPT	0.580	0.493	0.362	0.246	0.272	0.171
Observations	338,926	108,643	24,133	34,467	11,262	2,096
Destinations	ALL	ALL	ALL	USA	USA	USA

Notes: All regressions include firm-product and country fixed effects. Standard errors clustered at the firm-year level are depicted in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Finally, I study the relationship between the extent of pass-through and the age of firms in the export markets. To do this, I estimate specification (4.2) separately for new entrants and incumbent exporters. New entrants are defined as exporters that have been active in a market for less than 3 years, while incumbents are exporters with three or more years of experience. Alternatively, I estimate a regression that includes the interaction between the bilateral exchange rate and age in a market given by:

$$\Delta \ln p_{jpct} = \beta_0 + \beta_e \Delta \ln e_t + \beta_a age_{jpct} + \beta_{ea} \Delta \ln e_t \times age_{jpct} + \gamma_c + \gamma_{jp} + \epsilon_{jpct} \tag{3.3}$$

The variable age_{jpct} measures the number of consecutive years of experience that firm j has in the market for product p in country c. These estimates exclude from the sample all the left-censored observations whose first appearance in the sample is during 2008. Results for all the destinations and the ones focusing on the U.S. are depicted in Table 3.6. Columns (1) and (4) report the estimates for all the non-censored observations, columns (2) and (5) for the new entrants, columns (3) and (6) for incumbent exporters and columns (4) and (7) for the regressions including the interaction term. At the bottom, I compute the implied ERPT, and for the regressions with interaction, I compute the ERPT evaluated at the mean of the age. Estimation results when all destinations are included indicate that, on average, new exporters exhibit a pass-through rate that is almost double that of incumbent exporters. This is confirmed by the alternative specification, given that the estimate coefficient $\hat{\beta}_{ea}$ is positive, implying that an extra year of tenure increases the producer price elasticity in .10 points, which in turn reduces the amount of pass-through into international prices. Moreover, the ERPT evaluated on the average age in the sample yields a similar rate as in the regression that includes all the non-censored observations (column 1).

For the estimates that only focus on exports to the United States, a similar pattern is observed. Although smaller pass-through rates are estimated, it remains true that new exporters exhibit different pass-through rates than incumbents, with the difference almost three times higher. Additionally, the interaction coefficient is positive and significant, and for every year of tenure the elasticity of export prices increases .11 points. Therefore, the ERPT decreases with tenure too.

Table 3.6: ERPT over the lifecycle

	Δp_{COP}	Δp_{COP}	Δp_{COP}	Δp_{COP}	Δp_{COP}	Δp_{COP}	Δp_{COP}	Δp_{COP}
		Age < 3	Age ≥ 3			Age < 3	Age ≥ 3	
$\Delta e_{COP/LCU}$	0.622***	0.540***	0.743***	0.287***	0.907***	0.758*	0.944***	0.478*
	(0.0337)	(0.0655)	(0.0409)	(0.0684)	(0.102)	(0.412)	(0.117)	(0.248)
Age				-0.0185***				-0.0186**
				(0.00262)				(0.00762)
Age$\times\Delta e_{COP/LCU}$				0.102***				0.115**
				(0.0163)				(0.0512)
ERPT	0.378	0.460	0.257	0.311	0.093	0.242	0.056	0.072
Observations	163,245	56,254	91,142	163,245	17,295	1,028	10,194	17,295
Destinations	ALL	ALL	ALL	ALL	USA	USA	USA	USA

Notes: All regressions include firm-product and country fixed effects. Standard errors clustered at the firm-year level are depicted in parentheses. All the left censored observations are excluded.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Fact 4: Exchange rate pass-through is incomplete and new exporters exhibit a higher pass-through than old exporters.

Overall, these findings suggest a substantial heterogeneity in the response to exchange rate shocks across firms. In particular, new firms transmit a higher fraction of exchange rate shocks into international prices, while incumbent firms partially absorb these shocks into their profit margins. The latter is consistent with the fact that firms in the early stages of their life-cycle tend to adjust their prices with more frequency. This pattern is in line with the research focusing on differences in size as the main explanation of ERPT heterogeneity. For instance, Li et al. (2015) and Berman et al. (2019) find that more productive firms price more to market and thus have lower ERPT into consumer prices. Given the limitations of my data, I cannot directly control for the size or productivity of firms as these papers do; however, I provide compelling evidence that new entrants are smaller than incumbent exporters, and thus it is plausible to conclude that the age effect is important to explain heterogeneity in price responses.

3.3 Model

In this section, I adopt the good-specific relative habit model by Ravn et al. (2010) and embed it into a dynamic discrete choice model of exporting. Motivated by the empirical findings, the model features endogenous entry and exit and demand-side dynamics governing the exporter's expansion into international markets. Specifically, the demand for an exporter's differentiated product depends on the realization of a habit shock that increases with the value of previous exports. I explore the ability of the model to produce the observed dynamics of sales, survival rates and prices, as well as the heterogeneous exchange rate pass-through over the life-cycle of exporters.

Discussion: The model employed in this chapter, is motivated by the extensive literature in industrial organization documenting the existence of inertia and state-dependence in consumer's demand. For instance, as extensively discussed in Dubé et al. (2010), it has been found that consumers become loyal to the products they have purchased in the past, suggesting the presence of a utility premium from continuously purchasing the same product or, equivalently, psychological cost to switching products. Although state dependence in the demand can be generated by different mechanisms, in this chapter I adopt a tractable model of deep habits formation. The choice of this model is supported by the empirical evidence on the dynamics of prices and exchange rate pass through provided in the previous section. In general, theories that introduce demand accumulation through non-pricing investments made by firms, are unable to generate prices that increase with experience.[7]

Additionally, the analytical framework is closely related to recent developments using deep habits to study firm dynamics. For instance, Moreira (2016) develops an industry model of firm dynamics with a similar demand accumulation process to study the procyclicality of the average size of new entrants. Gilchrist et al. (2017) propose a general equilibrium model in which firms face financial frictions while setting prices in customer markets to explain the empirical fact that in response to adverse financial or demand shocks, firms with limited internal liquidity increase their prices while their liquidity-unconstrained counterparts respond by cutting their prices. Hong (2017), using a general equilibrium model with endogenous entry and exit and deep habits, studies the importance of firm-level price-markup dynamics for business-

[7] See Drozd and Nosal (2012) and Fitzgerald et al. (2016) for examples of models in which firms make advertising investments to increase their customer base. These models predict that prices are constant.

cycle fluctuations. Unlike these models, this chapter focuses on how demand dynamics can explain the post entry growth of new exporters and specifically focuses on how exporters adjust their prices to expand their customer base. Moreover, it argues that this dynamic pricing behavior has important implications for the degree of response of foreign consumer prices to movements in the bilateral exchange rate. Although the above-mentioned documents share similar features with my model, none of them focus on the dynamics of exporters nor are they interested in the type of analysis developed here.

3.3.1 Set-up

Time is discrete and agents in the economy face an infinite horizon. There are two countries: home and foreign. The home country is populated by a continuum of firms producing a unique good that can be exported to the foreign country under a monopolistic competitive environment. The main focus is on decisions made by home exporters regarding their export status, prices and sales of their exported goods.

3.3.2 Demand

In the foreign country there is a representative consumer demanding goods indexed by $i \in \Omega$, which are produced by exporters located in the home country. The preferences of the foreign consumers are defined over a habit-adjusted bundle C_t given by:

$$C_t = \left[\int_{i \in \Omega} \left(c_{it} b_{i,t}^{\theta} \right)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}} \qquad \text{where } \theta > 0 \text{ and } \sigma > 1 \tag{3.4}$$

where c_{it} is the quantity demanded of good i and b_{it} is the good-specific habit shock that is assumed to be external and thus taken as given by the consumer. The elasticity of substitution across varieties is σ, and θ controls the degree of habit formation. It is assumed that the external habit evolves according to the following law of motion:

$$b_{i,t+1} = (1-\delta) b_{i,t} + \delta s_{it} \qquad \text{where } 0 < \delta < 1 \tag{3.5}$$

where $\delta \in [0,1]$ governs the depreciation rate of previous habit shock and determines how sales s_{it}, denominated in foreign currency, converts into habit shocks. As described by (3.5), the habit formation introduces a word-of-mouth mechanism in which current sales boost the habit shock faced the next period. One of the major implications of this mechanism is that the pricing decisions of home exporters become dynamic, and thus they have incentives to lower their prices upon entry to foster future demand.

3.3.3 Firm's Technology and Costs

In the home country, there is a continuum of monopolistically competitive firms producing a differentiated good that can be exported to the foreign market. Each firm can produce output y^*_{it} using a linear production technology:

$$y^*_{it} = z^*_{it} l^*_{it} \tag{3.6}$$

where z^*_{it} denotes the idiosyncratic productivity and l^*_{it} the labor employed which is paid the home wage w^*_t. All the variables related to the home country are denoted by an asterisk. The utility maximization problem solved by the foreign consumer, implies that the producer of good i faces the demand given by:

$$c_{it} = p^{c\,-\sigma}_{it} b^{\theta(\sigma-1)}_{i,t} S_t P^{\sigma-1}_t \qquad \text{where:} \quad p^c_{it} = p_{it}(1+\tau)+\phi \tag{3.7}$$

where the foreign expenditure allocated to consume home varieties is S_t. Notice that I assume that the price faced by the consumers p^c_{it} depends on the producer price (denominated in foreign currency), the import tariff τ, and an additive markup that can be attributed to distribution or retailing costs as in Corsetti and Dedola (2005). It is important to mention, that the predictions of the model hold without the inclusion of ϕ; however, I use that parameter to effectively control the degree of passthrough into consumer prices. The habit-adjusted price index P_t is then given by:

$$P_t = \left[\int_{i\in\Omega} \left(\frac{p^c_{it}}{b^{\theta}_{i,t}} \right)^{1-\sigma} di \right]^{\frac{1}{1-\sigma}} \tag{3.8}$$

Let $X_{it} \in \{0, 1\}$ be an indicator for participation. The per-period profits denoted in terms of the foreign currency are given by:

$$\pi_{it}(X_{i,t-1}, b_{it}, z^*_{it}, e_t, p_{it}) = (p_{it} - mc_{it})(p_{it}(1+\tau)+\phi)^{-\sigma} b^{\theta(\sigma-1)}_{it} A_t - F_t - (1 - X_{i,t-1}) S_t \tag{3.9}$$

where $A_t \equiv S_t P^{\sigma-1}_t$ is the aggregate demand shifter, and $mc_{it} \equiv w^*_t/(e_t z^*_{it})$ is the marginal cost expressed in foreign currency using the bilateral exchange rate e_t. To enter the export markets, firms must pay a sunk cost S_t and then a fixed cost F_t for every period they wish to remain in the international markets. Notice the underlying assumption that export sales are priced in foreign currency, a feature known in the literature as local currency pricing.

In this model, firms face two persistent sources of uncertainty: one idiosyncratic and the other at the aggregate level. I assume that the productivity and the bilateral exchange rate follow AR(1) processes given by:

$$\ln z^*_{it} = \rho_z \ln z^*_{it-1} + \epsilon^z_{it} \qquad \epsilon^z_{it} \sim \mathrm{N}(0,\sigma^2_z)$$

$$\ln e_t = \rho_e \ln e_{t-1} + \epsilon^e_t \qquad \epsilon^e_t \sim \mathrm{N}(0,\sigma^2_e)$$

3.3.4 Dynamic Programming Problem

Every period, firms make a discrete choice decision about its export status and, conditionally on entry, choose the price of their exports. The firm's state variables are composed by the individual states $(X_{i,t-1}, b_{i,t}, z^*_{i,t})$ and the aggregate state variable e_t. The value function of the firm can be written as:

$$V(X_{i,t-1}, b_{it}, z^*_{it}, e_t) = \max_{X_{it}\in\{0,1\},\, p_{it}} \left\{ X_{it} \cdot \pi_{it}(X_{i,t-1}, b_{it}, z^*_{it}, e_t, p_{it}) + \beta \mathbb{E} V(X_{it}, b_{i,t+1}, z^*_{i,t+1}, e_{t+1} \mid z^*_{it}, e_t) \right\} \tag{3.10}$$

$$\text{s.t} \qquad b_{i,t+1} = (1-X_{it})b_0 + X_{it} \cdot \left\{ (1-\delta)b_{it} + \delta\Big[(p_{it}(1+\tau)+\phi)^{1-\sigma} b_{it}^{\theta(\sigma-1)} A_t \Big] \right\}$$

By choosing to be inactive in one period ($X_{it} = 0$), a firm earns zero profits and its habit shock resets to b_0; however, it maintains the possibility of entry into the export market the next period in case it receives favorable shocks in the future. Importantly, to be allowed to re-enter in future, the firm will have to pay the entry costs $F_t + S_t$. A more interesting case occurs when a firm chooses to be active ($X_{it} = 1$) because the firm also has to choose the optimal price p_{it} of its exports. Because of the presence of habit shocks that depend on past sales, exporting firms face a dynamic trade-off between setting high prices to *harvest* current profits, or lowering prices to attract more consumers and *invest* in its customer base.

To gain more insight into the dynamic incentives faced by exporters, I focus on a simplified version of the model in which $p^c_{it} = p_{it}$ (thus $\tau = \phi = 0$) and without re-entry, therefore I normalize the exit value to zero.[8] For this simple model, I derive the Euler equation, which describes the markup dynamics (full derivation in the Appendix):

$$\mu_{it}^{-1} - \bar{\mu}^{-1} = \beta \mathbb{E}\left\{ X_{i,t+1} \left[\frac{\theta\delta p_{i,t+1} c_{i,t+1}}{\sigma b_{i,t+1}} \mu^{-1}_{i,t+1} + (1-\delta)(\mu^{-1}_{i,t+1} - \bar{\mu}^{-1}) \right] \right\} \tag{3.11}$$

where $\mu_t = \frac{p_t}{mc_t}$ and $\bar{\mu} \equiv \frac{\sigma}{\sigma-1}$ is the CES markup. Equation 3.11 makes apparent the dynamic

[8]The resulting continuous-discrete choice problem has been extensively studied in the industrial organization literature. See Pakes et al. (1991) for a more detailed treatment and derivation of the dynamic control problem.

nature of the problem solved by the firms. By lowering their markup today, exporters can influence the habit accumulation process and shift their foreign demand tomorrow. In general, the optimal markup charged by firms is below the optimal markup charged by a firm solving a static profit maximization problem (i.e. the CES markup $\bar{\mu}$). Interestingly, the strength of the incentives to charge low markups depends on the expected continuation decision ($\mathbb{E}[X_{i,t+1}]$). That is, the closer the firms are to the exit margin the less incentives they have to accumulate future demand.[9]

In addition, the model has strong predictions for the dynamics of exporters. First, given that exporters start with a habit shock (b_0) that is below the steady state value, the export sales of new exporters upon entry are lower than the ones of incumbent firms. As firms continue to export, they are able to further accumulate their customer base and gradually increase their foreign demand. Additionally, the model endogenously produces a negative relationship between firm growth and age, even conditional on size. In particular, exporters with high levels of customer base grow at a smaller rate because their habit shock is close to the steady state level, and therefore, they have less incentive to keep making investments in their customer base.

Second, young exporters have lower markups than incumbent exporters and their markups converge to the steady state level from below. This is depicted in the right-hand side of equation 3.11. The first term in the square bracket $\frac{\theta\delta p_{i,t+1}c_{i,t+1}}{\sigma b_{i,t+1}}$ decreases with age, as the habit shock of firms that have been exporting for many periods is near the steady state and thus $b_{i,t+1}$ is closer to $p_{i,t+1}c_{i,t+1}$.[10] As this term decreases, the gap between μ_{it}^{-1} and $\bar{\mu}^{-1}$ closes. Finally, survival rates are initially low given that exporters start with low levels of sales and profits. However, these rates increase with size and tenure because old and large exporters with high levels of habit shock are less likely to exit the international markets.

Overall, the predictions of the model are in line with the empirical findings discussed in the previous section, namely, that export sales, continuation rates and prices increase with age in the export markets.

Deep Habits and Exchange Rate Pass-through

Now I examine the implications of the model for the degree of pass-through of exchange rates into international prices. To help visualize what factors affect the degree of firm pass-through in this model, I consider the special case in which the habit shocks completely depre-

[9] In fact, firms that are close to the exit margin $\mathbb{E}[X_{i,t+1}] \to 0$ will tend to charge markups closer to $\bar{\mu}$.

[10] This can be easily verified by observing the accumulation process of the habit shock described by equation 3.5. In steady state, $b_{ss} = p_{ss}c_{ss}$

ciate, hence $\delta = 1$. In this case, since $b_{i,t+1} = p_{it}c_{it}$ equation (3.11) can be rewritten as:

$$p_{it} = \frac{\sigma}{\sigma - 1}\left\{1 + \frac{\beta\sigma}{\sigma - 1}\mathbb{E}\left[X_{i,t+1}\frac{\theta\delta p_{i,t+1}c_{i,t+1}}{\sigma p_{it}c_{it}}\mu_{i,t+1}^{-1}\right]\right\}^{-1}\frac{w_t^*}{z_{it}^*}\frac{1}{e_t} \tag{3.12}$$

From equation (3.12) it is clear that the bilateral exchange rate directly affects the marginal costs of the firms and indirectly affects the expected growth rates and markups. Therefore, when the foreign currency depreciates or the Colombian peso appreciates, the exporting firms automatically experience an increase in marginal costs. It is evident that in the absence of deep habits, exporting firms charge myopic markups and thus fully transmit exchange rate movements into their prices. When the habit-formation mechanism is activated, the pass-through is incomplete, as exporters find it optimal to shrink their profit margins and current sales in order to limit the decline in future demand triggered by an increase in the marginal costs. Additionally, by allowing for endogenous entry and exit decisions, the model is able to generate a heterogeneous degree of pass-through across new entrants and incumbent exporters, which is in line with the previously documented empirical findings. In response to an adverse exchange rate shock, small and young firms that are near the exit margin, will have a lower valuation of the future expected profits and thus will have more incentive to increase prices in a higher proportion in order to increase their current profits before exiting the market. Alternatively, more established firms that are far from the entry-exit margin will maintain their incentive to invest in their customer base, and thus will incompletely transmit these shocks into their international prices.

The deep-habits mechanism has been previously used in the literature to study incomplete pass-through. In a seminal paper, Ravn et al. (2010) develop a relative deep-habits model to provide a theoretical explanation for the observed incomplete pass-through of marginal cost disturbances to prices. Drozd and Nosal (2010) evaluate the performance of different theoretical models and their ability to replicate a set of robust stylized facts about international prices. In particular the authors embed deep habits into a productivity shock-driven international business cycle model. One of their results regarding this model deserves careful consideration. In that paper, the authors find a negative exchange rate pass-through to export prices, a feature that is at odds with the empirical evidence available. In this chapter I follow a different modelling and calibration strategy, which could explain why I obtain different results. First, in Drozd and Nosal (2010), movements in the bilateral exchange rate are endogenously generated by deviations from the law of one price produced by country specific productivity shocks. Therefore, this model produces a negative correlation between export prices and exchange rates. In this chapter, I use a partial equilibrium model in which exchange rate fluctuations arise exogenously, which coupled with the assumption of local currency pricing resembles the theoretical analysis of pass-through and firm-specific cost shocks developed in Ravn et al. (2010). Closely related to this chapter is Jacob and Uusküla (2019), which uses a Neo-Keynesian model with additive habits and nominal frictions to explain incomplete exchange rate pass-through to international prices. In that paper, business cycle fluctuations are generated through perturbations in the uncovered interest rate parity (UIP), which weakens the negative correlation between export prices and exchange rates. Second, in Drozd and Nosal (2010), the parameters controlling the habit-formation process are calibrated exogenously and set to the values adopted in Ravn et al. (2010). Therefore, it is not clear whether the habit-formation mechanism is strong enough to offset the negative correlation between prices and productivity. Instead, I internally calibrate the deep-habits parameters to match moments related to firm dynamics and exchange rate pass-through.

3.4 Calibration

The model is calibrated to match a set of cross-section and dynamic features of Colombian exporters. To be consistent with the data, one period in the model corresponds to one year. The set of model parameters can be classified into two groups. The first group, reported in Table 3.7, includes parameters that are chosen based on the values used in the literature. As is standard for annual data, I assume that the inter temporal discount rate β is equal to 0.96, which implies an interest rate of 4%.

Table 3.7: Externally calibrated parameters

Parameter	Value	Source
β	0.96	Interest rate of 4%
σ	2	Piveteau (2020)
ρ_e	.92	AR(1) regression
σ_e	.78	AR(1) regression

Following Piveteau (2020), I set the elasticity of substitution σ to 2 which implies a CES markup of 200%. For the parameters that describe the process of the exchange rate, I estimate an AR(1) process for e_t using annual data on the real effective exchange rate for Colombia over the period 1980 to 2018. I find that $\rho_e = 0.92$ and $\sigma_e = 0.78$. The value of the nominal wage at home w^* and the aggregate demand shifter A_t are normalized to 1. To generate low survival rates and high exit rates for experienced firms, the model requires some unproductive young firms to enter the market. As is standard in the quantitative models of international trade, heterogeneous export costs are needed. I extend the model and allow for random export costs in the simplest way possible. With probability λ, exporters do not have to pay the fixed costs, and with the complement of the probability firms pay the usual fixed costs of exporting. The rest of the model, and most of its predictions, remain unchanged.

The rest of the parameters, eight in total, are calibrated internally using a simulated method-of-moments approach aiming to match a set of moments observed in the Colombian data. Thus, for a given vector of parameters, I solve the dynamic programming problem given by (3.10), and obtain the corresponding policy functions of the firms. I then simulate the outcomes for a panel of 40,000 firms for 110 years, in which the first 10 periods are discarded in order to reduce the dependance on the initial conditions. The estimated vector of parameters minimizes the average percentage deviation between the data moments and its model counterparts. Table 3.8 presents the calibrated parameters and the targeted moments.

Table 3.8: Internal calibration

Parameter	Value	Concept
θ	0.382	External habit .
δ	0.536	External habit.
ρ_z	0.575	Productivity shock.
σ_z	1.421	Productivity shock.
ϕ	0.061	Distribution costs.
λ	0.174	Random fixed cost.
S	1.025	Sunk costs.
F	4.484	Continuation costs.
Moment	**Model**	**Data**
Log-growth w.r.t. entry price , age= 2	0.075	0.076
Log-growth w.r.t. entry sales , age= 2	0.693	0.700
Continuation rate new entrants	0.470	0.362
ERPT	0.381	0.378
Entry rate	0.430	0.422
Exit rate	0.424	0.412
Revenue share new entrants	0.093	0.099
Coefficient of variation log export sales	0.957	0.980

Note: To compute the model moments, I simulate 40,000 firms for 110 periods. I repeat the procedure 100 times and I discard the first 10 periods every time. The average percentage deviation is 0.059

I choose eight moments to characterize the stationary distribution of the model: 1) the average entry rate, defined as the average across years of the number of firms that in $t-1$ were not exporters and in t became exporters divided by the number of exporters in period t; 2) the average exit rate, computed as the average across years of the number of firms that in t were exporters and exited the market in $t+1$ divided by the number of exporters in t; 3) The coefficient of variation of export sales, computed as the ratio of the mean to the standard deviation of the log export sales; 4) the average revenue share of new entrants; 5) the continuation rates of new entrants, computed as the fraction of new entrants that continued in the export markets the following year; 6) the ERPT rate, which is obtained by running regression (4.2) including firm-level fixed effects. Additionally, I target two moments related to the dynamics of sales and prices, namely the log growth of sales and prices of firms with two years of tenure with respect to the entry value. The last two moments correspond to the estimated coefficients $\hat{\phi}_2$ obtained by running a regression similar to (4.1) that includes firm×year fixed effects.

Since the calibrated parameters simultaneously affect each of the targeted moments, the model does not admit a mapping of each parameter to a unique moment. Instead, I provide a heuristic argument to help understand the link between the parameters and the data moments chosen. The serial correlation in the idiosyncratic productivity shocks (ρ_z) and its standard deviation (σ_z) mainly determine the export sales distribution, which can be summarized by the coefficient of variation of the export sales. The sunk costs (S) determine the entry rate and along with the fixed costs (F), the exit rate and continuation rates of new exporters. The habit parameters (θ, δ) mostly affect the growth rates of exports and prices as well as the revenue shares of new exporters. Finally, the distribution markup ϕ is used to control the degree of exchange pass-through in the economy.

3.4.1 Quantitative Fit

In this subsection, I explore some of the quantitative implications of the calibrated model and its ability to match the observed dynamics of firm performance and international prices. For the international prices, export sales and continuation rates, I plot the dynamics for the data and the model implied by the estimated coefficients $\hat{\phi}_a$ of regression (4.1). The omitted category in these regressions is age= 1, thus the coefficients measure the partial effect of tenure in the export markets with respect to the variable of interest in the first year. In the sales and prices regressions, the age coefficients $\hat{\phi}_2$ were targeted in the calibration, and for the continuation rate the survival rate upon entry was targeted. As shown in Figure 3.4, the model is able to replicate an increasing with tenure trajectory of export prices upon entry. Overall, the model closely matches the dynamics of prices.

Figure 3.4: Quantitative fit: Export price dynamics

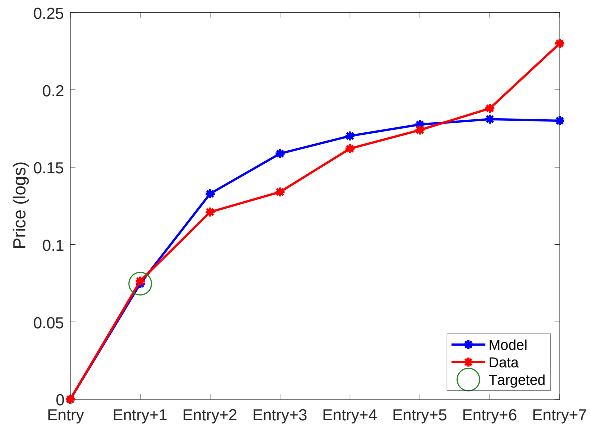
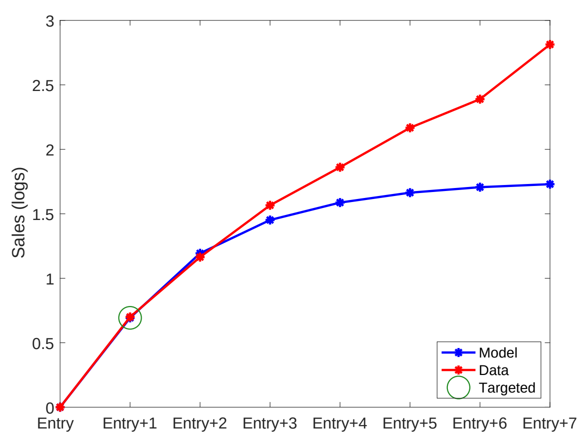


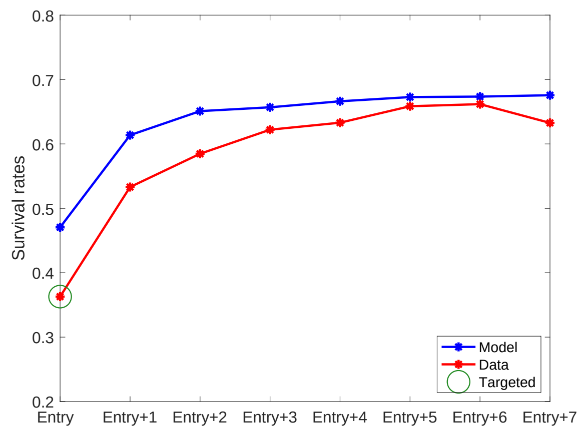
Figure 3.5 plots the dynamics of export sales, which also increase with age in the export markets. Of particular interest is that the model correctly predicts higher growth rates in the first years of tenure, following which the growth rates stabilize. The latter is consistent with the fact that the dynamic incentives of charging low markups are stronger for new exporters as opposed to experienced firms. The match with respect to the data is reasonable for the first years of tenure, and then it slightly diverges. One possible explanation for this divergence is that the model only incorporates two sources of heterogeneity, namely productivity and exchange rate movements, while in reality it is expected that additional sources of persistent heterogeneity across firms and destinations might be at play.

Figure 3.5: Quantitative fit: Export sales dynamics



The continuation rates are presented in Figure 3.6. Notice that the model, although it does not completely match the continuation rates of new entrants, generates low survival rates that increase with age in the exporting markets.

Figure 3.6: Quantitative fit: Continuation rates



Additionally, I focus on the implications of the model for the degree of pass-through over the life cycle of firms. In particular, I estimate the same specification as equation 4.2 separately for new and incumbent exporters. Consistent with the data, a new exporter is a firm with three or less years of tenure and an incumbent is a firm with more than three years of tenure. The estimated ERPT rates are depicted in Table 3.9.

Table 3.9: ERPT over the lifecycle

	ERPT	
	Model	Data
All firms	0.381	0.378
New exporters	0.616	0.460
Incumbents	0.277	0.257

The model does a good job at matching the degree of pass-through for the whole economy, which is a targeted moment, but also produces a remarkably close pass-through rate for matured exporters. Although the model generates heterogeneity in the ERPT rates over the life cycle of firms, it predicts a much higher rate for new exporters relative to the one observed in the data.

3.5 Aggregate Implications

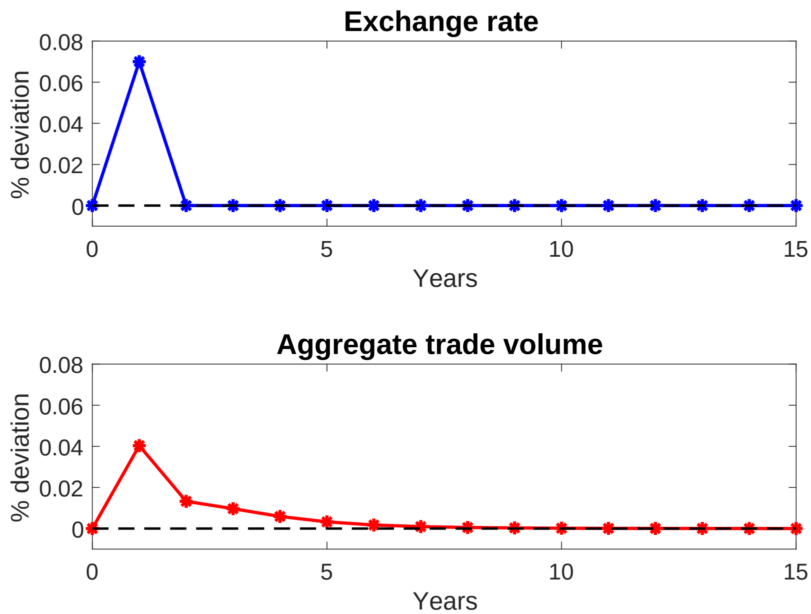
In this section, I study how firm-level decisions to maintain a foreign customer base can determine the aggregate trade response to external shocks. In particular, I analyze the response of aggregate trade volumes to a one-time and a persistent depreciation of the Colombian peso, and to a trade liberalization episode. To assess the effect of these shocks on the aggregate, I perform the following Impulse Response analysis. I simulate 1,000 economies, with 40,000 firms for T periods. In the baseline scenario, there are no shocks. In the counterfactual scenario, at time $\tilde{t} < T$, I impose either a one-time depreciation, a persistent depreciation or a permanent elimination of the trade tariff. Then, for every year, I aggregate the trade volumes by summing across the firm-level exports. I report the average over the 1,000 economies of the log-deviation of the aggregate volumes with shock relative to the baseline scenario.

3.5.1 Exchange Rate Shocks

One-time Depreciation

First, I analyze the aggregate trade response to one-time unanticipated depreciation of the Colombian peso. That is, in period $\tilde{t}$ the bilateral exchange rate measured in Colombian pesos per foreign currency increases the equivalent to one standard deviation, and after period $\tilde{t}$ the shock completely disappears. The IRF of the aggregate trade volumes along with the evolution of the bilateral exchange rate are depicted in Figure 3.7. As a consequence of the presence of deep habits in the model, on impact, the exchange rate depreciation is not completely transmitted into the aggregate trade volumes, although its effects are visible a few years after the shock. The elasticity of trade volumes with respect to a one-time depreciation of the Colombian peso is close to 0.57. Given the nature of the shock considered, most of the firm-level response is through the intensive margin rather than through the extensive margin.

Figure 3.7: One-time depreciation exchange rate

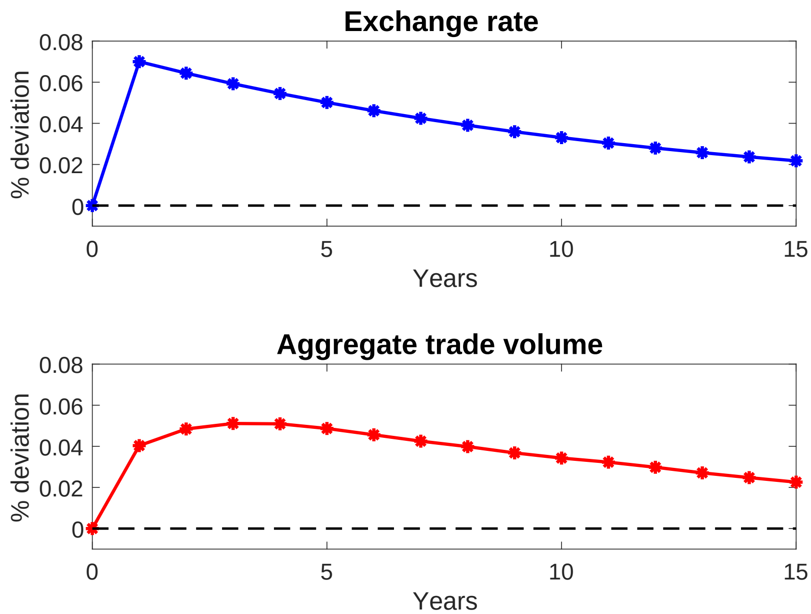


Persistent Depreciation

How different is the aggregate trade response when the economy is hit by persistent exchange rate shock? When exporters face a persistent depreciation, they perceive the exchange rate as remaining favorable for many periods. Therefore, they incorporate this information into their expectations and a more pronounced aggregate response is expected.

In Figure 3.8, I introduce a persistent depreciation of the Colombian peso. As in the previous experiment in period $\tilde{t}$, I increase the bilateral exchange rate in one standard deviation but allow the exchange rate to evolve according to the Markov process assumed. On impact, the aggregate volume's elasticity is slightly higher than that of the purely temporary exchange rate shock. However, there are important qualitative differences in the periods after the shock. When the depreciation is persistent, the effect on aggregate volume builds up and reaches its peak after 4 years, then gradually decays over time. The latter indicates that persistent movements in the exchange rate not only trigger investing motives in the customer base, but also induce a larger role for adjustments through the extensive margin. As a consequence, since firm-level entry also responds to the shock, the effect on aggregate volumes is amplified and a different response on impact and on the periods after the shock is observed.

Figure 3.8: Persistent depreciation exchange rate

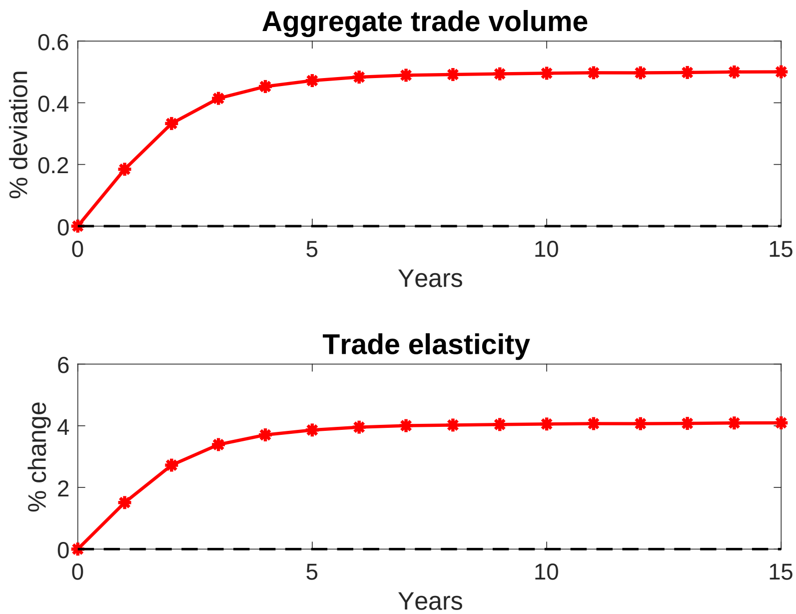


3.5.2 Permanent Tariff Decrease

Finally, I study the aggregate response to a permanent trade liberalization episode. As before, I simulate the firm-level response to the elimination of the 13% import tariff and compare it to a counterfactual scenario without tariff decrease. In the upper panel, Figure 3.9 reports the log-deviation of the aggregate trade volume in response to the tariff reduction; the bottom panel illustrates the implied trade elasticity.[11] The model generates a slow adjustment to trade. In the first year, the trade elasticity is almost 1.5, which is below the elasticity of substitution ($\sigma = 2$). This short-run elasticity is smaller than σ because building a customer base is a lengthy process that involves a high risk of failure and thus, exporters do not immediately respond to the shock. Regardless of that, given the permanent nature of a tariff reduction, the trade elasticity is above one even in the short run, which contrasts with the findings for the exchange rate movements in which the short-run elasticity was below one; this reinforces the idea that trade volumes are much more responsive to tariffs than they are to real exchange rates.

[11]Let X_t to denote the aggregate trade volume in time t. Thus the trade elasticity in period t is $\tilde{\sigma}_t = -\frac{\log X_t - \log X_t}{\log(1) - \log(1.13)}$

Figure 3.9: Trade liberalization



In the years following the trade liberalization episode, this initial response is amplified by the gradual accumulation of customer base. It takes almost 5 years for the effect of the tariff elimination to be fully reflected in the aggregate trade flows. The trade elasticity increases from 1.5 to almost 4 in the long-run. This discrepancy between trade elasticities at different horizons has been extensively documented in the literature and the estimated values are in line with what has been obtained in empirical studies. For instance, using data for Ireland and a regression strategy considering post-entry export dynamics, Fitzgerald and Haller (2018) estimate aggregate trade elasticities to tariff changes to be between 1.5 and 3.5 on impact, and between 2 and 5 in the long run.

3.6 Conclusion

This chapter has explored the dynamics of new exporters and the implications on the firm-level response to trade shocks. Using detailed custom level data for Colombia over the period 2008 to 2018, I find that continuation rates, exports, and prices increase with the years of tenure in the international markets. These findings indicate that an important fraction of the observed growth of new exporters may be explained by the fact that these firms use price adjustments to expand into international markets. Additionally, I explore how these post-entry dynamics are related to the firm-level response to trade shocks such as exchange rate movements. By estimating a series of exchange rate pass-through regressions, I find that the pass-through is incomplete and heterogeneous over the life cycle of exporters. In particular, I find that exchange rate pass-through of new exporters, is consistently higher than that of incumbent exporters.

To interpret these findings, I construct a quantitative model of exporting, featuring customer base accumulation and endogenous entry and exit into the international markets. In this model, the introduction of deep-habits mechanisms implies that new exporters start small and therefore face high exit rates upon entry. As these firms survive, they have dynamic incentives to use markup adjustments to construct their customer base. As a consequence, the prices of new exporters tend to be lower and adjusted with more frequency than the ones of incumbent exporters. Also, the model has further implications for the degree of response to exchange rate shocks. Given the tension between maximizing current profits and the present value of future profits introduced by the deep-habits mechanism, when exporters are affected by unfavorable exchange rate shocks (i.e. an appreciation of their own currency), they partially increase their prices. However, a different response is observed between new and incumbent exporters. Specifically, new exporters pass through a higher portion of the shock into their prices because these firms face higher exit probabilities than incumbent exporters and thus put more weight on maximizing current profits and less on long-term profits.

Then, I calibrate this model to match salient features of Colombian exporters, and in particular to generate new exporter dynamics that are consistent with the data. I use the calibrated model to examine, through impulse-response analysis, the aggregate response of trade volumes to different types of trade shocks: a one-time depreciation of the Colombian peso, a persistent depreciation, and a trade liberalization episode. The inclusion of deep habits and endogenous entry and exit has important aggregate implications. First, aggregate volume elasticities are more responsive to tariffs than to exchange rates. On impact, I estimate an elasticity of trade volumes to tariffs of 1.5 and to exchange rates of .5. Second, when the shocks are either persistent or permanent, the customer base accumulation model generates a sluggish response of trade volumes, which produces discrepancies between the short-run and long-run elasticities. Particularly, in response to a permanent tariff reduction, I estimate a long-run trade elasticity that is 2.6 times higher than the short-run elasticity.

This quantitative framework sheds some light on the mechanisms behind the new exporter dynamics and ERPT heterogeneity across exporters. Nonetheless, the framework is silent about the general equilibrium effects that export entry and expansion may have on the prices of goods or interest rates. For instance, Jacob and Uusküla (2019) examine how monetary policy and nominal exchange rate fluctuations influence the effective discount rate used by firms to evaluate expected profits from international sales.

Chapter 4

Import Wholesalers and the Effect of Trade on Canadian Producers

4.1 Introduction

Over the last three decades, a substantial increase in the number of free trade agreements between countries coupled with major technological advances in transportation and telecommunications has shifted international trade towards a frictionless state. Intuitively, following a reduction in both variable and fixed trade costs an increase in the amount of direct trade between producers in one country and final consumers in another should be expected, as well as a decrease in the share of trade passing through intermediaries such as wholesalers.[1] However, empirical evidence seems to point in the opposite direction. Using a unique administrative dataset for Canada for the period 2002 to 2012, I document that Canadian wholesalers have played a prominent role in international trade, and their importance in aggregate trade flows has increased over the last years. Specifically, I observe that the share of total import value accounted for firms in the wholesale trade sector, increased from 26% in 2002 to 34% in 2012.[2] Additionally, with this novel dataset of Canadian firms, I explore some features related to the type of goods in which wholesalers specialize in, as well as how they differ from manufacturing firms along several dimensions. First, I document that between 2002 to 2012 wholesalers were the dominant players in the import markets of final goods and considerably increased their presence in the intermediate goods import market. In 2002, wholesale trade firms accounted

[1] Theoretical models featuring trade intermediaries such as Ahn et al. (2011), Crozet et al. (2013) and Akerman (2017), predict a positive relationship between fixed and variable trade costs and the benefits of intermediation.

[2] Using data at the establishment level yields a more dramatic increase, as the share of total import value accounted by establishments in the wholesale trade sector increased from 27% in 2002 to 49% in 2009 (Statistics Canada 2011).

for 43% and 16% of the total import value of final and intermediate goods, respectively. And by the end of the period, those shares increased to 49% and 22%. Then I find that, when compared to manufacturing firms, wholesalers imported more products and from more countries. On average, wholesalers imported 28.6 products from 4.5 different countries, while manufacturing firms imported 22.3 products from 3.9 countries. Moreover, I observe that over the sample period the average number of products, number of countries and number of importing firms increased more in the wholesale trade sector than in the manufacturing one.

Although an extensive literature has studied the firm and industry-level response to higher import competition, less well understood is the role played by wholesalers in making these imports available in the domestic market. Given that wholesalers carry a substantial amount of trade and control large distribution networks, their decisions of where to locate, what products to import and from which countries, can determine how the effects of trade spread to domestic consumers and producers. In this regard, it is important to acknowledge that the imports of wholesalers would have a differential effect on manufacturing firms depending on their location in the supply chain. On the one hand, wholesalers importing final goods not only would expand the number of goods available for consumption, but also would expose domestic producers to more competition. On the other, wholesalers selling intermediate goods to local producers would allow them to have access to imported inputs even if they do not engage directly in trade themselves.

In particular, this chapter aims to identify the multiple margins along which manufacturing firms adjust in response to the increasing import competition induced by wholesalers, in the form of final and intermediate goods. For that purpose, I use the Statistics Canada's National Accounts Longitudinal Microdata File (NALMF). This unique dataset contains comprehensive information on the performance and characteristics of nearly all Canadian firms over time, and is augmented with detailed information on import transactions. To explore how domestic producers are affected by being exposed to the imports of intermediate and final goods made by wholesalers, I construct measures of *indirect import penetration* at the local market level.[3] I treat these local markets as subeconomies subject to different type of shocks and with different levels of exposure to indirect import competition as the result of the regional variation in the number and importance of wholesalers and manufacturing firms. By exploiting the geographic variation in the exposure to these imports, I empirically estimate its effect on sales, employment, productivity and survival of the domestic manufacturing firms operating in the same local market. The empirical analysis reveals a negative correlation between the exposure to indirect imports of final goods and domestic firms' labor, sales, productivity and survival.

[3]Formally, the indirect import penetration is measured as the ratio of the imports made by wholesalers to the total imports plus domestic manufacturing sales.

While a higher exposure to indirect imports of intermediate goods is positively correlated with the same set of variables. To identify the causal effect of the increasing imports made by wholesalers, I follow an instrumental variable approach to account for the potential endogeneity of the measures of domestic exposure to indirect imports. In particular, I instrument the indirect import penetration of final and intermediate goods with the average of the indirect import penetration in the local markets located outside an inner radius but within an outer radius. These instruments are aimed to remove all the variation associated with local market conditions and local policies, and at the same time maintain the variation attributed to the effects of being close to the imports of final and intermediate goods carried by wholesalers. The instrumental variable estimates confirm the negative effect of indirect imports of final goods on employment, sales and survival, as well as the positive effect of indirect imports of intermediate goods on employments and sales. However, no causal effect of indirect imports of intermediate goods on the survival of manufacturing firms is observed.

4.2 Literature Review

This chapter is mostly related to two streams of the literature. First, it is close to the research on the effects of trade on firm performance. An extensive empirical literature has examined the effects of import competition, mainly from low-income countries, on the reallocation of manufacturing within and across industries. By constructing measures of import penetration, some studies have found that higher import exposure is related to lower manufacturing employment and earnings (Autor et al. 2014, Acemoglu et al. 2016 and Kamal and Lovely 2017), reallocations towards capital-intensive activities and changes in the product mix (Bernard et al. 2006) and upgrades in product quality (Khandelwal 2010). Further work has used quantitative models to study how higher import competition can increase average productivity and reduce markup distortions (Melitz and Ottaviano 2008; Edmond et al. 2015), as well as to induce within-firm reallocations towards the most efficient products (Eckel and Neary 2010). Additionally, a recent literature on offshoring has estimated that input trade increases average productivity (Kasahara and Rodrigue 2008; Halpern et al. 2015), reduces prices (Blaum et al. 2016) and expands the product scope of manufacturing firms (Goldberg et al. 2010). Akin to this literature, this chapter studies how higher import competition can induce reallocations within and across manufacturing firms, and contributes to the literature by focusing on the role of intermediated imports of final and intermediate goods in inducing such reallocations.

Second, this chapter belongs to the literature on trade intermediaries. A well established theoretical literature on trade intermediation has studied the role of intermediaries in reducing the search and matching costs needed to connect buyers and sellers (Rubinstein and Wolinsky 1987, Antras and Costinot 2011 and Blum et al. 2012), and has developed models to characterize the process through which intermediaries create and maintain their supply network and rent it to other firms with information shortages (Rauch and Watson 2004, Petropoulou 2011 and Chaney 2014). More recently, Ganapati (2017) structurally estimates a model with downstream demand and entry/exit in the wholesale markets, and finds that despite the increase in market power obtained by wholesalers the benefits provided to downstream buyers offset the costs. On the empirical side of the literature, which is surveyed by Blum et al. (2017), numerous studies have documented the importance of intermediaries in international trade and aggregate trade flows. For instance, Bernard et al. (2010b) report that import intermediaries represented 56% of the total number of importing firms and accounted for 24% of the import shipments for the US in 2002, while Blum et al. (2010) find that between 2002 to 2008, Chilean wholesalers accounted, on average, for 45% of the total import value. On the export side, Bernard et al. (2010b) document that wholesalers accounted for 47% of the exporting firms and 11% of the export value in the US, and for Italy Bernard et al. (2015) find that wholesalers constituted 27% of the number of exporters and 10% of the export value. Moreover, the literature on import wholesalers has explored several other features about their involvement in international trade, as well as the similarities and differences with importing manufacturing firms. The available evidence indicates that wholesalers tend to import and export more products than manufacturing firms (Blum et al. 2017 and Utar 2017), that wholesalers have a larger share of trade with smaller countries (Bernard et al. 2010b), and tend to have small and young international trading partners (Bernard et al. 2015 and Blum et al. 2012). Related to this chapter is Utar (2017), that uses a dataset for Denmark to document a series of stylized facts about export and import wholesalers. In particular, the author finds that the characteristics of wholesale trade firms in international trade differ depending on whether they trade final or intermediate goods. In intermediate goods, export wholesalers have higher unit prices than the ones of manufacturing firms, while the opposite holds true for final goods exports. This chapter contributes to this literature by focusing on how the imports of wholesalers affect domestic manufacturing firms. And specifically, it argues that imports of intermediate and final goods would have a differential effect on these local producers.

The rest of the chapter is divided as follows. Section 3 describes the data and methods and documents a set of stylized facts regarding importing wholesalers. Section 4 presents the empirical results. And Section 5 offers some concluding remarks.

4.3 Data

This chapter employs the National Accounts Longitudinal Microdata File (NALMF), which is a comprehensive dataset compiled by Statistics Canada using several administrative datasets: the Business Register (BR), T2 Corporate Income Tax (T2), the General Index of Financial Information (GIFI), the Statements of Remuneration Paid (T4) and the Payroll Deductions and Remittances (PD7). The resulting longitudinal database contains annual information on sales, production costs, employment, capital, the economic region (ECR) and statistical area of location of nearly all Canadian firms over the period 2002 to 2012.[4] Additionally, the NALMF dataset assigns to each firm a unique 6-digit industry code based on the North American Industry Classification (NAICS). In this chapter, I restrict my attention to firms belonging to the manufacturing (2-digit NAICS codes 31, 32 and 33) and wholesale trade (2-digit NAICS code 41) sectors. On top of that, this dataset is matched with custom transaction-level data including information on the unique identifier of the Canadian-based firm engaging in the transaction, the 10-digit product code (according to the Harmonized System), the import value (in Canadian dollars) and the country of origin.

I further augment this dataset in two directions. First, I classify imports according to their end-use as final or intermediate goods. To make such distinction, I employ the correspondence tables between the HS and Broad Economic Categories (BEC) classification, which allows me to differentiate between capital, intermediate or final goods. Second, in order to determine the most likely industry of destination of the imported goods by wholesalers, I use the concordances tables between NAICS and the HS provided by Pierce and Schott (2012), which assign a unique 5-digit NAICS industry to each 6-digit HS product code.[5] Overall, the resulting dataset is particularly well suited for my analysis because it allows me to identify which firms are wholesalers, whether they import intermediate or final goods, and also which manufacturing industry is the most likely destination of those goods. Moreover, since I can observe the geographic location of both wholesalers and manufacturing firms I can construct local market measures of how exposed are manufacturers to the imports carried by wholesalers.

In the following subsections, I use the constructed dataset to document some empirical regularities describing the importance of wholesalers in total import values, as well as in the intermediate and final good markets. And then show how wholesalers compare to manufacturing firms engaging in international trade along several dimensions. Additionally, I discuss in detail how the measures of import exposure are constructed, as well as the manufacturing

[4]Specifically, the NALMF contains the economic region and statistical area where the headquarters of the firms are located.

[5]Around 90% of the 6-digit HS codes are assigned to a unique NAICS industry, whenever a HS code is assigned to more than one industry I use the mode.

firm-level variables used in the rest of the chapter.

4.3.1 The Surge of Canadian Wholesalers

In the early 2000s, Canadian wholesalers experienced a substantial expansion. In 2004, wholesalers reported sales worth $450 billion dollars, which represented a 42% increase in revenues between 1997 and 2004.[6] Over the same time period the output by wholesalers, measured by their contribution to gross domestic product (GDP), grew on average at 7.1% per year which considerably outperformed the annual growth of 4.2% of the economy as a whole. As a result, in 2004 wholesale trade positioned as the third most important sector in the Canadian economy, up from the fifth place in 1997.[7] Although, basically all the subsectors within the wholesale trade sector expanded between 1997 and 2004, most of the grow in revenues was driven by substantial increases in the personal and household goods, automotive products, building materials and supplies, food beverage and tobacco products and machinery, equipment and supplies subsectors. In particular, wholesale sales of personal goods and household goods rose by 75% during the same period, and most of this growth was accounted by the wholesaling of pharmaceuticals, which increased almost 185%.

At the same time, Canadian wholesalers sourced an important fraction of their products internationally and benefited from being the primary buyers and distributors of these imported products. As suggested by Hays (2009), on average, 35.2% of the total purchases of wholesalers between 1998 and 2001 were imported. Interestingly, the imports of wholesalers were not only concentrated on final goods sold to retailers and consumers, but also incorporated intermediate goods and supplies directed to other firms in different sectors. An illustrative example of this *dual* role of wholesalers is provided by Hays (2009) for the textile and clothing industry. The author documents that although approximately 50% of apparel wholesale sales were directed towards retailers, between 1997 and 2004, sales to retailers rose only by 5%. While wholesale sales to industrial, commercial and other business rose by 33%. The latter describes how wholesalers are important suppliers of finished apparel, and also of textiles to the Canadian industrial segment.

4.3.2 Wholesalers and Manufacturers in International Trade

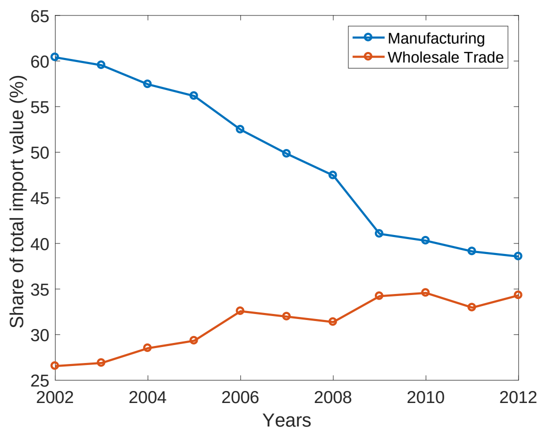
I begin the exploration of the role of wholesalers by detailing a set of facts describing their involvement in international trade, and by making comparisons with another important trading

[6]All money figures are in constant dollars.
[7]See Hays (2009) for a detailed study of the expansion of Canadian wholesalers between 1997 and 2004.

agent: manufacturers. Using the NALMF and the import transaction data, initially, I explore the importance of wholesalers and manufacturing firms in aggregate import flows and study its evolution over time. For each year, I compute the import shares across these two sectors as the sum of the import value of firms classified as manufacturers or wholesalers, divided by the total import value.[8]

As can be noted in Figure 4.1, the share of total import value carried by manufacturing dramatically fell from 60.4% in 2002 to 38.5% at the end of the period. An important fraction of this decline was picked-up by wholesalers, who observed an increase in the share of the total import value from 26.5% in 2002, to 34.3% in 2012.

Figure 4.1: Import shares by sector



Source: Own calculation with data from NALMF and import transactions.

Then I focus on the presence of wholesalers and manufacturers in the import markets of intermediate and final goods. Similarly, I sum the import value of goods classified as intermediate or final goods across sectors, and divide it by the total import value of the goods classified as final or intermediate goods. Figure 4.2 plots the evolution of the import shares by end-use across the manufacturing and wholesale trade sectors.[9] Notice that in the international market for intermediate goods, manufacturing firms were the dominant players but their importance considerably declined over the period of observation. In 2002, imports of manufacturing firms accounted for almost 75% of the imports of intermediate goods in Canada, and by 2012 that share dropped to 50%. On the contrary, Canadian wholesalers increased their presence in the market for imported inputs and positioned as important distributors of these type of goods. As depicted by the graph the share of the import value of intermediate goods accounted by

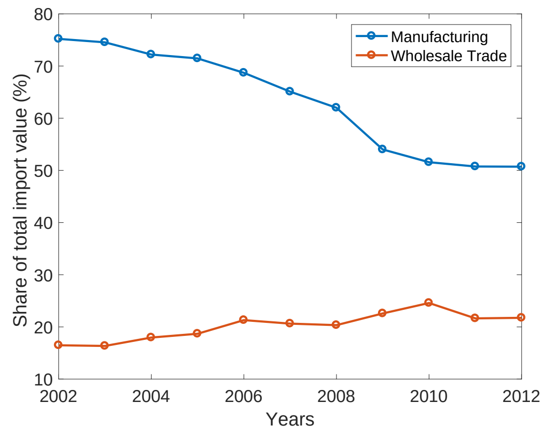
[8]The values used in the graph are contained in Table C1 in the Appendix C

[9]The actual values are contained in Table C2 in the Appendix C.

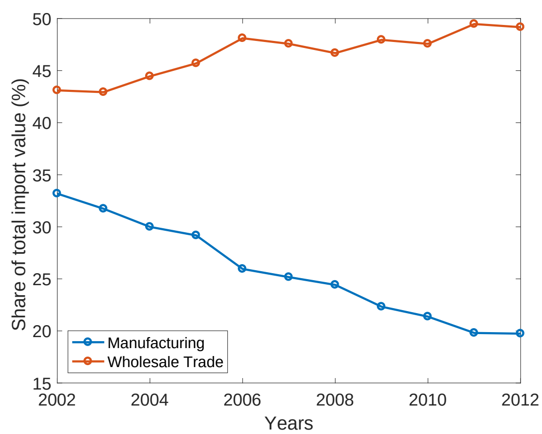
wholesalers increased from 16% to almost 22% by the end of the period.

Figure 4.2: Import shares by sector and end-use

Intermediate goods



Final goods



Source: Own calculation with data from NALMF and import transactions.

For the final goods market, firms in the wholesale trade sector were responsible for the bulk of the imports. In 2012, wholesalers carried almost 42% of Canada's total imports of final goods and that share gradually increased up to almost 50% ten years later. While the manufacturing sector observed a rapid decline in their share of import value over the 2002 and 2012 period, from 33% to less than 20%.

Table 4.1: Summary Statistics of Canadian Importers

Year	Manufacturing			Wholesale Trade		
	Mean	Median	# Firms	Mean	Median	# Firms
HS10 Products						
2002	21.14435	6	21060	24.67557	8	24397
2003	20.9215	5	20739	24.81357	8	24395
2004	22.34627	6	21804	27.69973	9	25134
2005	23.01065	7	24970	28.71928	9	27315
2006	22.60658	7	24953	28.01151	9	30411
2007	22.36395	6	25344	28.38415	9	31287
2008	22.54145	7	24835	28.69682	9	30747
2009	22.1228	6	23657	29.44549	9	29763
2010	22.30649	7	23371	29.92951	9	29224
2011	23.16751	7	23073	31.52312	10	28888
2012	22.95155	7	23056	31.83958	10	28575
Total	22.34708	6	256862	28.63829	9	310136
Countries						
2002	3.477303	2	21060	3.875927	2	24397
2003	3.536718	2	20739	3.955237	2	24395
2004	3.78747	2	21804	4.334845	2	25134
2005	3.973648	2	24970	4.525096	2	27315
2006	3.977077	2	24953	4.474598	2	30411
2007	3.964134	2	25344	4.503276	2	31287
2008	3.99549	2	24835	4.597229	2	30747
2009	3.925772	2	23657	4.615966	2	29763
2010	4.068504	2	23371	4.789317	2	29224
2011	4.178347	2	23073	4.917405	2	28888
2012	4.275069	2	23056	5.068416	3	28575
Total	3.933042	2	256862	4.534004	2	310136

Source: Own calculation with data from NALMF and import transactions.

Lastly, I make a comparison between wholesalers and manufacturers along several dimensions. In particular, I compute the average and median number of products imported by firm, as well as the average and median number of countries from which these firms import goods from. The evolution of these variables over time is depicted in Table 4.1:

On average, manufacturing firms imported 22.3 different HS10 products, while wholesalers carried 28.6 products. Over time, the average number of products imported by manufacturing firms mostly remained constant, while the number of products imported by wholesalers increased from 24.7 in 2002 to nearly 31.8 in 2012. Additionally, wholesalers imported on average from 4.53 countries, a number that increased from 3.8 in 2002 to 5.0 in 2012. Similarly, over the period of observation manufacturing firms imported from 3.9 countries on average. In 2002, manufacturing firms imported from 3.4 countries and in 2012 from 4.2. Finally, the number of importing firms experienced a more rapid increase in the wholesale trade sector than in the manufacturing one. Between 2002 and 2012, the number of importing firms in the manufacturing sector increased by 9%, while the number of importing firms in the wholesale trade sector grew by 17%.

The empirical regularities presented in this subsection suggest that wholesalers have increased their presence in the international markets. First, the share of total import value carried by wholesalers increased from 26.5% in 2002, to 34.3% in 2012. Second, wholesalers were the dominant players on the final goods import markets and earned notoriety in the import markets of intermediate inputs. Finally, when compared to manufacturing firms, wholesalers imported more goods and from more countries, and the number of firms engaging in international trade grew more in the wholesale trade sector relative to the manufacturing sector.

4.3.3 Indirect Import Penetration

Following the literature on import competition, I construct measures of the exposure to imports of intermediate and final goods carried by wholesalers. It differs from traditional measures of import competition in three ways: first, because it focuses on the indirect imports carried by wholesalers, second because it considers the end use of the goods (intermediate or final), and last because it is defined at the local market level. Let $IIPen^e_{it}$ denote the indirect import penetration of goods with end use e = {intermediate, final} in local market i in year t:

$$IIPen^e_{it} = 100 \times \frac{M^e_{it}}{M_{it} + S_{it}} \tag{4.1}$$

where M^e_{it} and M_{it} represent the value of the imports of goods with end use e and total import value in local market i and year t, respectively, and S_{it} is the value of the total manufacturing sales in local market i and year t. With respect to this measure of indirect import penetration two precisions are noteworthy. First, the total import value only considers the imports from firms in the wholesale trade and manufacturing sector. This is not an important issue, as these two sectors account for more than 75% of the total import value. And second, given data limitations the denominator does not exclude the total export value and thus it is not equal to the domestic absorption.

Additionally, I propose an alternative measure of import penetration that takes the form of the average of the indirect import penetration in local markets located within a certain radius. This measure is aimed to capture second-order effects of neighbouring locations around the local-market of a firm. Let $\underset{r}{IIPen^e_{it}}$ to denote the average import penetration for some radius r:

$$\underset{r}{IIPen^e_{it}} = \sum_{k \in \mathcal{N}^r_i} \frac{IIPen^e_{kt}}{\mid \mathcal{N}^r_i \mid} \tag{4.2}$$

$$\text{where: } \mathcal{N}^r_i = \{k \in I \mid d_{ik} \leq r\}$$

where I is the total number of labor markets, d_{ik} is the distance in kilometres between local market i and local market k and the set $\mathcal{N}^r_i$ contains the indices of all the local markets whose distance to i is less than r kilometres. Similarly, looking forward the instrumental variable specification used in this chapter, I define the average import penetration across labor markets located outside an inner radius and within and outer radius. When computing the average, this instrument excludes local market i and its immediate neighbours, and focuses instead on second-order neighbours of local market i. Formally it is defined as:

$$\underset{r,r'}{IIPen^e_{i,t}} = \sum_{k \in \mathcal{N}^{r,r'}_i} \frac{IIPen^e_{kt}}{\mid \mathcal{N}^{r,r'}_i \mid} \tag{4.3}$$

$$\text{where: } \mathcal{N}^{r,r'}_i = \{k \in I \mid r < d_{ik} \leq r'\}$$

It is important to notice that in order to estimate the local effects of the indirect imports exposure on firm-level outcomes, a definition of what is a local market is required. The empirical literature has often used administrative regions (Gyourko and Tracy 1991, Topel 1986) or combinations of administrative regions and industries (Glaeser et al. 1992) as local markets. In this chapter, I follow the second approach and define local markets as the pair of the 3-digit NAICS industries and the economic region (ECR) as defined by Statistics Canada. This definition is aimed to measure competition at a fine level, and assumes that firms within the same industry and geographic location are subject to the same shocks and only react to the imported goods that are directed to their industry of affiliation and economic region.

4.3.4 Manufacturing Firms' Variables

All the data regarding firm performance is obtained from the NALMF. Given that this extensive dataset is mostly derived from the T2 Corporate Income Tax Return files, and by law all corporations have to file a tax return every year, it is possible to construct a panel containing information on revenues, expenses, assets, the economic region, and industry of all the firms in Canada, in particular the firms that belong to the manufacturing sector.

The sales of the firms are measured by the total sales of goods and services and the production costs are computed as the sum of all the cost of sales, both of these variables are obtained from the T2 Income Statement. Capital is measured as the book value of all the tangible capital assets owned by the firms, and this information comes from the T2 Balance Sheet Information. Additional information on employment and payroll is derived from the T4 Statements of Remuneration Paid. In particular, the measure of employment corresponds to the sum of all the Individual Labor Units (ILU), where an ILU is a submitted T4 with a valid Social Insurance Number (SIN). The total payroll is given by the sum of all the wages and salaries from submitted T4s with valid SINs. The direct wages are measured as the sum of commissions, labor costs, production wages and supervision and are aimed to measured the fraction of the total payroll that constitutes labor costs associated with production. Most of these variables are measured in Canadian dollars, whenever real variables are required I deflate them using the appropriate industry-specific price indices from the KLEMS database. All the firms located in the same economic region are assigned the same geographic coordinates which correspond to the centroid of the economic region area.

Since one of the outcomes of interest is productivity, a firm-level measure of total factor productivity (TFP) is computed as the residual of a three-input Cobb Douglas production function, which is estimated by means of ordinary least squares (OLS):

$$\ln Q_{jt} = \alpha_0 + \alpha_K \ln K_{jt} + \alpha_L \ln L_{jt} + \alpha_M \ln M_{jt} + \epsilon_{jt} \tag{4.4}$$

where j refers to the manufacturing firm and t the year. The variable Q corresponds to the sales deflated by the gross output industry-specific price index, K is the book value of the tangible assets by the industry-specific price index for capital, L is the number of individual labor units and M is a measure of intermediate inputs which is constructed as in Leung et al. (2008) (sales - payroll - gross profits) that is deflated by the intermediate inputs price index from KLEMS.[10]

Moreover, following Bernard et al. 2006 I construct two measures of input intensity at the firm level. The first one, denoted as *capital intensity*, is computed as the logarithm of the ratio

[10] The results from the firm-level TFP estimation are available upon request.

of the real value of capital, to the real value of the total payroll. The second, denoted as *skill intensity*, is computed as the ratio of the wages paid to production workers (direct wages) to the total payroll. Both variables are included as controls of firm characteristics.

Finally, since I am interested on the firm-level response through the extensive margin I have to determine when a firm has exited the market. To do that, I exploit the successor-predecessor table that comes with the NALMF to take into account when firms merge, are absorbed or incorporate new firms. Intuitively, in the NALMF when a firm is observed in period t but not in a subsequent period $t+p$ it could be due to two reasons: 1) the firm indeed exited the market and stopped producing; or 2) the firm was absorbed by or merged with another firm, and now it has a new firm identifier. To help build intuition consider this simple example. Suppose firm a exists in period 1. Then in period 2, this firm merges with firm b, and together they form a new firm called c. In period 2, firms a and b will cease to exist, however is incorrect to assume that firm a exited the market in period 2 as it only became a bigger firm and changed its name. In the successor-predecessor table I would observe a link indicating that a is the predecessor of c. Thus for those firms that no longer appear in the sample and are not predecessors of any firm, we can safely assume that they exited the market. To restrict my attention to firms that actually exited the market, I construct an exit indicator variable $X^{t:t+p}$ that takes a value of 1 if the firm was active in period t, no longer appears in the sample after p years (where of course $t+p \leq 2012$), and at the same time this firm is not predecessor of any other firm(s), and 0 otherwise.

4.4 Empirical Results

The next step, is to empirically estimate the effect of higher exposure to imports of wholesalers along different margins of adjustment of manufacturing enterprises. Initially, I study how manufacturing firms respond to higher import competition in their local markets by adjusting their intensive margin. My definition of what constitutes a local market, is given by the combination of the 3-digit manufacturing industry and economic region. That is, it is assumed that manufacturing firms will only react to the imports made by wholesalers that are targeted to their own 3-digit industry and economic region. As dependant variables, I focus on the annual grow of firm-level employment, real sales and productivity, and estimate a similar specification as the one in Bernard et al. 2006:

$$\Delta \ln y_{ji,t+1} = \alpha + \beta^I IIPen^{Int}_{i,t-1} + \beta^F IIPen^{Fin}_{i,t} + \delta Z_{ji,t-1} + \epsilon_{jit} \tag{4.5}$$

where $\Delta \ln y_{ji,t+1} \equiv 100 \times \left(\ln y_{jit+1} - \ln y_{jit}\right)$ is the growth rate of the outcome of interest of firm j located in local market i in year $t+1$. The outcome y is either the real sales, employment or TFP of manufacturing firms. The variables $IIPen^{Int}_{i,t-1}$ and $IIPen^{Fin}_{i,t-1}$, correspond to the indirect import penetration of intermediate and final goods, respectively, at the local market i in period $t-1$, and are constructed either by only considering the import values and sales of firms located in the local market i as in equation (4.1), or as the average of the indirect import penetration in the local markets located within a 100 km radius around local market i, as described by equation (4.2). Vector $Z_{ji,t-1}$ contains a a set of lagged controls of the characteristics of the manufacturing firms, which include the capital intensity, skill intensity and the age.

The choice of a 100 km radius is reasonable mainly for two reasons. First, because that radius includes more than 30% of the total number of bilateral distances across Canadian firms in 2002.[11] Second, because is well known that wholesalers also control vast distribution networks and they mostly specialize in local availability. That is, wholesalers choose strategically their location in order maximize their market reach and at the same time minimize distribution costs. In this regard, empirical evidence supports the idea that wholesalers predominantly ship to nearby destinations. For instance, Ganapati (2017) reports that 54%, 67% and 75% of the total shipments made by US wholesalers where to the same State, Census Region and Census Division of the US, respectively. Finally, another important consideration is that the NALMF contains information at the firm-level, and thus it may neglect that some of the wholesalers and manufacturing firms could be associated with multiple plant locations. However, this might not be an important issue in this dataset because, as reported by Statistics Canada, almost 97% of the registered businesses were single unit firms. Regardless of that, measuring import penetration as the average of neighbouring locations could help to alleviate that concern.

[11] See the histogram of bilateral distances across firms depicted in Figure C.1 the Appendix C.

Table 4.2: Firm Outcomes and Indirect Import Penetration

	Labor	Labor	Sales	Sales	TFP	TFP
	(1)	(2)	(3)	(4)	(5)	(6)
$IIPen^{Int}_{i,t-1}$	0.119***		0.074**		0.008	
	(0.03)		(0.04)		(0.01)	
$IIPen^{Fin}_{i,t-1}$	-0.072***		-0.150***		0.002	
	(0.01)		(0.02)		(0.01)	
$IIPen^{Int}_{i,t-1}$		0.137***		0.094**		0.010
100 km		(0.03)		(0.04)		(0.01)
$IIPen^{Fin}_{i,t-1}$		-0.096***		-0.175***		0.002
100 km		(0.01)		(0.03)		(0.01)
Age	-0.090***	-0.090***	-0.025	-0.025	-0.038***	-0.038***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.01)	(0.01)
Capital intensity	0.458***	0.436***	-0.094	-0.119	0.295***	0.295***
	(0.10)	(0.10)	(0.15)	(0.14)	(0.04)	(0.04)
Skill intensity	0.265***	0.270***	-0.003	-0.003	-0.077*	-0.076*
	(0.10)	(0.10)	(0.00)	(0.00)	(0.04)	(0.04)
N	225,797	225,797	231,339	231,339	199,020	199,020

Note: Estimated using fixed effects at the Year + ECR level. Clustered standard errors at the ECR-level are included in parenthesis.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4.2 summarizes the relationship between the firm employment, sales and TFP annual growth and the local market exposure to imports of intermediate and final goods made by wholesalers, when the local markets are defined a the industry-ECR level. In all the specifications, I include fixed effects at the year level and also at the ECR level to control for aggregate variation in the firm outcomes and unobservable characteristics at the ECR that could be affecting the outcomes of interest. The standard errors reported are clustered at the ECR level. The results reveal that the local market indirect import penetration of intermediate goods is positively and significantly correlated with the average manufacturing firm growth of employment and real sales. At the same time, the local market indirect import penetration of final goods is negatively and significantly correlated with the same two variables. The results are maintained regardless of which measure of local market exposure to indirect imports is used. According to the estimations depicted in columns (1) and (3), a 10% indirect import penetration of intermediate goods in a local market, is associated with a 1.19% and a 0.74% increase on average manufacturing firm growth of employment and sales, respectively. While, a 10% indirect import penetration of final goods in a local market, is associated with a 0.72% and a 1.50% decrease on average manufacturing firm growth of employment and sales. The results depicted in columns (2) and (4), which correspond to the case in which the import penetration variables are constructed as the average across nearby locations, yield very similar coefficients. As described in columns (4) and (5), no statistical relation is observed between the indirect import penetration variables and the growth of the total factor productivity of manufacturing firms.

Additionally, I examine the response of manufacturing firms to intermediated international trade through the extensive margin. In particular, I study how a higher exposure to the imports of final and intermediate goods carried by wholesalers correlates with the exit rates of domestic manufacturing firms over different time horizons. For that purpose, I estimate a linear probability model described by:

$$X_{ij}^{t:t+p} = \alpha + \beta^I IIPen_{i,t-1}^{Int} + \beta^F IIPen_{i,t-1}^{Fin} + \delta Z_{ji,t-1} + \epsilon_{jit} \tag{4.6}$$

where $p = 1, 2, .., 5$ years. Recall that the variable of interest, is an exit indicator, $X^{t:t+p}$, that takes a value of 1 if the firm is active in period t and exited the market after p years, and 0 otherwise. As described before, to properly identify exit I require firms to not be predecessors of any other firms. These regressions employ the same firm characteristics and fixed effects as the previous specification. Table 4.3 reports the relationship between the probability of firm exit and the average local market exposure to indirect imports of intermediate and final goods for different time horizons.

At the top panel, the results where the import penetration variables are constructed at the industry-ECR level are depicted. The negative and statistically significant coefficient on $IIPen^{Int}$ indicates that the probability of exit decreases with the local market exposure to imports of intermediate goods from wholesalers. Moreover, this negative relationship strengthens as the interval increases, on average a 10% indirect import penetration of intermediate goods reduces the probabilities of exiting after one, two, three, four and five years in -2.1%, -5.2%, -8.5%, -13.3% and -18.8%, respectively. As expected, the positive coefficient on $IIPen^{Fin}$ shows a positive relationship between exit rates and exposure to indirect imports of final goods. The estimated coefficients imply that a 10% indirect import penetration of final goods increases the probabilities of exiting after one, two, three, four and five years in 3.7%, 8.2%, 14%, 18.9% and 23.5%, respectively.

Table 4.3: Exit rates and Indirect Import Penetration

	$Pr(X^{t:t+1})$	$Pr(X^{t:t+2})$	$Pr(X^{t:t+3})$	$Pr(X^{t:t+4})$	$Pr(X^{t:t+5})$
	(1)	(2)	(3)	(4)	(5)
$IIPen^{Int}_{i,t-1}$	-0.021**	-0.052***	-0.085***	-0.133***	-0.181***
	(-0.01)	(0.02)	(0.02)	(0.03)	(0.04)
$IIPen^{Fin}_{i,t-1}$	0.037***	0.082***	0.140***	0.189***	0.235***
	(0.01)	(0.01)	(0.02)	(0.03)	(0.05)
Age	-0.001***	-0.002***	-0.004***	-0.005***	-0.006***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Capital intensity	-0.002***	-0.001**	-0.000	-0.000	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Skill intensity	0.000	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
N	231,393	205,828	179,754	153,439	126,789
$IIPen^{Int}_{i,t-1}$	-0.016*	-0.045***	-0.073***	-0.112***	-0.151***
100 km	(0.01)	(0.01)	(0.02)	(0.03)	(0.05)
$IIPen^{Fin}_{i,t-1}$	0.044***	0.104***	0.177***	0.244***	0.309***
100 km	(0.01)	(0.01)	(0.03)	(0.04)	(0.05)
Age	-0.001***	-0.002***	-0.004***	-0.005***	-0.006***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Capital intensity	-0.002***	-0.001*	-0.000	0.000	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Skill intensity	0.000	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
N	231,393	205,828	179,754	153,439	126,789

Note: Estimated using fixed effects at the Year + ECR level. Clustered standard errors at the ECR-level are included in parenthesis.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The bottom panel of Table 4.3 depicts the results where the indirect import penetration variables are computed as the average of neighbouring local markets. Similar patterns are observed and the statistical significance of all the coefficients of interest is preserved. Specifically, I observe a negative correlation between the exposure to indirect imports of intermediate goods and exit probabilities and a positive relationship between the exposure to indirect imports of final goods and exit probabilities over different time intervals. The estimated coefficients on $IIPen^{Int}$ range from $-.016$ for the probability of exiting after 1 year, to $-.151$ for the probability of exiting after 5 years. While the estimated coefficients on $IIPen^{Fin}$ range from .044 for the probability of exiting after 1 year, to .309 for the probability of exiting after 5 years.

In summary, when the local markets are defined as the combination of the 3-digit NAICS industry and economic region I observe a robust positive coefficient of the exposure to indirect imports of intermediate goods on the manufacturing firms' annual growth of employment and real sales, and a negative correlation with firm exit probabilities after one to five years. Similarly, there is a negative and statistically significant correlation of the exposure to indirect imports of final goods on the growth of employment and sales, and a positive correlation with exit probabilities of manufacturing firms. These results are robust to the different measures of indirect import penetration either computed using imports and domestic sales at the local market, or computed as the average of the import penetration variables of local markets located within a 100 km radius. No statistically significant relation is observed between the import penetration in intermediate and final goods and the annual growth of the TFP of manufacturing firms.

4.4.1 Endogeneity

One of the major concerns of the estimated results is that both import penetration variables $IIPen^{Int}$ and $IIPen^{Fin}$ may suffer from endogeneity. Although it is reasonable to assume that the lagged indirect import penetration variables are taken as given at the time manufacturing firms solve their optimization processes, it may also be true that there could be omitted variables jointly affecting the indirect import penetration and the outcomes of manufacturing firms. To see that, consider the effect of policies aiming to boost employment and economic activity at the local market level. When provincial governments and municipalities provide incentives and tax stimulus aimed to retain and attract new firms, the location-specific component of these policies would naturally influence the output and input markets faced by domestic producers, and at the same time would have an effect on the location decisions of manufacturing firms and wholesalers. As a consequence, the degree of import exposure and the level of economic activity within a local market could be largely determined by a combination of underlying local conditions and shocks that are not always observable.

Usually, the literature has addressed the endogeneity in the import penetration variables using an aggregate approach. For instance, Bernard et al. (2006) and Kamal and Lovely (2017) instrument the industry-level import penetration with industry-year ad-valorem tariffs and freight rates, and exchange rate fluctuations. The validity of these type of instruments relies on the fact that movements in exchange rates and trade costs are mostly driven by global macroeconomic factors, but are expected to have a strong correlation with the industry import shares.[12] Alternatively, there is an extensive literature studying the effects of the surge of Chinese import competition on the US labor market, such as David et al. (2013), Autor et al. (2014), Acemoglu et al. (2016), and more recently Caliendo et al. (2019). These papers have aimed to identify the supply-driven component of Chinese imports by instrumenting the growth of US imports from China with the Chinese import growth of other high-income markets. The underlying assumption of this approach is that the import demand shocks in these high-income countries are not the main driver of China's substantial export increase, and instead this is the result of internal conditions and global changes in the trade policies toward that country.[13] Specifically, this approach computes measures of import penetration using industry-level growth of Chinese exports to other high-income countries other than the US, to instrument for the US industry-level import exposure variables.

Given that my interest is to estimate the local effects of higher indirect import exposure on the outcomes of manufacturing firms, the aggregate approach used in the literature is not suitable for my purpose. Instead, I propose a different approach in which I exploit the fact that I can observe the location of the importing wholesalers and their influence zones. In particular, I instrument the indirect import penetration in a given local market with the average of the indirect import penetration in the local markets located outside an inner radius but within an outer radius. The plausibility of these instruments, relies on the assumption that the radius of influence of local market conditions is smaller than the market reach of wholesalers. Thus by focusing on the average outside this radius, I would be able to exclude all the variation that depends on local government policies and local market shocks, and instead use the variation associated with being exposed to the goods imported by wholesalers.[14]

[12]In fact, Kamal and Lovely 2017 report that when using US firm-level data the power of these instruments is weak.

[13]For instance, in 2001 China joined the World Trade Organization (WTO) and benefited from lower tariffs from other member countries.

[14]To see that, consider a manufacturing firm located in London Ontario, this firm might not have the same regulations nor face the same local market conditions of firms located in the Greater Toronto Area (GTA), however it may easily have access to (or be competing with) the intermediate and final goods imported by wholesalers located in the GTA.

Table 4.4: Firm Outcomes and Indirect Import Penetration, IV

	Labor	Labor: Int	Labor: Fin	Sales	Sales: Int	Sales: Fin	TFP	TFP: Int	TFP: Fin
	2S	1S	1S	2S	1S	1S	1S	1S	1S
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$IImp^{Int}_{i,t-1}$ 100 km	0.208***			0.178**			-0.017		
	(0.06)			(0.08)			(0.02)		
$IImp^{Fin}_{i,t-1}$ 100 km	-0.113***			-0.225***			-0.002		
	(0.02)			(0.04)			(0.01)		
$IImp^{Int}_{i,t-1}$ 100, 500 km		0.546***	-0.196***		0.549***	-0.196***		0.545***	-0.194***
		(0.06)	(0.07)		(0.06)	(0.07)		(0.06)	(0.07)
$IImp^{Fin}_{i,t-1}$ 100, 500 km		-0.117***	1.078***		-0.116***	1.081***		-0.118***	1.078***
		(0.02)	(0.13)		(0.02)	(0.13)		(0.02)	(0.13)
Age	-0.094***	0.001	-0.007	-0.027	0.001	-0.007*	-0.037***	0.001	-0.004
	(0.02)	(0.00)	(0.00)	(0.03)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Capital intensity	0.450***	-0.069*	-0.228**	-0.107	-0.065*	-0.198**	0.302***	-0.083**	-0.227**
	(0.10)	(0.04)	(0.09)	(0.14)	(0.03)	(0.09)	(0.04)	(0.04)	(0.10)
Skill intensity	0.275***	-0.018**	0.043*	-0.003	0.000	0.000	-0.078*	-0.016**	0.043*
	(0.10)	(0.01)	(0.03)	(0.00)	(0.00)	(0.00)	(0.04)	(0.01)	(0.02)
N	224,735	224,735	224,735	230,286	230,286	230,286	198,117	198,117	198,117
Min. Eigenvalue	27097.0			27671.6			23982.8		

Note: Estimated using fixed effects at the Year + ECR level. Clustered standard errors at the ECR-level are included in parenthesis.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

I estimate specification (4.5) by means of two-stage least squares. Columns (1), (4) and (7) of Table 4.4 report the IV estimates. These estimates confirm that the firm growth of employment and real sales remains positively correlated to the indirect import penetration of intermediate goods in its local market. At the same time, firm growth of employment and sales is negatively correlated to the indirect import penetration of final goods. As before, no statistical relation is observed between import penetration variables and the annual growth of the TFP. Overall, the magnitude of the IV estimates is larger than the one reported in Table 4.2. I formally assess whether the instruments proposed are relevant. In Table 4.4, I depict the first-stage regressions, and as can be noted the instruments are strongly correlated with the endogenous variables and are statistically significant. Moreover, at the bottom of the table I report the minimum eigenvalue statistic developed by Cragg and Donald (1993). This statistic constitutes a generalization (for multiple endogenous variables) of the first-stage F-statistics used to detect weak instruments with one endogenous variable, in which the null hypothesis is that the coefficients on the instruments on the first stage are jointly zero. Notice that in all cases, the value of the statistic is extremely large and is well beyond the critical values proposed by Stock and Yogo (2005).[15] Therefore, it can be concluded that there are no problems of having

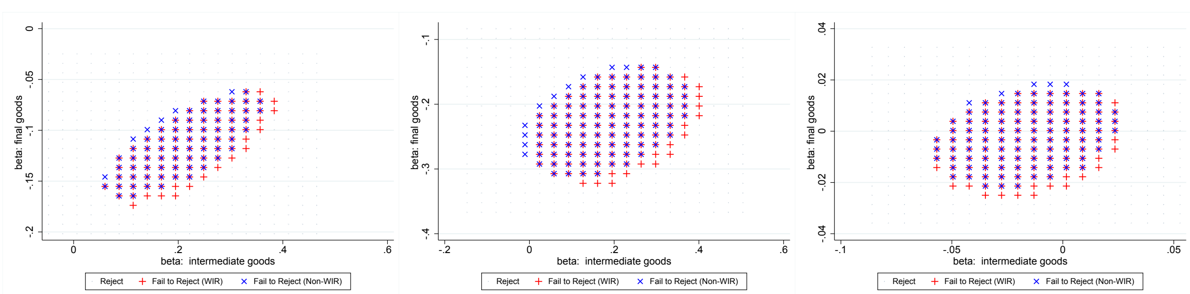
[15]The critical values proposed by Stock and Yogo (2005) assume that the errors are independent and identically distributed (i.i.d.) normal, which may not be appropriate for my application that uses cluster-robust standard errors.

weak instruments.

Additionally, I report the 95% confidence ellipsoids for the coefficients on the indirect import penetration of intermediate and final goods using the procedure described in Chernozhukov and Hansen (2008). Two of the main advantages of this procedure, is that is not only robust to the presence of weak instruments, but is also robust to heteroskedasticity and autocorrelation through the use of conventional cluster-robust covariance matrix estimators. To serve as a comparison, I also report the 95% confidence region of the parameters of interest using a procedure that is not robust to the presence of weak instruments but that takes into account the covariance across coefficients. As can be seen in Figure 4.3, in the employment and sales specifications the 95% confidence regions for the weak instrument robust (WIR) procedure exclude the zero effect on both coefficients and and are located in the lower right quadrant, meaning that the coefficient on final goods has a negative sign and the one of intermediate goods has a positive sign. Notice that although there is extensive overlap with the confidence regions obtained by means of the non-WIR procedure, there are some differences at the borders. Consistent with previous results, the confidence region for the TFP specification is located near the origin and include the zero effect on both coefficients.

Figure 4.3: 95% Confidence Ellipsoids

Labor Sales TFP



Finally, Table 4.5 contains the instrumental variable analogues of the linear probability specifications described by equation (4.6). The estimates confirm the positive effect of the indirect import penetration of final goods on the exit probabilities of manufacturing firms after one to five years. Again the magnitude of the coefficients is larger relative to the OLS estimates. Moreover, even when the coefficients on the indirect import penetration in intermediate goods are negative, these coefficients are close to zero and none of them are statistically significant. Thus, there is no clear evidence of a causal effect of the exposure to indirect imports of intermediate goods on the survival of manufacturing firms.

Table 4.5: Exit rates and Indirect Import Penetration, IV

	$\Pr(X^{t:t+1})$	$\Pr(X^{t:t+2})$	$\Pr(X^{t:t+3})$	$\Pr(X^{t:t+4})$	$\Pr(X^{t:t+5})$
	(1)	(2)	(3)	(4)	(5)
$IImp^{Int}_{i,t-1}$	-0.024	-0.045	-0.073	-0.090	-0.132
100 km	(0.02)	(0.04)	(0.07)	(0.09)	(0.11)
$IImp^{Fin}_{i,t-1}$	0.047***	0.126***	0.228***	0.333***	0.430***
100 km	(0.01)	(0.02)	(0.03)	(0.04)	(0.05)
Age	-0.001***	-0.002***	-0.004***	-0.005***	-0.006***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Capital intensity	-0.002***	-0.001*	0.000	0.001	0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Skill intensity	0.000	0.000	0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
N	230,286	204,821	178,851	152,652	126,169
Min. Eigenvalue	27767.3	24536.0	21494.6	18766.2	14968.7

Note: Estimated using fixed effects at the Year + ECR level. Clustered standard errors at the ECR-level are included in parenthesis.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.5 Conclusion

Using a unique administrative dataset for Canadian firms that combines detailed information on performance with import transactions, I explore the presence of wholesalers in international trade. With this dataset, I document a series of empirical regularities highlighting their role as trade intermediaries and distributors of imported final and intermediate goods. First, I find that the share of total import value accounted by wholesalers increased from from 26.5% in 2002, to 34.3% in 2012. Second, I document that wholesalers were the dominant players on the final goods import markets, accounting for almost 50% of the total import value of final goods in 2012, up from 43% in 2002. Similarly, they earned notoriety in the import markets of intermediate inputs by increasing their import share from 16% to almost 22% ten years later. Additionally, I find substantial differences on how wholesalers and manufacturing firms engage in international trade. Specifically, I document that when compared to manufacturing firms, wholesalers imported more goods and from more countries, and over the observation period the number of importing firms grew more in the wholesale trade sector relative to the manufacturing sector.

Given that the NALMF dataset allows me to observe the location of all the firms in Canada, I construct local market measures of the exposure to the imports of final and intermediate goods carried by wholesalers. Then, by exploiting the geographic variation in the exposure to these indirect imports, I empirically estimate their effect on sales, employment, productivity and exit rates of domestic manufacturing firms. The results suggest that there is a positive and statistically significant correlation between indirect imports of intermediate goods and the average firm growth of employment and sales, and a negative effect on the exit probabilities of manufacturing firms after different time intervals. Moreover, I find a negative and statistically significant correlation between indirect imports of intermediate goods and the average firm growth of employment and sales, and a positive effect on the exit probabilities of manufacturing firms after different time intervals. These correlations are robust to the measure of indirect import penetration that only considers information for each local market, or that is computed as the simple average of the indirect import penetration variables in neighbouring local markets located around a 100 km radius.

Finally, I use an instrumental variable approach to estimate the causal effect of the indirect import penetration in intermediate and final goods on manufacturing firm outcomes and exit probabilities. In particular, I employ a set instruments constructed as average of the indirect import penetration in the local markets located within a 100 km and 500 km around each local market. The plausibility of these instruments, relies on the assumption that the radius of influence of local market conditions is smaller than the market reach of wholesalers. Thus by focusing on the average outside an inner radius, these instruments remove all the variation associated with local market conditions and local policies, but maintain the variation attributed to the effects of being exposed to the imports of final and intermediate goods carried by wholesalers. The instrumental variable estimates confirm the negative effect of indirect imports of final goods on employment, sales and survival, as well as the positive effect of indirect imports of intermediate goods on employments and sales. However, no causal effect of indirect imports of intermediate goods on the exit probabilities of manufacturing firms is observed.

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Appendix A

Recursive Bayesian updating

For a firm with n and $n+1$ (notice the subscript is omitted for simplicity) years of tenure the means of the posterior belief are denoted as:

$$\begin{aligned}
\mu_n &= \frac{\sigma_\epsilon^2}{\sigma_\epsilon^2 + n\sigma_\theta^2}\theta_0 + \frac{\sigma_\theta^2}{\sigma_\epsilon^2 + n\sigma_\theta^2} \cdot n \cdot \frac{1}{n}\sum_{s=0}^{n} a_s \\
\mu_{n+1} &= \frac{\sigma_\epsilon^2}{\sigma_\epsilon^2 + (n+1)\sigma_\theta^2}\theta_0 + \frac{\sigma_\theta^2}{\sigma_\epsilon^2 + (n+1)\sigma_\theta^2} \cdot (n+1) \cdot \frac{1}{n+1}\left[a_{s'} + \sum_{s=0}^{n} a_s\right]
\end{aligned}$$

therefore $\mu_{n+1} - \mu_n$ is given by:

$$\begin{aligned}
\mu_{n+1} - \mu_n &= \sigma_\epsilon^2\theta_0\left[\frac{1}{\sigma_\epsilon^2 + (n+1)\sigma_\theta^2} - \frac{1}{\sigma_\epsilon^2 + n\sigma_\theta^2}\right] + \\
&\quad \frac{a_{s'}\sigma_\theta^2}{\sigma_\epsilon^2 + (n+1)\sigma_\theta^2} - \frac{\sigma_\epsilon^2\sigma_\theta^2\sum_{s=0}^{n} a_s}{\left(\sigma_\epsilon^2 + (n+1)\sigma_\theta^2\right)\left(\sigma_\epsilon^2 + n\sigma_\theta^2\right)} \\
&\quad \Longrightarrow \\
&= \frac{\sigma_\theta^2}{\sigma_\epsilon^2 + (n+1)\sigma_\theta^2}\left(a_{s'} - \mu_n\right)
\end{aligned}$$

Similarly for the variance:

$$\begin{aligned}
v_n^2 &= \frac{\sigma_\epsilon^2\sigma_\theta^2}{\sigma_\epsilon^2 + n\sigma_\theta^2} \\
v_{n+1}^2 &= \frac{\sigma_\epsilon^2\sigma_\theta^2}{\sigma_\epsilon^2 + (n+1)\sigma_\theta^2}
\end{aligned}$$

implies that $\nu_{n+1}^2 - \nu_n^2$ is given by:

$$\begin{aligned}
\nu_{n+1}^2 - \nu_n^2 &= \frac{\sigma_\epsilon^2 \sigma_\theta^2}{\sigma_\epsilon^2 + (n+1)\sigma_\theta^2} - \frac{\sigma_\epsilon^2 \sigma_\theta^2}{\sigma_\epsilon^2 + n\sigma_\theta^2} \\
&= -\frac{\sigma_\theta^2}{\sigma_\epsilon^2 + (n+1)\sigma_\theta^2} \nu_n^2
\end{aligned}$$

Lastly, for the log growth of the beliefs for a firm that has observed n and $n+1$ signals:

$$\begin{aligned}
\Delta \log b(\bar{a}', n+1) &= \frac{1}{\sigma}(\mu_{n+1} - \mu_n) + \frac{1}{2\sigma^2}\left(\nu_{n+1}^2 - \nu_n^2\right) \\
&= \frac{\sigma_\theta^2}{\sigma_\epsilon^2 + (n+1)\sigma_\theta^2}\left(\frac{a_{s'} - \mu_n}{\sigma}\right) - \frac{\sigma_\theta^2}{\sigma_\epsilon^2 + (n+1)\sigma_\theta^2} \frac{\nu_n^2}{2\sigma^2}
\end{aligned}$$

Appendix B

Alternative specifications

In addition to the specifications included in the main text. Here, I present the results when the partial-year bias is not taken into account. That is, the monthly sales an prices are annualized as the sum or average over the calendar year. The results and the significance of the coefficients remain mostly unaltered.

Table B1: Estimation results

	(1) Cont. rates	(2) Export sales	(3) Export prices
Constant	0.384***	2.442***	-2.948***
	(0.00157)	(0.00669)	(0.00396)
Age = 2	0.142***	0.908***	0.115***
	(0.00305)	(0.0148)	(0.00755)
Age = 3	0.218***	1.369***	0.148***
	(0.00376)	(0.0191)	(0.00910)
Age = 4	0.251***	1.726***	0.174***
	(0.00451)	(0.0237)	(0.0106)
Age = 5	0.275***	2.062***	0.199***
	(0.00511)	(0.0290)	(0.0123)
Age = 6	0.293***	2.353***	0.209***
	(0.00598)	(0.0363)	(0.0150)
Age = 7	0.291***	2.618***	0.217***
	(0.00671)	(0.0434)	(0.0168)
Age = 8	0.281***	2.987***	0.288***
	(0.00807)	(0.0562)	(0.0214)
Age = 9		3.316***	0.286***
		(0.0726)	(0.0304)
Observations	228,693	230,512	230,511

Notes: All regressions include firm-product-year plus country-year fixed effects. Standard errors clustered at the firm-year.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Model Derivations

When the exit value is normalized to zero, the exporters problem can be expressed as dynamic control problem which has been extensively studied by Pakes et al. (1991) and more recently Foster et al. (2016). The exporter's mixed continuous-discrete choice problem is given by:

$$V(b_{i,t}, z_{it}^*, e_t) = \max_{X_{i,t}} \left\{ 0(1-X_{i,t}), X_{i,t} \sup_{p_{it}, b_{i,t+1}} \quad (p_t - mc_t) \cdot c_{it} + \beta \mathbb{E}_{b_t, z_t^*} V(b_{i,t+1}, z_{i,t+1}^*, e_{t+1}) \right\}$$

$$+\lambda_t \Big[(1-\delta) b_{i,t} + \delta p_{it} c_{it} - b_{i,t+1} \Big]$$

F.O.C.

$$p_t : \qquad -(\sigma - 1) \cdot c_t + \sigma \frac{mc_t}{p_t} - (\sigma - 1)\lambda_t \delta \cdot c_t = 0 \tag{B.1}$$

$$b_{t+1} : \qquad -\lambda_t + \beta \mathbb{E}\left[X_{i,t+1} \cdot \frac{\partial V(b_{i,t+1}, z_{i,t+1}^*, e_{t+1})}{\partial b_{t+1}} \right] = 0 \tag{B.2}$$

Define $\mu_t = \frac{p_t}{mc_t}$ and the CES markup $\bar{\mu} \equiv \frac{\sigma}{\sigma - 1}$, thus equation can be rewritten as:

$$\mu_t^{-1} - \bar{\mu}^{-1} = \frac{\sigma - 1}{\sigma} \lambda_t \delta \tag{B.3}$$

Then, by means of the envelope theorem we have that:

$$\frac{\partial V(b_{i,t}, z_{i,t}^*, e_t)}{\partial b_t} = \frac{\theta}{b_t} p_t c_t - \frac{\theta}{b_t} mc_t c_t + \lambda_t (1-\delta) + \lambda_t \delta \frac{\theta}{b_t} p_t c_t$$

$\implies$

$$= \frac{\theta}{b_t} p_t c_t \left[1 - \frac{mc_t}{p_t} + \lambda_t \delta \right] + \lambda_t (1 - \delta)$$

after simplifying and iterating forward:

$$\frac{\partial V(b_{i,t+1}, z_{i,t+1}^*, e_{t+1})}{\partial b_{t+1}} = \frac{\theta}{b_{t+1}} p_{t+1} c_{t+1} \frac{\mu_{t+1}^{-1}}{\sigma - 1} + \frac{\sigma}{(\sigma - 1)} \frac{(1-\delta)}{\delta} (\mu_{t+1}^{-1} - \bar{\mu}^{-1}) \tag{B.4}$$

Finally, by combining equations B.2, B.3 and B.4 and taking expectations, the equation for the markup is obtained:

$$\mu_t^{-1} - \bar{\mu}^{-1} = \beta \mathbb{E}\left\{ X_{i,t+1} \left[\frac{\theta \delta p_{t+1} c_{t+1}}{\sigma b_{t+1}} \mu_{t+1}^{-1} + (1-\delta)(\mu_{t+1}^{-1} - \bar{\mu}^{-1}) \right] \right\}$$

Appendix C

Table C1: Import Shares by Sector

Year	Manufacturing		Wholesale Trade	
	Sector share	Firm share	Sector share	Firm share
2002	60.403	5.306	26.552	15.660
2003	59.538	4.895	26.889	15.125
2004	57.445	5.010	28.509	15.290
2005	56.162	5.051	29.332	15.728
2006	52.474	5.050	32.567	15.470
2007	49.826	5.081	31.973	15.388
2008	47.451	5.197	31.379	15.663
2009	41.048	4.928	34.217	15.115
2010	40.297	4.998	34.573	15.128
2011	39.121	4.938	32.963	15.443
2012	38.564	5.013	34.308	15.610

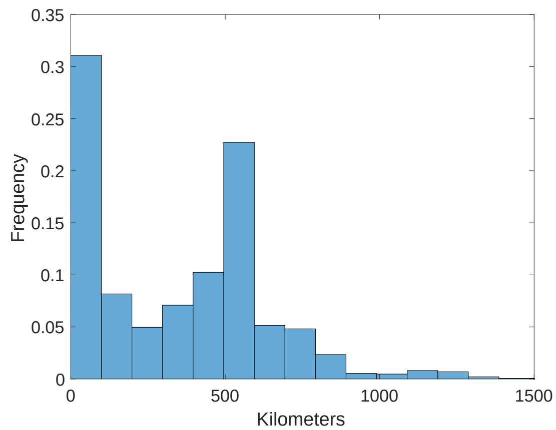
Source: Own calculation with data from Statistics Canada.

Table C2: Import Shares by Sector and End-Use

Year	Manufacturing		Wholesale Trade	
	Intermediate	Final	Intermediate	Final
2002	75.203	33.188	16.479	43.106
2003	74.544	31.732	16.351	42.933
2004	72.199	29.993	17.963	44.455
2005	71.461	29.172	18.687	45.701
2006	68.700	25.950	21.300	48.113
2007	65.087	25.166	20.630	47.576
2008	62.006	24.422	20.339	46.684
2009	54.007	22.324	22.581	47.955
2010	51.566	21.372	24.584	47.574
2011	50.747	19.804	21.636	49.477
2012	50.712	19.738	21.742	49.175

Source: Own calculation with data from Statistics Canada.

Figure C.1: Histogram of Bilateral Distances



Source: Own calculation with data from DMTI Spatial.

Inference with Weak Instruments

To further assess the validity of the proposed instruments, I compute the 95% confidence ellipsoids of the two endogenous variables based on the approach implemented by Chernozhukov and Hansen (2008). A key advantage of this approach is that it allows to do inference on structural parameters even in the presence of weak instruments. In what follows, I briefly describe the testing procedure. Suppose that we are interested in the structural parameters of the simultaneous regression framework described by:

$$Y = X\beta + W\Pi + \epsilon \tag{C.1}$$

$$X = Z\theta + W\gamma + \nu \tag{C.2}$$

where Y is a $T \times 1$ vector of outcomes variable X is a $T \times S$ matrix of endogenous regressors, W is a $T \times K$ matrix of controls and Z is a $T \times R$ matrix of excluded instruments where $R \geq S$. Now suppose we want to test the hypothesis $\beta = \beta_0$, notice that if we substitute (8) in (7) under the null hypothesis we have:

$$Y - X\beta_0 = Z\alpha + W\delta + \epsilon \tag{C.3}$$

therefore testing $\alpha = 0$ is equivalent to testing the null hypothesis $\beta = \beta_0$, and this test is robust to the presence of weak instruments. In particular, the Wald statistic $W_S(\beta_0)$ can be constructed as a robust statistic for testing $\beta = \beta_0$, and this statistic will be asymptotically distributed as a χ^2_R with R degrees of freedom. The steps for constructing the 95% confidence ellipsoid for the

Weak Instrument Robust procedure are:

1. Construct a grid $\mathcal{B}$ containing possible values of β. In my application, I construct a 30×30 grid including 5 standard deviations around the 2SLS coefficient $\hat{\beta}$.
2. For each $b \in \mathcal{B}$, define $\tilde{Y} = Y - Xb$ and regress $\tilde{Y}$ on Z and W. Obtain $\hat{\alpha}$ and the corresponding cluster-robust variance-covariance submatrix $\hat{V}(\hat{\alpha})$.
3. Construct the Wald statistic $W(b) = \hat{\alpha}' \hat{V}(\hat{\alpha})^{-1} \hat{\alpha}$.
4. Construct the $1-p$ level confidence region as the set of b such that $W_S(b) \leq C_{1-p}$ where C_{1-p} is the $(1-p)^{th}$ percentile of a χ^2_R distribution.

Curriculum Vitae

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