Information Spillovers in Export Destinations

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Abstract

We study how information spillovers, in terms of learning about other destinations when exporting, affect firms' entry and exit decisions in export markets. We provide empirical evidence on the existence of these spillovers and how firms use their export experience to make better choices when selling to foreign markets. We build a dynamic model of export supply and learning in which firms choose to which countries to export based on their beliefs about their profitability in these destinations. We quantify our model by estimating firms' export profitability and fixed costs of exporting, and conduct counterfactual simulations to evaluate the contribution of these spillovers to the diversification of export destinations. Without information spillovers, the share of Mexican firms exporting to destinations other than the US would decrease by 21.6%. We also find that lowering the fixed costs of exporting to a particular country could increase the share of firms exporting and exports to other destinations.

JEL Codes: D83, F12, F13

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1 Introduction

Several distinct factors determine a firm's export supply, such as its productivity or the trade costs it faces. Moreover, in a world with imperfect information, one could also consider a firm's perceived profitability in export destinations an essential factor. This is because uncertainty in demand could lead a firm not to enter a destination when it was profitable to do so, or on the contrary, lead a firm to enter a destination only to exit after discovering it was not profitable to export there, that is, an exporting failure. If uncertainty is present in export markets and therefore firms learn while exporting, one could also ask if learning about a destination is only possible when exporting there or if learning occurs not only when exporting to that destination but also when exporting to other similar export markets. This is precisely the central question of this paper: how do information spillovers affect a firm's entry and exit decisions from export markets?

The literature on the geographic expansion of a firm's exports considers two mechanisms: the first is that exporting tenure lowers the costs of exporting and thus increases the profitability of entering other export destinations. The second is that there are information spillovers across potential destinations; therefore, previous experience may lead a firm to enter new markets. This paper follows the second mechanism. On one hand, I provide empirical evidence of information spillovers affecting firm dynamics in export markets. On the other hand, using this empirical evidence as motivation, I built a structural model of export supply with learning to explore the mechanisms behind the geographical spread of a firm's exports. More work needs to be done on how export destinations shape the pattern of entry into other destinations and on building empirical models that allow us to ask interesting questions regarding firms' export choices under uncertainty.

For example, assume a Mexican firm is considering exporting to Germany and Switzerland but is uncertain about its profitability. Given some prior beliefs, the exporter chooses to enter Germany and, while exporting there, starts to learn about its true profitability in that country. However, the firm learns about Germany and Switzerland because of the similarity between these two countries. Therefore, the experience of exporting to Germany also leads the firm to export to Switzerland. This is what I call information spillovers, the fact that when exporting to a particular destination, a firm learns about that specific destination and other similar potential export destinations. If this mechanism is accurate, these information spillovers could generate the geographic spread of a firm's exports.

This paper contributes to the literature on uncertainty and entry choices such as the work by Das et al. (2007), Impullitti et al. (2013) and Dickstein and Morales (2018), to the literature on extended gravity such as the work by Morales et al. (2019) which remarks

the importance of export experience when trying to explain exporter dynamics and to the literature on firm's destination choices such as the work by Nguyen (2012) where it is assumed that there is demand uncertainty across potential destinations -which is immediately resolved once a firm enters a market-, but only explores a two country static model. In contrast, we are proposing a dynamic framework in which demand shocks are imperfectly correlated across destinations and firms do not immediately discover their profitability but rather start a learning process, which seems more akin to the stylized facts for new exporters identified in the data as in Ruhl and Willis (2017). Another key difference is that the author only performs numerical simulations to evaluate, on average, how many destinations a firm enters; in contrast, this paper structurally estimates a model and conducts counterfactual simulations to assess the effect of information spillovers.

In Albornoz et al. (2012), the authors consider a two-period, two-country model with perfectly correlated demand shocks and immediate learning. In contrast, this paper explores an environment with multiple potential destinations where demand is imperfectly correlated across these. Defever et al. (2015) provide reduced-form evidence of how it is more likely a firm will enter a destination geographically close to another destination the firm has previously exported to. Another paper in this line is that of Evenett and Venables (2002). Still, they consider that past export experience only affects the cost side of firms and that firms need to be forward-looking, i.e., when deciding whether to enter a new destination, it is not taking into account that the new location will provide information on other destinations.

The work by Schmeiser (2012) also considers the geographic expansion of a firm's exports but rather than being a story of demand uncertainty, it is a story about learning to export in which the fixed costs of entry into a destination are decreasing in the number of destinations previously served. Because of this, a destination that previously was not profitable to export might become profitable once sufficient experience is acquired, thus generating geographical expansion. This differs from the framework we present since their work is more about firms getting the know-how of exporting -through reduced fixed costs of doing so- rather than firms acquiring more information while exporting to a given market.

The rest of the paper is organized as follows. Section 2 describes the data we use, discusses how we compute a similarity measure of export destinations, and provides reduced-form evidence on information spillovers and how these affect firms' entry and exit choices in export destinations. In Section 3, we present a model of export supply and information spillovers, in which we describe how firms choose their export destinations and learn according to their experience in these markets. Section 4 details the quantification of our model, while Section 5 presents the counterfactual scenarios we explore to evaluate the role of information spillovers. Section 6 summarizes our main findings and discusses their policy implications.

2 Empirical Evidence

This section describes how we use Mexican customs data on the universe of exporting firms, with which we compute a similarity index between export destinations and present reduced-form evidence on the existence of information spillovers and how they affect firm behavior in export markets. The most prominent empirical work regarding how past destination choices affect entry into new export markets is that of Defever et al. (2015), which tests if having previously exported to a given country increases the probability of entering a similar destination, e.g., if a firm has exported to Germany, the firm is more likely to start exporting to Switzerland given that Germany and Switzerland are similar countries. This approach is standard in the literature, and even though it is intuitive, we need to take a different approach in this paper.

While the sign of the coefficient for the effect of export experience on entry is positive in the work mentioned above, we are silent about it. Having previously exported to a destination may only sometimes lead to entry into a similar destination. Still, it should allow the firm to make more informed decisions. For example, suppose a firm, while exporting to Germany, learns that exporting to Switzerland would not be profitable. In that case, export experience decreases the probability of a firm entering Switzerland after entering Germany. Under this argument, all that exporting to Germany does is give the firm more information about Switzerland: whether it is profitable to export to Switzerland. Moreover, if destinations provide information about other export markets, the information a destination provides might incentivize firms to enter that particular export market.

2.1 Data

The data used in this paper comes from the Exporter Dynamics Database published by the World Bank and constructed by Fernandes et al. (2015). The Mexican data contains yearly information on export destination, value of sales, year, product -at the HS 6-digit disaggregation level- and, for some observations, quantity. As shown in Table 1, data is for the period between 2000 and 2012 and covers 203,869 distinct firms exporting to 226 destinations and 2,879 unique markets. A market is defined as a unique destination-product combination aggregating products into a 2-digit disaggregation level.

Table 1 also provides a brief overview of some exporter characteristics relevant to this paper. The average number of destinations exported by a firm in a single period is 2.08 destinations -standard deviation of 3.63-, while the average number of exported destinations for all years in the sample is 2.54 -standard deviation of 4.57-. These low values for the mean number of destination countries reflect the small diversity in export destinations for

Statistic	Value
Years	2000 - 2012
# of firms	201,739
# of destinations	226
# of markets	2,879
Average $\#$ of destinations served per period	2.04
	(1.00)
Average $\#$ of markets served per period	3.38
	(1.00)
Average $\#$ of destinations served in total	2.47
	(1.00)
Average $\#$ of markets served in total	4.57
	(2.00)
Average tenure of a firm in an export destination	1.87
	(1.00)
Average tenure of a firm in an export market	1.67
	(1.00)
Average tenure of a firm as an exporter	2.25
	(1.00)

Table 1: Descriptive Statistics.

Mexico. Mexican exports are concentrated in a small number of destinations, e.g., exports to the United States account for 82.63% of total export value during this period. This fact is only reinforced by the medians shown in parenthesis, which indicate that half of all Mexican firms only export to one country in their tenure as exporters.

As for the number of periods a firm exports to a particular destination, which we refer to as tenure in an export market, the average firm exports only for 1.93 years -with a standard deviation of 1.60-. This points out that most firms experience exporting failures since they only enter an export market for a few periods and exit from it. Meanwhile, the average tenure as an exporter is 2.36 years -with a standard deviation of 1.99 years-, which again shows that most firms only engage in international trade for a few periods. This fact has been well documented in the literature. As for why this behavior persists in the data, rather than a story of demand shocks driving firms out of export markets, it is one of uncertainty when engaging in international trade, which further motivates this paper.

2.2 Similarity of Export Destinations

To calculate a similarity index between export destinations, We follow the work by Finger and Kreinin (1979) in which the authors develop an export similarity index. Their index measures the similarity of two countries regarding their exports to a common third country and is defined as:

$$S_X(i,j;k) = \sum_l \min\left(\frac{X_{ik}^l}{X_{ik}}, \frac{X_{jk}^l}{X_{jk}}\right)$$
(1)

where i and j are the two origin countries in consideration, k is the third country that is exported to, l represents some trade classification system and X represents the value of exports. For this work, rather than using this export similarity index, we define and calculate an import-based similarity index. We are using imports rather than exports since Mexican firms serving a particular destination care about how similar that destination is to others regarding their exports to those countries, which can be seen as imports from their perspective. The import-based similarity index is thus defined as:

$$S(i,j;k) = \sum_{l} \min\left(\frac{M_{ik}^{l}}{M_{ik}}, \frac{M_{jk}^{l}}{M_{jk}}\right)$$
(2)

The index takes values such that $S \in [0, 1]$, where higher values of S represent a higher degree of similarity between countries *i* and *j* with respect to their imports from *k*. If the index equals 0, then *i*'s and *j*'s import patterns from *k* are entirely dissimilar. If the index equals 1, then the commodity distribution of *i*'s and *j*'s imports from country *k* is identical. To calculate the import-based similarity index, we use our customs data as firm exports can be aggregated at the product-destination level, and thus, we can calculate the value of imports of a particular country coming from Mexico for every product in the data. Products are defined following the HS classification system at a 2-digit disaggregation level.

Figure 1 shows how similar the United States is to the rest of the world regarding their imports from Mexico. The index predicts intuitive results such as the similarity between the USA and Canada or Commonwealth countries such as the United Kingdom, Australia, South Africa, etc. The complete end-product of this exercise is a symmetric matrix that shows how similar every country-pair is for the destinations to which Mexican firms exported between the years 2000 and 2012. The index is calculated yearly but then averaged over all periods in the data for our reduced-form estimations.



Figure 1: The US compared to the ROW in terms of their imports from Mexico.

2.3 Identification Strategy

This section provides empirical evidence on information spillovers and whether these affect firms' choices in export markets. If destinations contain information about other potential destinations, then the following testable implications should follow:

Implication 1: If destinations provide information about other similar destinations, then a firm that has previously exported to countries similar to i should be less likely to make a wrong decision regarding entry into i.

Assuming there is uncertainty on destination-specific profitability and information spillovers across similar destinations, a firm with higher export experience relevant to a certain destination is less likely to make a wrong decision regarding entry into that destination.

Implication 2: If destinations provide information about other similar destinations, then destinations are valuable for how much information about other countries they provide. More informative destinations should be more likely to be entered.

In the presence of information spillovers, and assuming firms are aware of these spillovers and are forward-looking, destinations are valuable not only because of their expected profitability but also because of how informative they are about destinations that firms have not previously exported to. A firm might enter a destination even when expecting non-positive profits if the destination will lead to lower uncertainty concerning other destinations and, thus, higher profits or at least better decisions in the future.

2.3.1 Relevant Export Experience and Wrong Decisions

The ideal identification strategy would be regressing the probability of making a "wrong decision" concerning entry into a destination on a measure of how much information a firm has about this destination, where we use export experience as a proxy for the amount of information a firm has. However, estimating or defining what making a wrong decision means is challenging, even more so when we only have customs data without firm characteristics.

Testing this implication first requires us to define what we mean by a wrong decision. We will consider the case in which a firm enters a particular market, realizes it is not profitable to export there, and thus decides to exit. That is, entry when entry was not profitable. This requires us to define what we consider an exit from a market and how to proxy for the firm being profitable or unprofitable. For the case of exit, we will consider two distinct cases:

- An exit is when a firm enters a market and exits from it in the next period.
- An exit is when we observe entry and then exit at some point before the last year in the data.

Measuring when a firm is profitable or not in an export market poses a greater challenge. Given the lack of firm characteristics in our data, we proxy for it using whether a firm exited -continued- the market when demand was increasing -decreasing-. That is:

- The firm was profitable if it did not exit the market despite a negative demand shock.
- The firm was not profitable if it exited the market despite a positive demand shock.

The reasoning behind this is if the firm exited the market even with a positive demand shock, it could indicate that it was not profitable in that market and thus exited. On the contrary, if we observe that a firm did not exit the market even with a negative demand shock, then it might be the case that the firm was profitable, that is, if the firm was able to withstand a negative demand shock then it is likely that the firm was profitable in that market.

Lastly, we define a positive/negative demand shock using changes in demand. Even though the analysis is conducted at the market level, a product-destination combination, we define demand shocks at the destination level to account for the fact that a few firms might serve a market. Thus, a firm's exit would generate a negative market shock, which would cause a problem of reverse causality. We propose two measures of what a positive demand shock is:

- The growth rate of demand is positive.
- The growth rate of demand is above its average growth rate.

And equivalently for a negative demand shock. With these definitions in hand, Table 2 shows how our dependent variable is constructed. We ignore the cases in which the firm exited with a negative demand shock and when it continued with a positive demand shock since it is less clear if the firm was or was not profitable in these cases. Suppose the firm exited the market, but there was a negative demand shock. In that case, We cannot say that the firm was not profitable since its exit might be driven precisely by a negative demand shock and not by its profitability in that export market. The same intuition applies to the case in which a firm continued, and there was a positive demand shock.

	Positive demand shock	Negative demand shock
Exit	Wrong decision	-
Continue	_	Right decision

Table 2: Definition of a wrong decision.

Now, we turn our attention to the independent variable of this analysis, the measure of relevant export experience. We emphasize the word relevant to acknowledge the fact that not all previously exported destinations provide the same amount of information about a particular destination, but rather, it depends on how similar those destinations are to the one in consideration. Suppose the destinations a firm has previously exported are more similar to the one in consideration. In that case, the firm should have more information about this destination and thus be more likely to make a better decision concerning entry.

The measure of relevant export experience should be a function of two things: which destinations firm i has exported before period t and the similarity of each of these destinations with market m. Defining z_{imt} to be the amount of export experience that firm i has with respect to market m at time t, then:

$$z_{imt} = \sum_{j \in V_{i,t-1}} S(m,j) \tag{3}$$

where we sum across all destinations j in set $V_{i,t-1}$, which is the set of destinations to which firm i has exported up to period t-1. z_{imt} is increasing in the size of V_{it-1} as long as its elements are such that S(m, j) > 0, that is, if firm i has previously exported to countries somewhat similar to m. The specification to test whether having more information leads to better decision-making regarding entry into a destination is:

$$\mathbb{P}_{imt} = \alpha_0 + \alpha_1 z_{imt} + \epsilon_{imt} \tag{4}$$

where \mathbb{P}_{imt} represents the probability of firm *i* having made a wrong decision concerning entry into market *m* at time *t*, where wrong decision is defined according to one of the criteria above, that is, we are estimating a linear probability model of how relevant export experience affects the likelihood of making a wrong decision regarding entry into a destination.

The specification in Equation (4) is not without problems, as other factors could affect entry into export markets. In particular, two issues are of concern. The first one is that a positive demand shock could be driving entry into a destination and thus threatening the identification of the effect of export experience on entry. For example, imagine a demand shock affecting Germany and Switzerland, perhaps with different timing. The shock could lead to entry into Germany, and then, as the shock hits Switzerland, it could also lead to entry into Switzerland. If this is the case, the estimated coefficient for export experience would have an upward bias and, thus, yield an incorrect estimate of the effect of export experience on how the firm makes entry decisions.

The second issue is that of firms learning how to export. The literature has found evidence that the more a firm has exported in the past, the better it is at exporting. If this is the case, export destinations' profitability would increase in export experience and thus, again, threaten the identification of the effect of increased information on a firm's entry choices. An example of this could be that a firm does not start exporting to Switzerland because by exporting to Germany, it has learned that it is profitable to do so, but rather because by exporting to Germany, it becomes more efficient in exporting, which later drives entry into Switzerland.

To control for both of these concerns, we propose the following specification:

$$\mathbb{P}_{imt} = \alpha_0 + \alpha_1 z_{imt} + \eta_1 \% \Delta x_{dt} + \eta_2 \% \Delta x_{it} + \phi_{f,m,t} + \epsilon_{imt} \tag{5}$$

where $\%\Delta x_{dt}$ represents the percentage change in demand from destination d and time tand $\%\Delta x_{it}$ represents firm *i*'s aggregate exports in time t. We also include product, market, and time-fixed effects to capture any unobservables that our explanatory variables might not capture. On one hand, variable $\%\Delta x_{dt}$ controls for demand shocks driving entry. If there is a demand shock in destination d at time t, this will affect all other firms in that destination and thus will be picked up by this variable. On the other, variable $\%\Delta x_{it}$ controls for learning how to export effects and quality upgrading. If export experience makes the firm more efficient at exporting, this should increase exports to all other destinations the firm serves, which the firm's aggregate exports will thus pick up.

Results for a random sample of firms are shown in Table 3. In it, each column represents a different definition of a wrong decision. Here, dependent variable $\mathbb{P}_{x,y}$ should be read as the probability of making a wrong decision according to criteria x, y, where x represents when the firm exited the market and y how is a positive demand shock measured. The case in which x = inm is when a firm exited the market immediately. The case in which y = pdg is when a positive demand shock is defined as positive demand growth and y = dgaa is when demand growth is above average. Other combinations for these definitions can be explored and would serve as robustness checks.

	$(1)\\\mathbb{P}_{inm,pdg}$	$(2) \\ \mathbb{P}_{inm,pdg}$	$(3) \\ \mathbb{P}_{inm,dgaa}$
Export Experience	-0.00527*** (-18.41)	-0.0118*** (-5.78)	-0.0120*** (-5.34)
$\%\Delta x_{dt}$		-1.85e-08 (-0.79)	-7.93e-08 (-1.46)
$\%\Delta x_{it}$		$1.22e-09^{*}$ (2.84)	$1.87e-09^{**}$ (3.23)
Constant	0.187^{***} (81.78)	$\begin{array}{c} 0.216^{***} \\ (21.79) \end{array}$	$\begin{array}{c} 0.435^{***} \\ (51.05) \end{array}$
Fixed Effects Observations	40,984	✓ 25,561	✓ 17,922

* p < 0.05, ** p < 0.01, *** p < 0.001

Table 3: Relevant Experience.

Table 3 shows results both for the specification in Equation (4), without any controls or fixed effects, and for the full specification according to Equation (5). The coefficient for our measure of relevant export experience seems biased if we do not control for other factors affecting a firm's entry behavior. Columns (2) and (3) are the exact full specifications, but they differ in the definition of a wrong decision we use. Comparing them, the coefficient for export experience is robust to changes in this definition.

As can be seen, the coefficient for relevant export experience is significant and has the expected sign, indicating that higher relevant export experience results in a lower likelihood of a firm making a wrong decision regarding entry into an unprofitable export market. Moreover, the magnitude of the coefficient is also reasonable, as it implies that if relevant

export experience increases by one standard deviation -5.4 points- then a firm is 6.4% less likely to make a wrong decision. In the last two specifications, standard errors are clustered at the firm, market, and time level to capture any correlation on unobservables among these groups. It should also be noted that the decrease in observations when including controls is because some destinations are not exported to in contiguous years, combined with many firms not exporting two years in a row. Additionally, the size of the estimated coefficients on the control variables results from having significant growth rates of demand again because of the high turnover rates in some export markets.

In summary, there is evidence of firms acquiring information about other potential destinations when exporting and using that information to make better decisions regarding their entry into export markets. This supports the hypothesis claimed in **Implication I**.

2.3.2 Informativeness of Destinations and Entry

The objective of this section is to provide evidence that if destinations offer information about other potential destinations, then forward-looking firms might enter destinations to acquire information about other destinations. That is, testing whether the informativeness of a destination affects the probability of entry into it. To do this, Equation 6 defines our measure of the informativeness of an export destination. The index represents how informative destination d is for firm i at period t by considering the destinations to which firm i has not exported before and the similarity of those destinations to the destination in consideration. It is defined as:

$$I_{idt} = \sum_{j \notin V_{i,t-1} \cup \{d\}} S(d,j) \tag{6}$$

With the same notation as in Section 2.3.1 except that now we are summing over destinations that firm i has not exported before. The relationship we test is the following:

$$\mathbb{P}[\text{entry}_{idt}] = \beta_0 + \beta_1 I_{idt} + \epsilon_{idt} \tag{7}$$

We expect the sign of the coefficient for informativeness to be positive, representing that the more informative a destination is for a firm, the higher the probability the firm will enter that destination, given that it would allow it to learn about other potential markets. As with the analysis for the effect of relevant export experience, the specification in 7 could be misleading as other factors can potentially affect the probability of entry into a destination. One of these factors, as discussed in Section 2.3.1, is demand shocks driving entry into a destination, i.e., if a firm entered a given destination, it might be just because of a positive destination demand shock, which now made the destination profitable.

Considering this issue, we propose the specification in Equation (8). If the profitability of a destination is increasing -proxying profitability with positive demand shocks- it should be captured by variable $\%\Delta x_{dt}$. Furthermore, we add destination and time-fixed effects to account for any other unobserved source of variation in entry choices.

$$\mathbb{P}[\text{entry}_{idt}] = \beta_0 + \beta_1 I_{imt} + \eta_1 \% \Delta x_{dt} + \phi_{d,t} + \epsilon_{idt}$$
(8)

Table 4 shows these specifications' results for a random sample of firms. The first column represents the specification in Equation (7), and the second includes our control variable. Still, it does not account for fixed effects, and lastly, the third column is the full specification as stated in Equation (8).

	$(1) \\ \mathbb{P}(entry)$	$\begin{array}{c} (2) \\ \mathbb{P}(entry) \end{array}$	$(3) \\ \mathbb{P}(entry)$
Informativeness	$\begin{array}{c} 0.0000577^{***} \\ (166.70) \end{array}$	$\begin{array}{c} 0.0000782^{***} \\ (160.07) \end{array}$	$\begin{array}{c} 0.00338^{***} \\ (10.93) \end{array}$
$\%\Delta x_{dt}$		$7.67 e-10^{***} \\ (124.68)$	$2.52e-09^{*}$ (2.37)
Constant	-0.00152^{***} (-151.87)	-0.00265^{***} (-145.95)	-0.163^{***} (-10.85)
Fixed Effects Observations	33,132,504	27,671,505	✓ 27,671,505

* p < 0.05, ** p < 0.01, *** p < 0.001

 Table 4: Informativeness Index.

Focusing on the results for the third specification, the estimated coefficient associated with our measure of informativeness is positive, which supports the hypothesis that if destinations contain information about other potential export markets, more informative destinations are more likely to be entered. Moreover, the magnitude of the estimated coefficient is reasonable; it implies that if the informativeness of a destination increases by one standard deviation -20.06 points- then a firm is 6.8% more likely to enter that destination. One important thing to note here is that looking at the standard errors for the first and second columns, there is evidence of the need to cluster our standard errors since there is a correlation between unobservables. We do this for the third column, the full specification, by clustering our standard errors at the firm and destination levels. As in Section 2.3.1, there is a loss in the number of observations because some destinations do not have observations in contiguous years, given our random sample and the high turnover rates in export markets.

In summary, there is evidence in favor of **Implication II**, that is, if destinations are informative about other potential destinations and assuming firms are forward-looking, more informative destinations are more likely to be entered since firms value this information as it can lead them to make better choices in terms of their entry into export market choices.

3 A Model of Export Supply and Information Spillovers

The most prominent papers that develop models of information spillovers and firm entry into export markets are that of Nguyen (2012), Albornoz et al. (2012), and Morales et al. (2019). We follow the model developed in Cebreros (2016) but generalize it to multiple export destinations and allow for information spillovers across them. The model builds on the standard heterogeneous firms framework by Melitz (2003) but adds uncertainty regarding destination-specific demand shocks. Exporters can discretely choose which destination to export based on their prior beliefs, which they update according to Bayes' Rule.

3.1 Consumer Demand at Export Destinations

For the demand side, we assume that CES preferences describe utility in export destination j:

$$U_j = \left(\int_{\Omega} \epsilon_j(\omega) q_j(\omega)^{\frac{\sigma-1}{\sigma}} d\omega\right)^{\frac{\sigma}{\sigma-1}}$$
(9)

where $\sigma > 1$ is the elasticity of substitution across varieties, $q_j(\omega)$ is consumption of variety ω and $\epsilon_j(\omega)$ is a demand shifter. Given aggregate expenditure X_j , the demand function firm ω faces from country j is:

$$q_j(\omega) = \epsilon_j(\omega)^{\sigma} p_j(\omega)^{-\sigma} X_j P_j^{\sigma-1}$$
(10)

where P_j is the Dixit-Stiglitz price index:

$$P_j \equiv \left(\int_{\Omega} \epsilon_j(\omega)^{\sigma} p_j(\omega)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$$
(11)

Using the fact that revenue is given by $r(\omega) \equiv p_j(\omega)q_j(\omega)$, we can use the expression for demand to rewrite an exporter's revenue in market j as:

$$r(q_j) = \epsilon_j(\omega) X_j^{\frac{1}{\sigma}} P_j^{\frac{\sigma-1}{\sigma}} q_j^{\frac{\sigma-1}{\sigma}}$$
(12)

We assume that all uncertainty in export market j depends on underlying export profitability θ_{jt} which is unknown to the firm. This allows us to rewrite the demand shifter a firm faces in export market j as $h(\theta_{jt})$, which captures both aggregate $X_j^{\frac{1}{\sigma}} P_j^{\frac{\sigma-1}{\sigma}}$ and idiosyncratic $\epsilon_j(\omega)$ determinants of demand. For simplicity, we assume a firm faces no uncertainty in the domestic market and normalize its demand shifter to unity. Given these assumptions, a firm faces the following revenue functions:

Domestic Revenue:
$$r(q_j) = q_j^{\frac{\sigma-1}{\sigma}}$$
 (13)

Export Revenue:
$$r(q_j) = h(\theta_{jt})q_j^{\frac{\sigma}{\sigma}}$$
 (14)

3.2 Static Exporter Behavior

For now, we will describe a firm's profit maximization problem as static in nature. Conditional on vector θ_t , a firm's total revenue is the sum of revenue in every market:

$$r_t = q_{ht}^{\frac{\sigma-1}{\sigma}} + \sum_{j \in D} d_{jt} h(\theta_{jt}) q_{jt}^{\frac{\sigma-1}{\sigma}}$$
(15)

where:

$$d_{jt} = \begin{cases} 1 & \text{if the firm exports to destination } j \text{ in period } t, \\ 0 & \text{otherwise.} \end{cases}$$

with q_{ht} and q_{jt} being quantities sold at home and at export market j respectively. Conditional on export status $d_t \in \mathbb{R}^D$, profit-maximizing firms will equate marginal revenue at home and every export destination:

$$q_{jt} = d_{jt} h(\theta_{jt})^{\sigma} q_{ht} \quad \forall j \in D$$
(16)

and thus we can define a firm's total output as:

$$q_t = \left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^\sigma\right) q_{ht} \tag{17}$$

Equations (16) and (17) allow us to rewrite a firm's total revenue as:

$$r_{t} = q_{ht}^{\frac{\sigma-1}{\sigma}} + \sum_{j \in D} d_{jt} h(\theta_{jt}) [d_{jt} h(\theta_{jt})^{\sigma} q_{ht}]^{\frac{\sigma-1}{\sigma}} = q_{ht}^{\frac{\sigma-1}{\sigma}} + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma} q_{ht}^{\frac{\sigma-1}{\sigma}}$$
$$= \left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma}\right) q_{ht}^{\frac{\sigma-1}{\sigma}} = \left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma}\right) \left[\left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma}\right)^{-1} q_{t}\right]^{\frac{\sigma-1}{\sigma}}$$
$$= \left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma}\right)^{\frac{1}{\sigma}} q_{t}^{\frac{\sigma-1}{\sigma}}$$
(18)

Let f_j denote the fixed costs of exporting to destination j, which we assume a firm must pay every period it is in the market. Conditional on θ_t and the firm's export status d_t , firms choose their total quantity to maximize profits:

$$\max_{q_t} \left\{ \left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma} \right)^{\frac{1}{\sigma}} q_t^{\frac{\sigma-1}{\sigma}} - \left(f + \sum_{j \in D} d_{jt} f_j \right) - \left(1 + \sum_{j \in D} \tau_{jt} d_{jt} h(\theta_{jt})^{\sigma} \right) \left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma} \right)^{-1} q_t \right\}$$
(19)

where the first term in parenthesis is total revenues, the second term is the fixed costs of serving the domestic and export markets, and the third represents the firm's variable costs. The only source of heterogeneity between firms is differences in export profitability. We normalize the marginal cost of serving the domestic market to unity; thus, the marginal cost of serving export market j equals τ_{jt} .

Solving the firm's maximization problem, the optimal scale of operation for a firm is given by:

$$q_t = \left(\frac{\sigma - 1}{\sigma}\right)^{\sigma} \left(1 + \sum_{j \in D} \tau_{jt} d_{jt} h(\theta_{jt})^{\sigma}\right)^{-\sigma} \left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma}\right)^{1+\sigma}$$
(20)

From which we can obtain an expression for profits as a function of export status d_t conditional on export profitability:

$$\Pi(d_t|\theta_t) = \frac{1}{\sigma} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} \left(1 + \sum_{j \in D} \tau_j d_{jt} h(\theta_{jt})^{\sigma}\right)^{1-\sigma} \left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma}\right)^{\sigma} - \left(f + \sum_{j \in D} d_{jt} f_j\right)$$
(21)

Given that the firm has uncertainty concerning its export profitability θ_t , the firm's expected profits are given by:

$$\tilde{\Pi}(d_t|\Gamma_t) = \frac{1}{\sigma} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} \mathbb{E}_{\theta_t} \left[\left(1 + \sum_{j \in D} \tau_j d_{jt} h(\theta_{jt})^{\sigma}\right)^{1-\sigma} \left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma}\right)^{\sigma} |\Gamma_t] - \left(f + \sum_{j \in D} d_{jt} f_j\right)$$
(22)

where Γ_t represents the firm's information set at period t, a function of its export experience up until that point. Equation (22) is a crucial object as it represents a firm's expected profits as a function of its export status d_t given information set Γ_t . That is, in every period a firm is going to choose its export status $d_t = [d_{1t}, ..., d_{Dt}]$ such that the expression in Equation (22) is maximized given information set Γ_t , which is a function of its export experience. Defining:

$$A_t(d_t|\Gamma_t) \equiv \mathbb{E}_{\theta_t} \left[\left(1 + \sum_{j \in D} \tau_j d_{jt} h(\theta_{jt})^{\sigma} \right)^{1-\sigma} \left(1 + \sum_{j \in D} d_{jt} h(\theta_{jt})^{\sigma} \right)^{\sigma} |\Gamma_t]^{\frac{1}{\sigma}}$$
(23)

Results in the final expression for a firm's expected profits given d_t :

$$\tilde{\Pi}(d_t|\Gamma_t) = \frac{1}{\sigma} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} A_t(d_t)^{\sigma} - \left(f + \sum_{j \in D} d_{jt} f_j\right)$$
(24)

where $A_t(d_t)$ captures all possible uncertainty regarding a firm's export profitability in export markets. Notice that this expression represents a static optimization problem for the firm; that is, it does not consider the dynamic implications of its entry choices. Dynamics have to be taken into account because if information spillovers are present and firms are forwardlooking, then a firm might choose to enter a destination not only because of its expected profits but also because of the information content the destination has.

3.3 Learning and Information Spillovers

This section shows how firms acquire information and update their beliefs according to Bayes' Rule. Assuming that firms know the exact functional form of $h(\cdot)$, once a firm chooses to export to destination j and observes realized demand in t, it receives a noisy signal of its export profitability in destination j:

$$s_{jt} = \theta_j + \epsilon_{jt} \quad \text{where} \quad \epsilon_{jt} \stackrel{\text{i.i.d.}}{\sim} \mathbb{N}(0, \sigma_{\epsilon}^2)$$

$$(25)$$

where the vector of a firm's true export profitability $\theta \in \mathbb{R}^D$ follows by assumption a multi-

variate normal distribution $\mathbb{N}(\mu_{\theta}, \Sigma_{\theta})$. Firms knows both μ_{θ} and Σ_{θ} , as well as the distribution of ϵ_{jt} .

True export profitability is constant through time but is subject to random shocks unobservable to firms. Every period a firm exports to destination $j \in D$, it receives signal s_{jt} and uses it to update its beliefs on the entire distribution of θ . Suppose there were no information spillovers among export destinations. In that case, the only belief that would be updated is precisely that for θ_j since exporting to j would give no information on the profitability of exporting to any other destination. The way we introduce information spillovers among export destinations is by assuming that true export profitabilities $\{\theta_j\}_{j\in D}$ are correlated with each other, that is, covariance Σ_{θ} is a symmetric and non-diagonal matrix. In particular, the covariance between θ_j and θ_k is a function of the similarity between destinations j and k.

Learning works in the model as follows: At t = 0 every firm gets a random draw of their θ from distribution $\mathbb{N}(\mu_{\theta}, \Sigma_{\theta})$. Firms know this distribution, and thus, it represents firms' prior beliefs about their export profitability. At t = 1 and based on these prior beliefs, firms choose export status d_1 to maximize Equation (23). For any t > 1, firms will choose which destinations to export in that particular period according to their updated beliefs on their export profitability, which are a function of their export history up to that point. The derivation of a firm's learning process for any export history $d^t = (d_1, ..., d_t)$ is as follows.

Bayes' Rule states that the distribution of θ conditional on observing signals s_t is proportional to the likelihood of observing those signals times the prior distribution of θ :

$$\pi(\theta|z_t) \propto L(s_t|\theta)\pi(\theta) \tag{26}$$

where s_t is the vector of signals observed during period t and $\pi(\theta)$ is the distribution of θ , which is common knowledge. Define $\Phi_t = \{j | d_{jt} = 1\}$ as the set of destinations a firm exported to in period t, then:

$$s_{jt} = \theta_j + \epsilon_{jt} \ \forall j \in \Phi_t \tag{27}$$

$$\Rightarrow s_{jt} | \theta_j \sim \mathbb{N}(\theta_j, \sigma_\epsilon^2) \tag{28}$$

Conditional on θ , realizations of s_t are i.i.d. due to the distribution of error term ϵ_{jt} and therefore we can express the likelihood of s_t conditional on θ as follows:

$$L(s_t|\theta) = \prod_{j \in \Phi_t} \mathbb{N}(\theta_j, \sigma_{\epsilon}^2)$$

$$\propto \exp\left(-\frac{1}{2} \sum_{j \in \Phi_t} \left(\frac{s_{jt} - \theta_j}{\sigma_{\epsilon}}\right)^2\right)$$
(29)

Define $\Omega_t \equiv \text{diag}((1/\sigma_{\epsilon}^2)d_t)$ which is a diagonal and therefore symmetrical matrix such that $\Omega_{t_{jj}} = 0$ if $d_{jt} = 0$. We can then rewrite the likelihood above as:

$$L(s_t|\theta) \propto \exp\left(-\frac{1}{2}(\theta_t - \theta)'\Omega_t(\theta_t - \theta)\right)$$
(30)

Beliefs are updated after a firm has chosen its export status, which are the beliefs it carries into the next period. Using Equation (26), the posterior distribution of a firm's export profitability given any export history d^{t-1} can be expressed as:

$$\pi(\theta|d^{t-1}) = \pi(\theta) \prod_{i=1}^{t-1} L(s_i|\theta)$$
(31)

where $\pi(\theta)$ is common knowledge and thus acts as firms' prior beliefs at the beginning of the learning process. Conditional on θ , the s_i terms are i.i.d. which allows us to express the above as the product of likelihood functions and therefore:

$$\pi(\theta|d^{t-1}) \propto \pi(\theta) \prod_{i=1}^{t-1} \exp\left(-\frac{1}{2}(s_i - \theta)'\Omega_i(s_i - \theta)\right)$$
$$\propto \exp\left(-\frac{1}{2}(\theta - \mu_\theta)'\Sigma_\theta^{-1}(\theta - \mu_\theta)\right) \times \prod_{i=1}^{t-1} \exp\left(-\frac{1}{2}(s_i - \theta)'\Omega_i(s_i - \theta)\right)$$
$$\propto \exp\left(-\frac{1}{2}(\theta - \mu_\theta)'\Sigma_\theta^{-1}(\theta - \mu_\theta) - \frac{1}{2}\sum_{i=1}^{t-1}(s_i - \theta)'\Omega_i(s_i - \theta)\right)$$
(32)

For the sake of convenience, we take the natural logarithm of the whole expression and multiply both quadratic terms, resulting in the following:

$$\ln \pi(\theta | d^{t-1}) \propto -\frac{1}{2} (\theta - \mu_{\theta})' \Sigma_{\theta}^{-1} (\theta - \mu_{\theta}) - \frac{1}{2} \sum_{i=1}^{t-1} (s_{i} - \theta)' \Omega_{i} (s_{i} - \theta)$$

$$= -\frac{1}{2} \Big[\theta' \Sigma_{\theta}^{-1} \theta - \theta' \Sigma_{\theta}^{-1} \mu_{\theta} - \mu_{\theta}' \Sigma_{\theta}^{-1} \theta + \mu_{\theta}' \Sigma_{\theta}^{-1} \mu_{\theta}$$

$$+ \sum_{i=1}^{t-1} s_{i}' \Omega_{i} s_{i} - \sum_{i=1}^{t-1} s_{i}' \Omega_{i} \theta - \sum_{i=1}^{t-1} \theta' \Omega_{i} s_{i} + \sum_{i=1}^{t-1} \theta' \Omega_{i} \theta \Big]$$

$$= -\frac{1}{2} \theta' \Big(\Sigma_{\theta}^{-1} + \sum_{i=1}^{t-1} s_{i}' \Omega_{i} \Big) \theta + \frac{1}{2} \Big(\sum_{i=1}^{t-1} s_{i}' \Omega_{i} \theta + \sum_{i=1}^{t-1} \theta' \Omega_{i} s_{i} \Big)$$

$$+ \frac{1}{2} \Big(\theta' \Sigma_{\theta}^{-1} \mu_{\theta} + \mu_{\theta}' \Sigma_{\theta}^{-1} \theta \Big) - \frac{1}{2} \Big(\mu_{\theta}' \Sigma_{\theta}^{-1} \mu_{\theta} + \sum_{i=1}^{t-1} s_{i}' \Omega_{i} s_{i} \Big)$$
(33)

Since μ_{θ} , Σ_{θ} , Ω_i and s_i are either observed or known by the firm, we can ignore the last term in parenthesis. Moreover, because of the dimensions of these matrices, we have that $s'_i\Omega_i\theta = \theta'\Omega_i s_i$ and $\mu'_{\theta}\Sigma_{\theta}^{-1}\theta = \theta'\Sigma_{\theta}^{-1}\mu_{\theta}$ and therefore:

$$\ln \pi(\theta | d^{t-1}) \propto -\frac{1}{2} \theta' \left(\Sigma_{\theta}^{-1} + \sum_{i=1}^{t-1} \theta'_i \Omega_i \right) \theta + \sum_{i=1}^{t-1} \theta' \Omega_i s_i + \theta' \Sigma_{\theta}^{-1} \mu_{\theta}$$
$$= -\frac{1}{2} \theta' \left(\Sigma_{\theta}^{-1} + \sum_{i=1}^{t-1} s'_i \Omega_i \right) \theta + \theta' \left(\Sigma_{\theta}^{-1} \mu_{\theta} + \sum_{i=1}^{t-1} \Omega_i s_i \right)$$
(34)

which yields the following proportional expression:

$$\ln \pi(\theta | d^{t-1}) \propto -\frac{1}{2} \left(\theta - \mu_{\theta}^{p} \right)^{\prime} \left(\Sigma_{\theta}^{-1} + \sum_{i=1}^{t-1} \Omega_{i} \right) \left(\theta - \mu_{\theta}^{p} \right)$$

with $\mu_{\theta}^{p} = \left(\Sigma_{\theta}^{-1} + \sum_{i=1}^{t-1} \Omega_{i} \right)^{-1} \left(\Sigma_{\theta}^{-1} \mu_{\theta} + \sum_{i=1}^{t-1} \Omega_{i} s_{i} \right)$ (35)

All of this results in the firm's posterior beliefs for its export profitability at the beginning of period t given export history d^{t-1} being:

$$\theta | d^{t-1} \sim \mathbb{N}\left(\left(\Sigma_{\theta}^{-1} + \sum_{i=1}^{t-1} \Omega_i\right)^{-1} \left(\Sigma_{\theta}^{-1} \mu_{\theta} + \sum_{i=1}^{t-1} \Omega_i s_i\right), \left(\Sigma_{\theta}^{-1} + \sum_{i=1}^{t-1} \Omega_i\right)^{-1}\right)$$
(36)

The posterior distribution in Equation (36) holds for any t > 0. In particular, note from the mean and covariance matrix that in period t = 1, when the firm has not had any export experience before, the beliefs a firm has on its export profitability collapse to:

$$\theta | d^{0} \sim \mathbb{N}\left(\left(\Sigma_{\theta}^{-1}\right)^{-1} \left(\Sigma_{\theta}^{-1} \mu_{\theta}\right), \left(\Sigma_{\theta}^{-1}\right)^{-1}\right)$$
$$= \mathbb{N}\left(\mu_{\theta}, \Sigma_{\theta}\right)$$
(37)

That is, as discussed earlier, a firm's beliefs when it has not had any export experience are precisely the distribution of θ , which by assumption is common knowledge to all firms. As a summary, a firm's beliefs at period t on its export profitability as a function of its export history d^{t-1} are as follows:

$$\Gamma_t(d^{t-1}) = \begin{cases} (\mu_\theta, \Sigma_\theta) & \text{if } t = 1\\ (\mu_\theta^p, \Sigma_\theta^p) & \text{if } t > 1 \end{cases}$$
(38)

where:

$$\Omega_{i} = \operatorname{diag}((1/\sigma_{\epsilon}^{2})d_{i})$$

$$\mu_{\theta}^{p} = \left(\Sigma_{\theta}^{-1} + \sum_{i=1}^{t-1}\Omega_{i}\right)^{-1} \left(\Sigma_{\theta}^{-1}\mu_{\theta} + \sum_{i=1}^{t-1}\Omega_{i}s_{i}\right)$$

$$\Sigma_{\theta}^{p} = \left(\Sigma_{\theta}^{-1} + \sum_{i=1}^{t-1}\Omega_{i}\right)^{-1}$$
(39)

Note that we use Γ_t to refer to the firm's learning process as in Equation (23) because we assume that the information set that a firm has in period t is precisely its updated beliefs on the distribution of its true export profitability given its export history up until that period. This is where the learning process ties to the firm's discrete choice problem. At period t, a firm will choose export status d_t such that the expression in Equation (24) is maximized. To compute the expected value in Equation (23), the firm is simply going to use its posterior beliefs which evolve according to Equation 39 as a function of its export history d^{t-1} .

3.4 Dynamic Exporter Behavior

We have discussed the firm's problem as static, but this is not the case. As the learning process shows, export decisions have dynamic implications. Once a firm decides to enter an export market, it will affect its beliefs about its profitability in every export market and, thus, affect future entry and exit decisions. Data shows that some firms reenter an export market after exiting from it. Since a firm's precision concerning its true export profitability θ is non-decreasing in tenure, one way to rationalize this behavior is to assume the fixed costs a firm has to pay when exporting to a destination are subject to random shocks. As in Cebreros (2016), we assume that the fixed costs of exporting to market j at time t are constant but subject to some random shock:

$$f_{jt} = f_j + \eta_{jt} \quad \text{where } \eta_{jt} \stackrel{\text{i.i.d.}}{\sim} \mathbb{N}(0, \sigma_\eta^2)$$

$$\tag{40}$$

Using Equation (24), expected profits in t given export status d_t will now be given by:

$$\tilde{\Pi}(d_t|\Gamma_t) - \sum_{j \in D} d_{jt} \eta_{jt} \tag{41}$$

where η_{jt} is observed $\forall j \in D$ by a firm before choosing export status d_t . Importantly, a firm's recursive problem regarding its entry and exit choices from export markets is characterized by the following Bellman equation:

$$\mathbb{V}_{\Psi}(\mu^{p}_{\theta}, \Sigma^{p}_{\theta}, \eta) = \max_{d \in \Xi} \{ \tilde{\Pi}(d | \mu^{p}_{\theta}, \Sigma^{p}_{\theta}) - \sum_{j \in D} d_{j}\eta_{j} + \beta \mathbb{E}_{\mu^{p'}_{\theta}, \Sigma^{p'}_{\theta}, \eta'} [\mathbb{V}_{\Psi}(\mu^{p'}_{\theta}, \Sigma^{p'}_{\theta}, \eta')] \}$$
(42)

subject to the evolution of a firm's beliefs about its profitability in export markets according to Equation (39). In this recursive formulation, Ξ is the set of all possible combinations of export status d, β represents a discount factor, and Ψ represents the vector of parameters of the model.

As discussed in Section 2.3.2, firms are forward-looking and thus exporting to a particular destination is not only valuable because of the effect it has on expected profits $\tilde{\Pi}(d|\mu_{\theta}^{p}, \Sigma_{\theta}^{p})$ but also because of the information it provides about other potential destinations; this is contained in the continuation value of the Bellman equation. Since entry into j will update a firm's beliefs on its export profitability in every potential destination, it affects its choice to enter the export market j.

4 Quantification of the Model

Estimation of the model presented in Section 3 proves to be computationally challenging as the state variables a firm has when choosing to which countries to export in a given period are its beliefs for its profitability for all export markets, i.e. a vector of means and a covariance matrix, and a vector of shocks to fixed costs of exporting. Suppose a Mexican firm can export to D different countries, then the number of state variables a firm has equals 2D + D * (D + 1)/2.

This is challenging for two reasons. First, our dynamic model implies that we must perform value function iteration when estimating it. Even for a relatively small number of export destinations, e.g., ten countries, we would have to implement a value function iteration algorithm including 75 state variables, which, as of today, is unfeasible from a computational perspective. Second, our model is one of combinatorial discrete choice, which implies firms have to choose the best combination of export countries out of the set of all possible combinations, and this set increases exponentially with the number of possible export destinations.

We address these challenges in the following way. First, we assume that Mexican firms can only export to 5 countries, that is, D = 5. These five destinations will be the top five export destinations from the Mexican customs data: the United States, Canada, Spain, Germany, and China. Second, we assume there are no iceberg-type trade costs, resulting in the choice of entering export markets being independent across them. Under this assumption, the expression for expected total profits in Equation (22) becomes:

$$\tilde{\Pi}(d_t|\Gamma_t) = \left\{\frac{1}{\sigma} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} - f\right\} + \sum_{j \in D} d_{jt} \left\{\frac{1}{\sigma} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} \mathbb{E}_{st} \left(h(s_{jt})^{\sigma}|\Gamma_t\right) - f_j\right\}$$
(43)

which shows that firms' entry problem is separable across export destinations. Lastly, we assume firms are myopic in the sense that they are not aware of these information spillovers, i.e., when choosing to enter a particular export destination, they are not aware of how this decision will affect their beliefs regarding other export destinations, nor how their experience exporting to similar destinations is informative on their profitability in the export market in consideration. This assumption results in firms only having three state variables when deciding to enter a particular export market: their beliefs on the mean and variance of export profitability and the current shock to fixed costs of exporting, which is observable to the firm. The downside of this assumption is that the quantification of our model will not capture firm behavior as described in Section 2.3.2 where firms are forward-looking and might choose to enter a particular destination because of the information it provides about other export markets.

4.1 Independent Export Destinations and Myopic Firms

We characterize firms' optimization problem and derive expressions for their beliefs when the choice of entry is independent for each export market and firms are myopic regarding information spillovers. For this section, we drop the subindex notation in favor of a recursive one to distinguish between variables' current and future values.

Following Equation (42), a firm's Bellman equation in a particular export market is:

$$\mathbb{V}_{\Psi}(\mu, \Sigma, \eta) = \max_{d \in \{0,1\}} \{ \tilde{\Pi}(d|\mu, \Sigma) - d\eta + \beta \mathbb{E}_{\mu', \Sigma', \eta'} [\mathbb{V}_{\Psi}(\mu', \Sigma', \eta')] \}$$
(44)

where μ and μ' stand for current and future beliefs for the expected value of a firm's export profitability, Σ and Σ' represent current and future beliefs for the variance of export profitability, and η and η' are the current and future value of the shock to fixed costs of exporting.

Expected profits of exporting to a given destination are given by:

$$\tilde{\Pi}(d|\mu,\Sigma) = d\left\{\frac{1}{\sigma} \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} \mathbb{E}_s\left(h(s)^{\sigma}|\mu,\Sigma\right) - f\right\}$$
(45)

As detailed in Equation (25), a firm's profits in a given export destination depend on signal s, which is comprised of a firm's export profitability and some noise. Firms observe this signal by observing realized export profits if they choose to export in a given period.

In terms of how firms form their expectations for signal s, and thus on how profitable they expect to be when choosing to export to a particular destination, recall that the signal each firm receives is given by:

$$s = \theta + \epsilon \tag{46}$$

where we are assuming that $\theta \sim \mathbb{N}(\mu_{\theta}, \sigma_{\theta}^2)$ and $\epsilon_{jt} \sim \mathbb{N}(0, \sigma_{\epsilon}^2)$, and both these distributions are known to the firm. The expected value of signal *s* conditional on a firm's current beliefs for the mean μ and variance Σ of export profitability θ is:

$$\Rightarrow \mathbb{E}(s|\mu, \Sigma) = \mathbb{E}(\theta + \epsilon|\mu, \Sigma)$$
$$= \mathbb{E}(\theta|\mu, \Sigma) + \mathbb{E}(\epsilon|\mu, \Sigma) = \mu + 0$$
(47)

while the variance of the signal, again conditional on a firm's current beliefs, is given by:

$$\Rightarrow \mathbb{V}(s|\mu, \Sigma) = \mathbb{V}(\theta + \epsilon|\mu, \Sigma)$$
$$= \mathbb{V}(\theta|\mu, \Sigma) + \mathbb{V}(\epsilon|\mu, \Sigma)$$
$$= \Sigma + \sigma_{\epsilon}^{2}$$
(48)

Using the assumption that θ and ϵ are independent. The observed signal is believed by firms to be distributed according to:

$$s|\mu, \Sigma \sim \mathbb{N}(\mu, \Sigma + \sigma_{\epsilon}^2)$$
 (49)

For computing the expectation of the continuation value in Equation (44), it is useful to characterize the distribution of the next period's beliefs μ' and Σ' given a firm's current beliefs. When export destinations are independent, Equation (39) for current beliefs implies that:

$$\mu = \left(\frac{1}{\sigma_{\theta}^2} + \frac{n}{\sigma_{\epsilon}^2}\right)^{-1} \left(\frac{\mu_{\theta}}{\sigma_{\theta}^2} + \frac{1}{\sigma_{\epsilon}^2} \sum_{i=1}^{t-1} d_i s_i\right)$$
(50)

$$\Sigma = \left(\frac{1}{\sigma_{\theta}^2} + \frac{n}{\sigma_{\epsilon}^2}\right)^{-1} \tag{51}$$

We can see that the updated beliefs for the covariance matrix Σ are deterministic in the sense that it only depends on known parameter Σ_{θ} and the number of periods a firm has exported to a destination in the past n. For a given realization of s' in the next period, the updated mean will then be given by:

$$\mu' = \left(\frac{1}{\sigma_{\theta}^2} + \frac{n+d}{\sigma_{\epsilon}^2}\right)^{-1} \left(\frac{\mu_{\theta}}{\sigma_{\theta}^2} + \frac{1}{\sigma_{\epsilon}^2} \sum_{i=1}^{t-1} d_i s_i + \frac{d}{\sigma_{\epsilon}^2} s'\right)$$
(52)

Note that if a firm decides not to export today, d = 0, then beliefs are not updated, i.e., $\mu' = \mu$. Since s' is not observed until the next period, the expected value of tomorrow's beliefs for the mean, conditional on today's beliefs and today's export choice, is given by

$$\mathbb{E}(\mu'|\mu, n, d) = \left(\frac{1}{\sigma_{\theta}^2} + \frac{n+d}{\sigma_{\epsilon}^2}\right)^{-1} \left(\frac{\mu_{\theta}}{\sigma_{\theta}^2} + \frac{1}{\sigma_{\epsilon}^2}\sum_{i=1}^{t-1} d_i s_i + \frac{d}{\sigma_{\epsilon}^2}\mathbb{E}(s'|\mu, n)\right)$$
(53)

which using Equation (49) gives us:

$$\mathbb{E}(\mu'|\mu, n, d) = \left(\frac{1}{\sigma_{\theta}^2} + \frac{n+d}{\sigma_{\epsilon}^2}\right)^{-1} \left(\frac{\mu_{\theta}}{\sigma_{\theta}^2} + \frac{1}{\sigma_{\epsilon}^2}\sum_{i=1}^{t-1} d_i s_i + \frac{d}{\sigma_{\epsilon}^2}\mu\right)$$
(54)

The variance of the updated beliefs for the mean μ' is given by:

$$\mathbb{V}(\mu'|\mu, n, d) = \left(\frac{d}{\sigma_{\epsilon}^{2}}\right)^{2} \left(\frac{1}{\sigma_{\theta}^{2}} + \frac{n+d}{\sigma_{\epsilon}^{2}}\right)^{-2} \mathbb{V}(s'|\mu, n)$$
$$= \left(\frac{d}{\sigma_{\epsilon}^{2}}\right)^{2} \left(\frac{1}{\sigma_{\theta}^{2}} + \frac{n+d}{\sigma_{\epsilon}^{2}}\right)^{-2} \left(\left(\frac{1}{\sigma_{\theta}^{2}} + \frac{n}{\sigma_{\epsilon}^{2}}\right)^{-1} + \sigma_{\epsilon}^{2}\right)$$
(55)

Note that if a firm chooses not to export today, e.g. d = 0 then $\mathbb{V}(\mu'|\mu, n) = 0$ which is intuitive as there is no uncertainty regarding the future value of μ' , as beliefs will not be updated and will stay at μ .

4.2 Parametrization of the Model

We use the following functional form for demand shifter $h(\cdot)$ in Equation (23):

$$h(s) = \kappa \exp(-\lambda \exp(-gs)) \quad \text{where} \ \kappa, \lambda, g > 0 \tag{56}$$

in which κ controls the upper-bound of the $h(\cdot)$ function and λ and g control its growth rate. This parametrization has the advantage of being a continuous, differentiable, bounded, positive, and monotone function.

Table 5 details the value of specific parameters of our model. We take from the literature the elasticity of substitution σ and parameters of the $h(\cdot)$ function λ and g. We use the estimates in Cebreros (2016) for the parameters of this function as their paper also uses Mexican data for their estimation. We set discount factor β to be equal to 0.95 and assume a value of 2.5 for κ such that the model can replicate observed firm-level exports while still having exports being bounded from above. Lastly, we set the variance of the shocks to export profitability σ_{ϵ}^2 to 0.23 as this value helps us match the observed variance of export revenue.

We assume that the correlation coefficient between the export profitability of two countries is captured by our import-based similarity index $S(i, j) \in [0, 1]$ described in Section 3.3, thus reflecting that the more similar two export destinations are, the higher the correlation coefficient between firms' export profitability in these countries. Given these correlation coefficients, and our estimates for the variances of export profitability, we can later recover the covariance of export profitability between a pair of countries and construct the entire

Parameter	Value	Source
β	0.95	-
σ	3.85	Antras et al. (2017)
λ	2.64	Cebreros (2016)
g	2.69	Cebreros (2016)
κ	2.50	Calibrated
σ_{ϵ}^2	0.23	Calibrated

Table 5: Parameters from the literature.

covariance matrix Σ_{θ} for a firm's export profitability, which we will then use once we simulate our model and perform counterfactual scenarios.

Finally, to lower the computational burden of our estimation, we assume that the shock to fixed costs of exporting η as shown in Equation (44) can only take two different values, either $-\bar{\eta}$ or $\bar{\eta}$; these values having equal probabilities. As argued before, this shock to fixed costs of exporting is needed to rationalize why some firms might re-enter an export market after exiting from it.

4.3 Estimation of Export Profitability and Fixed Costs

This section describes how we structurally estimate firms' export profitability and fixed costs of exporting independently for each export destination, as discussed in Section 4.1. We use the Nested Fixed-Point algorithm, first introduced by Rust (1987). The algorithm consists of two distinct loops: an outer loop that implements the estimation routine and an inner loop that solves the firms' problem for each particular guess for our estimates.

First, for the outer loop, we use the Simulated Method of Moments (SMM) to find the element of the parameter space that best matches a simulation of the model with a set of moments observed in our Mexican customs data. We choose to use SMM as is in our model we do not have closed-form solutions to firm behavior and thus need to resort to simulation. Let x represent data and ξ a point in the parameter space. Our implementation of SMM consists in finding the ξ that minimizes the following objective function:

$$\min_{\Psi} ||e(\tilde{x}, x|\Psi)||$$

The moment error function $e(\tilde{x}, x | \Psi)$ is expressed as the percent difference between the

vectors of simulated and data moments:

$$e(\tilde{x}, x|\Psi) = \frac{\hat{m}(\tilde{x}|\Psi) - m(x)}{m(x)}$$

where $m(\cdot)$ represents a set of R distinct moments, and \tilde{x} is simulated data from our model under parametrization Ψ . We use the L^2 distance norm, and therefore, our implementation of SMM consists in finding the point in the parameter space that minimizes the sum of squared errors:

$$\hat{\Psi} = \operatorname*{arg\,max}_{\Psi} e(\tilde{x}, x | \Psi)^T I_R e(\tilde{x}, x | \Psi)$$

with I_R being an $R \times R$ identity matrix. We define our objective function in percentage deviations so that all moments in $m(\cdot)$ are expressed in the same units, and no moment receives an unintended larger weight.

The vector of parameters we estimate using SMM for each of the export destinations included in our quantification is the following:

$$\Psi = [\mu_{\theta}, \sigma_{\theta}^2, f, \bar{\eta}]$$

that is, the mean and variance of export profitability, the fixed cost of exporting, and the size of the shock to fixed costs of exporting. The set of moments we include to identify parameter vector $\hat{\Psi}$ are:

- 1. Average log exports at the firm level: We use this moment to identify mean of export profitability μ_{θ} as larger values of this parameter will result in larger draws for signals s and thus, larger export revenue.
- 2. Standard deviation of log exports at the firm level: This moment helps us identify the variance of export profitability σ_{θ}^2 since the higher this variance is, the greater the variability in signals s and thus, the larger the variance of export revenue becomes.
- 3. Share of firms exporting: We use this moment to identify the fixed cost of exporting f, as larger values will result in a larger share of firms being unable to cover it with their operating profits.
- 4. Average length of export spells: The moment helps identify the shock to fixed costs of exporting $\bar{\eta}$ as the larger it is, the more it can compensate adverse shocks to signal s.

Second, for the inner loop of the estimation algorithm, we use Value Function Iteration. For a particular point Ψ in the parameter space and starting from an arbitrary initial guess $\mathbb{V}_{\Psi}^{0}(\cdot)$, according to Equation (44) we can recursively iterate as follows:

$$\mathbb{V}_{\Psi}^{t+1} = \max_{d \in \{0,1\}} \{ \tilde{\Pi}(d) - d\eta + \beta \mathbb{E}[\mathbb{V}_{\Psi_j}^t] \}$$
(57)

where superscript t represents a particular iteration. Because of our choice of $h(\cdot)$ being a continuous and bounded function, expected profits $\tilde{\Pi}(d)$ also inherit these properties and thus, for a sufficiently large number of iterations, a fixed-point is found in which $\mathbb{V}_{\Psi}^{t+1} = \mathbb{V}_{\Psi}^{t}$.

At every iteration, we compute \mathbb{V}_{Ψ}^{t} for every point of the state space, with a firm's state variables being its current beliefs for mean profitability μ , the number of periods it has exported in the past n, and the current shock to fixed costs of exporting $\bar{\eta}$. As Equations (49), (51), and (52) show, these variables are sufficient for computing $\tilde{\Pi}(d)$ and the expectation of the continuation value in Equation (57). The only control variable firms have is their choice of entry d into an export market.

We discretize the state space using grids with 50 different values for μ , 20 different values for n -which implicitly assumes firms can export up to twenty different time periods-, and two different values for the shock to fixed costs of exporting, $-\bar{\eta}$ and $\bar{\eta}$. Note that these grids are different for every point Ψ of the parameter space, i.e., for every guess of the outer loop. We compute $\tilde{\Pi}(d)$ using Monte-Carlo integration, and construct transition probability matrices using Equations (54) and (55) to compute the expectation of the continuation value in Equation (57).

Once the algorithm has converged to a fixed point of the value function, we proceed to simulate firm behavior. For a particular guess of Ψ , we take 10,000 random draws from $\mathbb{N}(\mu_{\theta}, \sigma_{\theta}^2)$, which are firms' profitabilities in the export market, and simulate for 20 periods how firms choose to enter or exit from it. In each period, firms choose whether to export, and if they do so, they observe signal *s*, which is again a random draw, and use it to update their beliefs as described in Section 4.1. We use the results of this simulation to compute moments $\hat{m}(\tilde{x}|\Psi)$, which we then compare to data moments m(x). If these two sets of moments are sufficiently close, given some tolerance level, we have found $\hat{\Psi}$.

Our estimation results are shown in Table 6. According to the model, Canada, China, and Spain have the same export profitability for a Mexican exporter on average. It is not striking that the USA is estimated to be significantly more profitable for Mexican firms, reflecting that it is a huge export market and its consumers are likely to have a stronger preference for Mexican varieties than the rest of the countries. Estimates for the variance of export profitability are larger for Canada and the USA. Since these destinations have the largest share of firms exporting to them, the sets of exporters to these countries feature the largest heterogeneity, which results in higher estimates for the variance of export profitability for these destinations.

Parameter	Canada	China	Germany	Spain	USA
$\mu_{ heta}$	0.96	0.99	0.85	0.96	1.25
$\sigma_{ heta}^2$	0.33	0.29	0.27	0.21	0.35
f	3.34	3.04	2.61	2.95	0.39
$_{}\bar{\eta}$	0.95	0.42	0.61	0.72	0.90

Table 6: SMM Estimated Parameters.

For both the fixed cost of exporting and its shock, units are log USD. These estimates show that Mexican firms find exporting to the USA much cheaper than the rest of the destinations. This, together with the higher mean of export profitability, is reflected in most Mexican firms exporting to the USA at some point. In contrast, these firms have much lower entry rates to other destinations. Lastly, regarding the shock to the fixed cost of exporting, we estimate lower values for China and Germany, consistent with these countries having export spells last the least on average.

	Canada	China	Germany	Spain	USA
Canada	0.33	0.16	0.18	0.06	0.27
China	0.16	0.29	0.11	0.08	0.20
Germany	0.18	0.11	0.27	0.04	0.15
Spain	0.06	0.08	0.04	0.21	0.07
\mathbf{USA}	0.27	0.20	0.15	0.07	0.35

Table 7: Estimated Covariance Matrix of Export Profitability.

As detailed in Section 4.2, we proxy correlation coefficients in export profitability using our similarity index across export destinations, which, together with our estimates for the variances, allows us to construct covariance matrix of export profitability $\hat{\Sigma}_{\theta}$, shown in Table 7. Results show that the largest covariances, and thus the largest information spillovers, are between the USA and Canada, Canada and Germany, and the USA and China. Surprisingly, the covariance between Germany and Spain is very low, as both European countries are geographically close, although they possibly have very different preferences for Mexican varieties.



Figure 2: Fit of the model regarding the mean and variance of log exports.

Figures ?? and 3 compare several moments between the data and our simulation to evaluate the model's performance. Overall, the model does a satisfactory job of matching these moments, except for China's standard deviation of log exports and the average length of export spells in the USA. The former could be the result of overestimating China's variance in export profitability. In contrast, the former indicates we could be overestimating the size of the shock to fixed costs of exporting to the USA.

4.4 Evolution of Entry Shares and Beliefs

To show how our model's simulation works, we present its results in Figures 4 and 5. Regarding the former, Panel 4a shows the share of firms exporting to each destination against tenure in that same market. This figure shows that from the moment a firm first exports in our data sample, it is unlikely to last several periods exporting to a particular destination. Panel 4b shows the simulation of our model, in which we can replicate the decreasing relationship between entry shares and tenure. In our model, initial entry into the export market is partly driven by a positive shock to the fixed costs of exporting. However, once firms learn about their export profitability, a large share of them choose to export no longer. For the case of the USA, the model cannot replicate this decreasing relationship, as it predicts that only a few firms will stop exporting to the USA over time.

Figure 5 shows how average export profitability and beliefs for it change over time. Panel



Figure 3: Fit of the model regarding entry shares and export spells.

5a shows Canada, China, and Germany, and Panel 5b shows Spain and the USA. Solid lines represent firms' beliefs about the expected value of their export profitability, and dashed lines represent their actual export profitability. While export profitability is constant across time, the composition of the firms that export does change. This explains why export profitability changes across time: when a larger share of firms chooses not to export, Panel 4b suggests that the firms that remain in the export market are the more profitable ones and thus, average export profitability increases with tenure in the export market.

Dashed lines are not necessarily consistent with the estimated means shown in Table 6 as the former represent mean export profitability conditional on exporting, while the latter correspond to unconditional means. Figure 5 shows us the relationship between export spells and the precision of the signals. As firms accumulate experience, their uncertainty regarding their profitability decreases, leading their beliefs to converge towards firms' true export profitability, i.e., the solid and dashed lines get closer as the number of time periods increases. While variation in the set of firms that export to a particular destination affects average export profitability. For example, even if a firm is profitable in a particular destination, it could receive a negative demand shock that results in the firm believing it is not profitable to export and exit the market. This firm would only re-enter the export destination if it experiences a positive shock to fixed costs of exporting, which would result in the firm acquiring more information and perhaps discovering it is profitable to export. (a) Data for the share of firms exporting

(b) Simulation for the share of firms exporting



Figure 4: Data and simulation of the model for the share of firms exporting.

5 Counterfactual Scenarios

In this section, we conduct two distinct sets of counterfactual simulations. First, we explore the role of information spillovers on export diversification. In our first counterfactual, we remove information spillovers, and using our estimates found in Section 4, we evaluate how key moments of our model change relative to the baseline simulation with information spillovers. The second set of counterfactuals uncovers the effects of reductions in fixed costs of exporting on the same key moments of the model, particularly on the average number of destinations a firm exports to. Reductions to fixed costs of exporting can result from policies such as governments facilitating domestic firms to engage in international trade or countries enacting free trade agreements which reduce the costs firms face of entering export markets.

The results of the second set of counterfactual scenarios provide evidence for a potential second-order effect of free trade agreements: the diversification of a country's exported destinations. We stress the word potential as information spillovers do not necessarily result in a larger share of firms exporting to a particular destination. As argued in Section 2, all that learning should do is provide firms with better information on demand conditions in foreign markets, leading them to make better decisions regarding entry and exit from export markets.

5.1 Removing Information Spillovers

We remove information spillovers by assuming that even if firms' export profitability is correlated across destinations, they are unaware of this. To do so, we assume the covariance (a) Simulation for export profitability and beliefs (b) Simulation for export profitability and beliefs



Figure 5: Simulation of the model for export profitability and firms' beliefs.

matrix shown in Table 7 holds, but it is no longer common knowledge for firms when forming beliefs on their export profitability. This implies that a firm's prior beliefs on its export profitability, when the firm has not had any export experience, are distributed according to:

$$\theta | d^0 \sim \mathbb{N}(\hat{\mu}_{\theta}, \tilde{\Sigma}_{\theta}) \text{ where } \tilde{\Sigma}_{\theta} \equiv I_D \odot \hat{\Sigma}_{\theta}$$

$$\tag{58}$$

Effectively, even if export profitability is still correlated across export destinations according to $\hat{\Sigma}_{\theta}$, the fact that firms believe profitability is distributed according to the diagonal covariance matrix $\tilde{\Sigma}_{\theta}$ results in them not learning about other markets when exporting to a particular one. For performing this counterfactual, we simulate a large number of firms as described in Section 4.3 but assuming all firms have prior beliefs as in Equation (58). Results for this counterfactual exercise are shown in Figure 6, which compares the key moments of the model between our baseline simulation against those for this alternative specification for the covariance matrix of prior beliefs.

First, without information spillovers, the share of firms exporting to Canada, China, and Germany, would decrease by 26.6%, 45.42%, and 22.3%, respectively. For Spain and the US, the share of firms exporting to these destinations would increase by 8.1% and 25.2%, respectively. These results suggest the significant role that exporting to the US and information spillovers have on the diversification of Mexican exports. It is in the US where Mexican exporters learn about their profitability in other foreign markets, leading some of them to export to these destinations.

The intuition behind these results is as follows. Recall that our estimates for the fun-



Figure 6: Effects of removing information spillovers.

damentals of export profitability, as shown in Table 6, constitute firms' prior beliefs when they have no export experience. Under these common prior beliefs, exporting to destinations such as Canada, China, and Germany, is not profitable, i.e., the average firm would not be profitable in these countries. Since removing information spillovers implies firms only learn about their profitability in a particular market when exporting to it, sustained exporting to a destination only happens when a profitable firm, one with a large enough random draw for its export profitability, experiences a positive shock to fixed costs of exporting. This results in a much slower learning process compared to the case with information spillovers when firms can learn in the US, a profitable destination for the average firm, about their profitability in non-US destinations.

Average firm-level export revenue, conditional on exporting, would decrease in all destinations except for Spain, resulting from the change in the composition of firms that keep exporting to these destinations. When there are no information spillovers and therefore, firms do not learn about their profitability while exporting to other markets, entry into destinations such as China or Germany is mainly driven by positive shocks to fixed costs of exporting, and these shocks are independent from firms' export profitability in a particular market.

Lastly, the average length of export spells would decrease for Canada and Germany. This is consistent with entry into these destinations now being mainly driven by shocks to fixed costs of exporting, which results in firms exporting for a shorter amount of time. In particular, the length of export spells in Canada and Germany would decrease by 5.3% and 10.8%, respectively. However, the length of export spells would increase for China, Spain, and the US by 1.4%, 9.9%, and 93.2%, respectively. The considerable increase in the length of average export spells in the US is explained by the decrease in the share of firms exporting to other destinations. When firms export to fewer foreign markets, learning about their profitability becomes slower regarding the time periods it takes for firms' beliefs to be sufficiently precise. In the case of the US, a large share of firms would enter the export market incentivized by the large mean export profitability and the low fixed costs of exporting, only to take some firms longer to realize they are not profitable in the US.

Overall, this counterfactual shows information spillovers' critical role in export markets, particularly in export diversification. Our results suggest entry into smaller, less profitable markets is mainly driven by the experience Mexican firms have while exporting to the US. On average, without information spillovers, the number of non-US destinations Mexican firms export would be 21.6% lower, corresponding to a decrease of 1.08 in the number of export destinations.

5.2 Reductions in the Fixed Costs of Exporting

This counterfactual quantifies the effects of decreased fixed costs of exporting (FCE) to a particular country. To do so, we set f = 0 for one destination at a time and then simulate how firms would make their entry and exit choices from our chosen export destinations. Intuitively, these results depend on which destination experienced the decrease in FCE and its similarity with the rest of the destinations. Entry into destinations is still partially driven by shocks to FCE $\bar{\eta}$ and we assume that the covariance matrix of export profitability is again the one shown in Table 7.

Figure 7 shows the results of these counterfactual simulations for average firm-level exports and the share of firms exporting. Each group of bars in these panels shows the effects over all export destinations resulting from lowering FCE to a particular foreign market, as indicated in the y-axis. Panel 7a shows how the share of firms exporting to each destination would change when lowering a particular FCE. Unsurprisingly, this share dramatically increases for the destination that experienced the decrease in FCE.

For the case of the decrease in FCE to Canada, the share of firms exporting to China, Germany, and Spain would increase by 12.7%, 8.7%, and 2.9%, respectively. Higher entry into a destination would not necessarily result in higher entry into other ones; it might even decrease entry, such as in the case of the decrease in China's FCE. These decreases in entry could be driven by firms discovering they are not profitable in China and assuming that, therefore, they would not be profitable in other export markets as well. The reduction in



Figure 7: Effects of a reduction in fixed costs of exporting.

FCE to Germany would result in 43.6% higher entry into Spain, and the decrease for the case of Spain would result in 62.9% higher entry into Germany. Even if, according to our results, Germany and Spain are not very similar in terms of export profitability, the correlation among these European countries is sufficient for generating higher entry. Results also show that the reduction in FCE to the US would not yield higher entry into this destination since many Mexican exporters have already exported to the country. Intuitively, the share of firms exporting to other destinations remains the same since entry into the US is not affected, and thus, firms do not acquire additional information on their profitability in other export destinations.

Panel 7b shows the effects on firm-level exports. Overall, average exports decrease due to the larger shares of firms exporting when FCE decrease. This is again a composition effect. When the less profitable firms face lower fixed FCE, they enter the foreign market and lower the firm-level average. This effect is the strongest for the destination that experienced the decrease in FCE since this is the destination that experiences the largest increase in entry shares. Panel 8a shows the effects on the average length of export spells. Overall, the length of export spells increases in line with the increases in the share of firms exporting. This effect is present in the country experiencing the decrease in FCE and other destinations. Higher entry results in more precise beliefs about profitability because of information spillovers, leading firms to make better choices regarding entry and, thus, longer export spells.

Lastly, Panel 8b shows the effects on export diversification. For this figure, we compute the firm-level average number of exported destinations excluding the destination for which FCE decreased. The reason for this is that we want to quantify the effects on diversification

(a) Average length of export spells

(b) Number of exported destinations



Figure 8: Effects of a reduction in fixed costs of exporting.

coming exclusively from information spillovers, and if we do not exclude the country that experienced the decrease in FCE, the results will be driven mainly because of it. Results show that decreases in FCE to Canada and Spain lead to higher export diversification. In particular, lowering FCE to Canada would increase the number of destinations Mexican firms export on average by 0.14 countries, while decreasing FCE to Spain would increase the number of destinations on average by 0.61 countries.

In the case of lower FCE to China, diversification would decrease following the decrease in the share of firms exporting to destinations other than China, while in the case of lower FCE to Germany, diversification would also slightly decrease since the effect of lower entry into Canada and China dominates the increased entry into Spain. Again, lowering FCE to the US does not significantly affect diversification since the decrease does not generate changes in entry shares.

This counterfactual shows that lowering FCE to foreign markets can result in higher shares of exporting firms and greater diversification in destinations. The magnitude of these changes depends on how similar countries are to the one experiencing the lower FCE and the experience firms receive while exporting, e.g., a firm experiencing adverse demand shocks in a destination will result in lower entry shares into similar destinations. These results suggest that policies that facilitate domestic firms engaging in international trade or multilateral free trade agreements that lower the cost of exporting could indeed result in greater export diversification or, at the very least, lead domestic firms to make better choices regarding the destination of their exports.

6 Conclusions

This paper explores how information spillovers across foreign markets affect firms' entry and exit decisions. When demand conditions are correlated across destinations, firms learn about how profitable they are when exporting and form their beliefs based on these experiences. Using data on the universe of Mexican exporters, we provide empirical evidence on how the probability that a firm makes a wrong decision concerning entry into an unprofitable export market is lower the higher the amount of relevant export experience a firm has. Conversely, since export destinations allow firms to learn about other markets, the higher the informativeness of a destination, the more likely a firm will start exporting to it.

We build and quantify a dynamic model of export supply and information spillovers. In our model, Mexican firms choose in each period to which countries to export, and accumulate experience which affects their beliefs on their profitability in other markets, therefore affecting future entry decisions. We quantify firm-level export profitability in five export markets and the fixed costs Mexican firms face when exporting to them. Having estimated our model, we conduct counterfactual simulations to quantify the effects of information spillovers across export destinations. Without information spillovers, the share of firms exporting to destinations other than the US would decrease by 21.6%. This suggests that exporting to the US is critical for Mexican firms because it allows them to learn about their profitability in export markets. In a different set of counterfactuals, we show how decreased fixed costs of exporting to a particular destination can result in increased export diversification and increased exports and longer export spells in destinations other than the one experiencing the shock.

The results of this paper highlight the importance of learning in foreign markets on firm behavior and export diversification, and how trade policies aimed at increasing firms' participation in international trade can improve outcomes such as their exports or how long they sell to foreign markets. Policies such as free trade agreements that decrease barriers to entry or governments incentivizing firms to export to foreign markets should give firms better information on their profitability, ultimately leading them to make better decisions regarding entry into export markets.

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