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Exporting Through Intermediaries: Impact on Export Dynamics and Welfare

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Abstract

In many countries, a sizable share of international trade is carried out by intermediaries. While large firms tend to export to foreign markets directly, smaller firms typically export via intermediaries (indirect exporting). I document a set of facts that characterize the dynamic nature of indirect exporting using firm-level data from Vietnam and develop a dynamic trade model with both direct and indirect exporting modes and customer accumulation. The model is calibrated to match the dynamic moments of the data. The calibration yields fixed costs of indirect exporting that are less than a third of those of direct exporting, the variable costs of indirect exporting are twice higher, and demand for the indirectly exported products grows more slowly. Decomposing the gains from indirect and direct exporting, I find that 18 percent of the gains from trade in Vietnam are generated by indirect exporters. Finally, I demonstrate that a dynamic model that excludes the indirect exporting channel will overstate the welfare gains associated with trade liberalization by a factor of two.

JEL classifications: F12, F14.

Keywords: indirect exporting, direct exporting, customer accumulation, variable costs, bilateral trade liberalization, welfare gains, tariff revenues, Vietnam.

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Contents

1 Introduction

Trade intermediaries account for a non-trivial share of total exports. For example, nearly 20 percent of Chinese and French exports (Ahn, Khandelwal, and Wei (2011) and Crozet, Lalanne, and Poncet (2013)), and around 10 percent of U.S. and Italian exports (Bernard, Jensen, Redding, and Schott (2012b) and Bernard, Grazzi, and Tomasi (2011)) are carried by intermediaries. Firms that export via intermediaries are known as indirect exporters. Previous empirical research has shown that these exporters tend to be smaller and less productive than direct exporters (Krüger (2009), Abel-Koch (2013), and Grazzi and Tomasi (2016)). While much has been documented about these firms, little is known about their dynamic behavior. Once firms start exporting indirectly, do they grow over time? Do they eventually become direct exporters? What share of the gains from trade is generated by indirect exporters?

The purpose of this paper is to address these questions empirically and theoretically. I use firm-level data to document the dynamic patterns of indirect exporters. Then, I develop a dynamic trade model with indirect and direct exporting modes and calibrate it to be consistent with the empirical findings. I use the model to decompose the gains from indirect and direct exporting. Furthermore, I quantify by how much trade models that omit the indirect exporting channel mismeasure the welfare gains arising from trade liberalization.

Using Vietnamese firm-level data, I document that, first, indirect exporting is not as persistent as direct exporting; on average, the probability of remaining an indirect exporter for two consecutive years is lower than the probability of remaining a direct exporter. Second, indirect exporters are more likely to transition to direct exporting in the following years than non-exporters. Finally, among new direct exporters, the group with indirect exporting experience has a higher average export-to-sales ratio compared to the group without such experience.

Armed with these facts, I develop a dynamic model of trade with both indirect and direct exporting. I use a small open economy framework in which Vietnam is the home country and the rest of the world is the foreign country. The model builds on Melitz (2003) and Ahn, Khandelwal, and Wei (2011) and extends them into a dynamic setting. Firms are heterogeneous, and indirect and direct exporting modes are modeled as two different exporting technologies. These technologies differ in their per-period fixed costs and in their variable costs. A key feature of this model is customer accumulation. Upon entry, new exporters have access to a small share of aggregate demand in the foreign country. As firms export indirectly or directly, this share expands.

On average, indirect exporters have access to a higher share of the foreign demand com-

pared to non-exporters, due to their exporting tenure. That explains why indirect exporters have a higher probability of exporting directly in the future compared to non-exporters, and why, among new direct exporters, the group with indirect exporting experience has a higher average export-to-sales ratio. In the model, firms' profitability in the foreign market depends on their productivity, *iid* shocks to the foreign demand, the share of available foreign demand, and the fixed and the variable costs of exporting. Every period, given this information, firms decide whether to participate in the global market indirectly or directly, or to produce only for domestic consumers.

I examine the quantitative implications of the model by calibrating its parameters to match the moments from the data that characterize the dynamic behavior of the indirect and direct exporters. The calibrated model demonstrates that the mean of the fixed costs of indirect exporting is only 0.27 of the mean of the fixed costs of direct exporting, and that indirect exporting expands the share of foreign demand available to the firms more slowly than direct exporting. It takes 10 years for indirect exporters and 5 years for direct exporters to gain access to nearly entire foreign demand. Using the calibrated model, I evaluate the importance of availability of indirect exporting. I find that, in the absence of indirect exporting, the share of exporters declines by 10.5 percentage points, export volume contracts by 11.1 percent, and welfare drops by 1.3 percent. I find that indirect exporting accounts for at least 18 percent of the gains from trade in Vietnam.[1]

Bilateral trade liberalization is modeled as dropping the tariff rates of both countries to zero. Welfare gain from bilateral trade liberalization is 0.96 percent in the home country. Welfare is measured as the real income of the representative household. I find that the dynamic trade models that neglect indirect exporting overstate the welfare gains from trade liberalization (1.88 percent). I show that, in these models, the variable cost of exporting is underestimated.[2] The aggregate price index is non-decreasing and concave in the variable costs of exporting.[3] Thus, an x percentage points drop in the variable costs of exporting results in a larger drop in the aggregate price index for lower levels of variable costs. This means, trade liberalization of the same size, lowers the aggregate price index more in the dynamic models without indirect exporting. While the total income of the household drops in both models, the larger drop in the aggregate price index in the model without indirect exporting results in higher welfare gains.

The first counterfactual exercise is related to the trade license requirement in Vietnam. Until 20 years ago, if firms chose to export or import, they had to utilize a handful of

[1]This is the lower bound since firms that report exporting indirectly and directly in the same year are marked as direct exporters.

[2]This is because the total export volume is observed but only direct exporters are considered as exporters. This means the total export volume is attributed to a smaller set of exporters.

[3]Using a few simplifying assumptions, this relationship is shown in Appendix E.

state-owned enterprises as trade intermediaries. I evaluate the impact of reinstating the trade license requirement by closing the direct exporting channel. Exporting indirectly for highly productive firms or firms that face high foreign demand is not the optimal exporting decision. Thus, the share of exporters reduces by 11 percentage points; export volume drops by 74 percent; and welfare reduces by 6 percent. In the second counterfactual experiment, I show that moderate subsidies to the fixed cost of indirect exporting is welfare improving when indirect exporting features economies of scope. However, the welfare gains are negligible.

My work is related to important strands of literature in international trade:

Intermediation in Trade: Recently, a few papers have studied the characteristics of indirect exporters and documented that indirect exporters tend to be smaller and less productive than direct exporters. For example, see Krüger (2009), Abel-Koch (2013), McCann (2013), and Grazzi and Tomasi (2016).[4] My work adds to this empirical literature by documenting facts on the dynamic characteristics of indirect exporters. Ahn, Khandelwal, and Wei (2011) and Bai, Krishna, and Ma (2017) provide evidence that indirect exporters compared to non-exporters have a higher probability of exporting directly in the future. I add to this empirical finding by documenting the impact of indirect exporting experience on the intensive margin of direct exporting. That is, new direct exporters with indirect exporting experience have higher export-to-sales ratio.

There is also extensive theoretical work on the role of trade intermediaries in the trade literature. As discussed in Spulber (1999), intermediaries can play different roles in facilitating transactions between buyers and sellers, such as holding inventories, mitigating the adverse selection problem by monitoring quality, and providing liquidity. For example, Rubinstein and Wolinsky (1987), Biglaiser (1993), Antrs and Costinot (2011), and Petropoulou (2008) assume intermediaries match buyers and sellers by alleviating the search friction problems. Moreover, Akerman (2010), Ahn, Khandelwal, and Wei (2011), Felbermayr and Jung (2011), Crozet, Lalanne, and Poncet (2013), and Ganapati (2016) explain the emergence of indirect exporters and intermediaries using different channels such as an extra exporting technology available to the firms, the economies of scope technology of intermediaries, lack of contract enforceability, and economies of scale.[5]

I add to the theoretical literature by developing a dynamic model of trade with two exporting technologies and customer accumulation. Bai, Krishna, and Ma (2017) develop a

[4]These results are consistent with the findings documented by Peng and Ilinitch (1998), Peng and York (2001), Feenstra and Hanson (2004), and Bernard et al. (2012a,b, 2013) that investigate the characteristics of trade intermediaries.

[5] For more examples, please see Cosimano (1996), Rauch and Watson (2004), Blum, Claro, and Horstmann (2009), Dasgupta, Mondria et al. (2012), Bardhan, Mookherjee, and Tsumagari (2013), Krishna and Sheveleva (2014), and Chan (2014)

discrete choice model with learning-by-exporting on demand, productivity, and the cost of exporting to show that direct exporters learn faster than indirect exporters. In this paper, I build a parsimonious dynamic model that accounts for the empirical findings of the paper by only allowing for customer accumulation mechanism. Furthermore, I decompose the gains from indirect and direct exporting and quantify the size of mismeasurement in welfare gains in the dynamic models that omit indirect exporting channel.

Customer Accumulation: My work on customer accumulation is related to Ruhl and Willis (2017). They show that new exporters' export-to-sales ratio grows for 5 years before reaching its average level. Similarly, I assume the share of foreign demand available to the firms grows with exporting tenure. However, I do not limit the growth of demand to a certain number of years. I allow for a functional form that tracks the foreign demand accessible to the firm in each period and has different growth rates for indirect and direct exporters.[6]

Welfare Gains: Several papers have studied the welfare implications of trade liberalization through the lens of various models. Arkolakis, Costinot, and Rodríguez-Clare (2012) calculate the welfare gains of trade in a wide class of trade models and find that welfare gains only depend on the percentage drop in the share of expenditures spent on domestic products and on the elasticity of bilateral imports with respect to changes in variable trade costs. This paper departs from this class of models since in this model the tariff revenues are reimbursed to the households and the productivity of the firms is not drawn from a Pareto distribution. Note that mismeasuring the gains from trade liberalization in the models without indirect exporting does not depend on whether the model follows Arkolakis, Costinot, and Rodríguez-Clare (2012) or not. Melitz and Redding (2012) study how the aggregate economy is affected by trade liberalization in settings in which there is firm heterogeneity. They focus on the gains from the reallocation of resources toward more productive firms following trade liberalization. The model in this paper follows Chaney (2008) and assumes a fixed mass of firms enters the economy every period. Therefore, the entry and exit rates are not affected by trade liberalization.[7]

The paper is organized as follows. Section 2 introduces the datasets and presents the empirical findings. Section 3 develops a theory of firms' exporting decisions. Section 4 summarizes the calibration strategy. Results and robustness checks are discussed in Section 5. Counterfacutual experiments are studied in Section 6. Section 7 concludes.

[6]For more examples of customer accumulation, see Foster, Haltiwanger, and Syverson (2008, 2016), Arkolakis (2010), Drozd and Nosal (2012), Gourio and Rudanko (2014), Eaton, Eslava, Jinkins, Krizan, and Tybout (2015), and Fitzgerald, Haller, and Yedid-Levi (2016).

[7]For the impacts of endogenous exit and entry on welfare gains see Atkeson and Burstein (2010). Alessandria and Choi (2014) and Alessandria, Choi, and Ruhl (2014) study the welfare gains from trade liberalization along the transition path. Costinot and Rodriguez-Clare (2013) review the methodological contributions that attempt to measure the welfare gains from trade.

2 Data and Empirical Findings

This section describes the data used and presents the main findings. I utilize three datasets that contain information about the production, employment, revenues, expenses, and trade patterns of manufacturing firms in Vietnam to document how indirect exporting affects the performance of the firms that participate in international markets. The following definitions are used in two of the datasets:

Indirect exporting: goods are sold domestically to a third-party agent such as a wholesaler that exports the goods to the destination country on behalf of the producing firm.

Direct exporting: goods are exported without going through any further sales chain before leaving the country of origin. [8]

Using the data, I find that:

1. Indirect exporting is not as persistent as direct exporting.
2. Indirect exporters have a higher probability of exporting directly in the upcoming year compared to non-exporters.
3. Among new direct exporters, the ones with indirect exporting experience have a higher average export-to-sales ratio compared to ones without the experience.

2.1 Data

I use three firm-level panel datasets from Vietnam to document new observations about indirect exporters. See Appendix A for a more detailed description and the summary statistics for each dataset.

Small- and Medium-Sized Enterprise Survey: This dataset surveys a subset of small- and medium-sized enterprises (hereafter SMEs) in the manufacturing sector. SMEs are defined as firms with less than 300 employees. Survey is conducted biannually from 2005 to 2015, covers around 2650 firms in each round, and provides a panel dimension. The dataset contains information about each firm's production, sales structure, input costs, employment, trade, and investments. Most importantly, firms are asked whether they exported their products directly, indirectly, or both within the past year.

EBRD-World Bank Business Environment and Enterprise Survey: This survey is conducted on a subset of firms in 2005, 2009, and 2015 and contains information about

[8] Goods might be distributed by a wholesaler in the destination country but, if the producer ships them out of the country of origin, the exporting process is classified as direct exporting.

firms' sales and supplies, trade, employment, costs, borrowing, and business environment. Analogous to the survey of SMEs, this survey questions firms about the share of their sales that is sold domestically, exported indirectly, and exported directly. Thus, unlike other papers that need to infer whether firms export directly or indirectly, identifying indirect and direct exporters in these two datasets is trivial.[9]

Vietnamese Enterprise Survey (VES): This survey is conducted annually and the data is available from 2012 to 2015. VES covers the universe of registered firms in Vietnam with more than 20 employees and samples the smaller firms. In the survey, firms answer questions about their characteristics, production, trade, balance sheet, and employment. Although the survey does not ask firms if they are direct or indirect exporters, I use the data to compute several aggregate variables and to discipline the model's parameters since this dataset covers the universe of registered firms in Vietnam.

2.1.1 The Representativeness of World Bank and SME Surveys

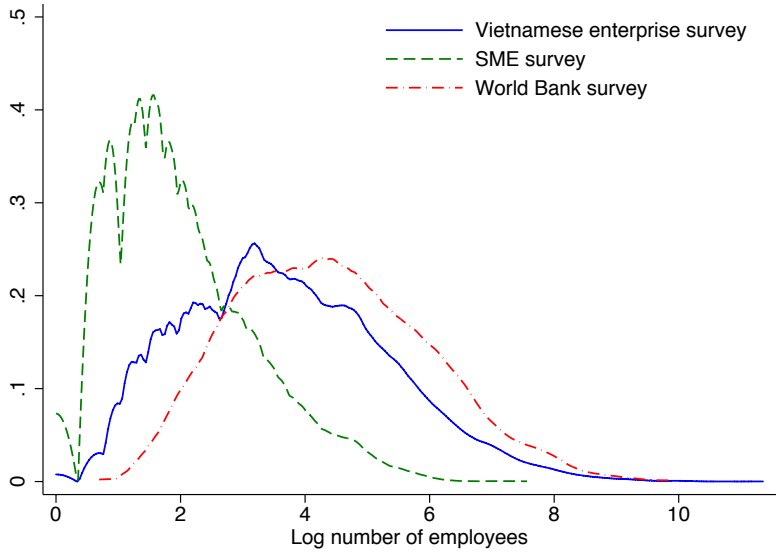
Figure 1 depicts the distribution of the log of the number of employees in the three datasets. The SME Survey is designed to target smaller firms and provides no information about large firms. On the other hand, World Bank (WB) Survey includes firms of all sizes. However, compared to the distribution of the firms in VES (covers the universe of the firms in Vietnam), WB Survey is biased towards larger firms. While the mean number of employees of manufacturing firms in the VES is 189, this number is as high as 304 in the WB Survey. Moreover, in the WB Survey, the share of exporting firms is much higher than that of VES (0.46 versus 0.27). This also suggests that the WB Survey does not represent the whole population of Vietnamese firms. Thus, in this paper, I assume that SME dataset and WB dataset represent small and large firms, respectively. I use both surveys to compare the characteristics and dynamics of the small and large firms.

2.1.2 Cross-sectional Characteristics of Indirect Exporters

Table 1 summarizes the share of exporters by exporting mode (indirect, direct, and both) for each dataset. The share of exporters among small and large firms is 6.3 and 45.5 percent, respectively. While the share of small exporters is much lower, indirect exporting is more common among them compared to large exporters. 55.6 percent of

[9] Bai, Krishna, and Ma (2017) match the annual manufacturing survey and customs data and Ahn, Khandelwal, and Wei (2011) identify the set of intermediaries based on Chinese characters. These methodologies are prone to misidentifying indirect exporters. More specifically, in a manufacturing survey, part of a firm's export might be in services, which does not show up in customs data. Therefore, the value of exported services might be misidentified as goods being exported indirectly.

Figure 1: Size distribution of firms



Notes: The log of the number of employees in the three datasets. The data is pooled across years.

small exporters export indirectly but among large firms, only 36.0 percent use indirect exporting. 12.0 percent of the exports is carried indirectly in the WB Survey. The SME Survey does not separate the value of exports by exporting mode. Thus, computing the export volume carried indirectly for small firms is not possible.

Table 1: Share of exporting firms, SME, WB, and VE Surveys

	SME Survey	WB Survey	VES
Share of indirect exporters	0.024	0.108	.
Share of direct exporters	0.028	0.291	.
Share of indirect & direct exporters	0.011	0.056	.
Share of exporters	0.063	0.455	0.274

Notes: Share of indirect, direct, and all exporters in the manufacturing sector in each dataset. Data is pooled across years. In VES, the export mode is not specified.

Indirect exporting is more common among firms that are located far away from big cities (i.e., Hanoi and Ho Chi Minh City). For example, in the SME Survey, indirect exporting is the most common among exporters in Quang Nam and Lam Dong provinces. Transporting goods to an exporting port might be very costly for remotely located firms and they might find it more profitable to sell their products domestically to a trade intermediary that ships and exports the goods on behalf of the producer.

2.2 Findings on the Persistence of Indirect Exporting

For the analysis, I divide firms into three mutually exclusive groups of non-exporters, indirect exporters, and direct exporters. I classify firms that export directly and indirectly in the same year as direct exporters. In the SME and WB Surveys, 1 and 5.6 percent of the firms report indirect and direct exporting in the same year, respectively. In Appendix B, I provide evidence that demonstrates that, on average, firms that export indirectly and directly simultaneously are larger than direct exporters and have higher sales.

I exploit the panel dimension of the SME and WB Surveys by investigating the cross tabulation of firms' transition between exporting modes over time. Since these surveys are not conducted annually, I use the transition probabilities between years $(t-T)$ and t to compute the transition matrix between years $(t-1)$ and t. This assumes that the transition matrix between $(t-1)$ and t is the same across the periods.

Table 2 displays the transition probabilities of firms' exporting status in year $(t-1)$ against firms' exporting status in year t for large firms. The last row of the table illustrates the share of firms in each exporting mode at time t. The number in each cell displays the share of the firms at time t in the exporting mode specified by the column given the exporting mode in the previous year $(t-1)$, specified by the row. The main diagonal of the table suggests that 92.2 percent of the firms that did not export in $(t-1)$ remain non-exporters in the following period t and 93.6 percent of the firms that engaged in direct exporting in $(t-1)$ export directly in year t as well. The transition matrix of these two states confirms the phenomenon that Baldwin and Krugman (1989) refer to as export hysteresis. This means that non-exporters and direct exporters stay in the same state over time with a high probability. Among firms that export indirectly in $(t-1)$, 79.0 percent of them continue to export indirectly in period t. This suggests that the probability of remaining an indirect exporter for two years in a row is smaller than the probability of remaining a direct exporter for two years.

Table 2: Cross-tabulation of lag export mode and change in export status for large firms

$(t-1)/t$	Domestic only	Indirect exporting only	Direct exporting
Domestic only	0.922	0.045	0.033
Indirect exporting only	0.108	0.790	0.102
Direct exporting	0.041	0.023	0.936
Share in t	0.545	0.108	0.347

Notes: All firms are observed in the sample for at least two consecutive rounds. This table does not include the dynamics of the entrants since their exporting mode in period $(t-1)$ is not defined. "Indirect exporting only" category refers to firms that report positive amounts of indirect exporting and no direct exporting. "Direct exporting" refers to firms that report positive amounts of direct exporting. Please note that the exit patterns of the firms cannot be studied since using survey data, one cannot distinguish between firms that have stopped their production (exited) versus firms that did not respond to the survey.

I repeat the same experiment using the SME Survey to investigate the persistence of different export modes for small firms. Table 3 shows that 98.8, 72.6, and 83.5 percent of firms remain non-exporters, indirect, and direct exporters, respectively, two periods in a row. These numbers suggest that small non-exporters have a very small entry rate into either of the export modes compared to large exporters and the probability of small firms dropping out of foreign markets is higher. However, similar to large firms, the persistence of exporting indirectly is lower than the persistence of exporting directly.

Table 3: Cross-tabulation of lag export mode and change in export status of SMEs.

$(t-1)/t$	Domestic only	Indirect exporting only	Direct exporting
Domestic only	0.988	0.007	0.005
Indirect exporting only	0.200	0.726	0.074
Direct exporting	0.098	0.067	0.835
Share in t	0.938	0.024	0.038

Notes: Firms are in the manufacturing sector and appear in the sample for at least two consecutive rounds. This table does not include the dynamics of the entrants since their exporting mode in period $(t-1)$ is not defined. The definitions follow those described in Table 2.

In the short-run, a high share of small and large firms remain in the exporting states, but in the long-run, these shares drop noticeably. Table 4 summarizes the long-run behavior of transition matrices for small and large firms. Only 13.9 percent of the of the large firms and 3.4 percent of the small firms remain indirect exporters in the long-run. The share of the large and small firms that remain direct exporters in the long-run is 43.9 and 4.3 percent, respectively. This evidence suggests that indirect exporting is not as persistent as direct exporting. Many firms use this exporting channel for a short period of time and eventually either only produce domestically or choose to export directly.

Table 4: Long-run behavior of transition matrices

	Domestic Only	Indirect exporting only	Direct exporting
Large firms	0.423	0.139	0.439
Small firms	0.923	0.034	0.043

Notes: The numbers computed for small firms are close to the share of exporters in Table 3 which suggests that small firms are in the stationary state. However, this is not valid for large firms. The difference suggests that the share of exporters among large firms is growing.

2.3 Findings on the Impacts of Indirect Exporting on the Extensive Margin of Direct Exporting

The finding in Subsection 2.2 demonstrates that, on average, firms use indirect exporting for a shorter period of time compared to direct exporting. However, it is not clear whether indirect exporting impacts the exporting behavior of the firms in the following years or

not. Table 2 illustrates that, among large non-exporters in $(t-1)$, only 3.3 percent of them export directly in period t. However, 10.2 percent of large indirect exporters in period $(t-1)$ become direct exporters in the following year. This implies that large indirect exporters have a higher probability of becoming direct exporters in the subsequent year compared to the non-exporters. The same pattern is also observed for small firms as shown in Table 3. 7.4 percent of the small indirect exporters export directly in the following period, but only 0.5 percent of the small non-exporters in period $(t-1)$ access foreign markets directly in period t.

The difference between the fraction of non-exporters and indirect exporters that export directly in the upcoming year might be due to the characteristics of the firms such as age, size, and ownership type or the revenue and financial status of the firm. The regression specified in equation 1 controls for these characteristics:

$$D(dir_{j,t}) = \beta_0 D(ind_{j,(t-k)}) + \beta_1 \log(rev_{j,(t-k)}) + \beta_2 \log(emp_{j,(t-k)}) + \beta_3 D(owner_j) + \gamma_i + \gamma_t + \epsilon_{j,t} \tag{1}$$

where $D(dir_{j,t})$ is a dummy variable equal to one if firm j exports directly in period t and zero otherwise. $D(ind_{j,(t-k)})$ is a dummy variable that takes the value one if firm j exported indirectly in period $(t-k)$ and it is zero if the firm did not export. $D(ind_{j,(t-k)})$ is not defined for firms that exported directly in period $(t-k)$ since I am not interested in explaining the impacts of direct exporting on the probability of firm remaining a direct exporter. $\log(rev_{j,(t-k)})$ is the log of the revenue, $\log(emp_{j,(t-k)})$ is the log of number of employees, and $D(owner_j)$ is a dummy variable equal to one if the firm is a domestic private firm and equal to zero if the firm is foreign- or state-owned. γ_i and γ_t are the industry and year fixed effects, respectively. I run this regression on small and large firms. Table 5 reports the results.

The second column of Table 5 summarizes the impact of indirect exporting experience on the probability of exporting directly for small firms. The coefficient of lagged indirect exporting shows that the probability of exporting directly in period t is 8.05 percent higher for firms that exported indirectly in period $(t-k)$ after controlling for several firm-specific characteristics and fixed effects. In column 3, I run the same regression model for the large firms. Indirect exporting experience in period $(t-k)$ increases the probability of exporting directly in period t by 12.45 percent. It is worth noting that the coefficients in Table 5 cannot be compared to the probabilities reported in the transition matrices in Table 2 and Table 3 directly. The coefficients of the regressions report the impacts of indirect exporting in period $(t-k)$ for $k > 1$ on the probability of being a direct exporter in period t (the data is not available annually). This means the coefficients must be compared to transition probabilities between $(t-k)$ and t.

Table 5: Impacts of indirect exporting on the extensive margin of direct exporting

	— Small firms —	— Large firms —
$P(\text{D}(\text{dir}_{j,t}) = 1)$		
$1.(ind_{j,(t-k)})$	0.0805***	0.1245*
	(0.0071)	(0.0568)
$\log(rev_{j,(t-k)})$	0.0047***	0.0219
	(0.0012)	(0.0193)
$\log(emp_{j,(t-k)})$	0.0076***	0.0199
	(0.0018)	(0.0272)
$1.(owner_j)$	-0.0150***	-0.1440*
	(0.0032)	(0.0698)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	10,333	301
R-Squared	0.1108	0.3592

Notes: The dependent variable in each regression is a dummy variable that takes the value 1 if firm j is a direct exporter in period t and 0 otherwise. $D(ind_{j,(t-k)})$ is an indicator variable that is 1 if firm exported indirectly and 0 if the firm did not export in period $(t-k)$. $\log(rev_{j,(t-k)})$ and $\log(emp_{j,(t-k)})$ are the log of total revenue and log of number of employees of firm j. The constant in each regression is suppressed. Significance: $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$.

This evidence suggests that indirect exporting not only makes it possible for some firms to get access to international markets but it is also positively correlated with the probability of exporting directly in upcoming years. Combining the last two findings, one can conclude that, on average, firms use indirect exporting for a short period of time. However, indirect exporters either learn about their performance in the foreign markets or expand their business so that, eventually, they face a higher probability of exporting directly in subsequent years.

Indirect exporting can potentially impact the performance of the firms along many dimensions. Specifically, it can affect supply-side factors such as a firm's productivity, financial constraints, and capacity constraints or demand-side factors such as market specific demand for a firm's products and the number of customers. I show that a supply-side factor that impacts the performance of the firm in the domestic and foreign markets equally cannot explain the finding in Section 2.4.

2.4 Findings on the Impacts of Indirect Exporting on the Export-to-Sales Ratio of Direct Exporting

Table 6 illustrates the average export-to-sales ratios of direct exporters based on their export status in period $(t-k)$. The numbers in the table show that, for both small and large

firms, the mean export intensity of direct exporters with indirect exporting experience is higher than that of the direct exporters with exporting experience. I perform a t-test to ensure that the mean of the export-to-sales ratio of these two groups are significantly different. The result confirms that the two samples have significantly different means for both small and large firms.

Table 6: Cross-tabulation of lag export mode and mean export intensity

	— Small Firms —	— Large Firms —
$(t-k)/t$	Direct Exporting	Direct Exporting
Domestic only	0.388	0.301
	(0.039)	(0.053)
Indirect exporting only	0.556	0.544
	(0.072)	(0.102)
Difference	0.168**	0.243*

Notes: New direct exporters in period t are divided into two disjoint categories based on their export activity in period $(t-k)$. The last row indicates the result of the t-test. The numbers in parenthesis report the standard errors from the t-test.

Analogous to equation 1, I control for some firm characteristics and fixed effects using the following regression:

$$\frac{exp}{sales}(dir_{j,t}) = \beta_0 D(ind_{j,(t-k)}) + \beta_1 \log(rev_{j,(t-k)}) + \beta_2 \log(emp_{j,(t-k)}) + \beta_3 D(owner_j) + \gamma_i + \gamma_t + \epsilon_{j,t} \tag{2}$$

where $\frac{exp}{sales}(dir_{j,t})$ is the export-to-sales ratio of firm j that exports directly at time t. Table 7 summarizes the result of this regression for small and large firms. Columns 2 and 3 contain linear probability models that study the impact of indirect exporting experience on the export-to-sales ratio of new direct exporters. Both models control for observable firm-specific characteristics such as revenue, total employment, and ownership type. Indirect exporting experience increases the export intensity of the new direct exporters, on average, by 11.27 percent for small firms and 22.17 percent for large firms.

This evidence confirms that the impact of indirect exporting experience cannot only be driven by supply-side factors that impact the performance of the firms equally in the domestic and foreign markets. For example, if indirect exporting only improves the productivity of the firm, the firm is more productive in both domestic and foreign markets. This change in productivity does not impact the export intensity of the firm. In the model, I utilize a market-specific component to account for this empirical observation.

Due to the lack of export data at the product-level, I cannot investigate whether the increase in the export intensity is due to adding new products, adding new destination markets, or increasing the exports of existing products to the old foreign markets. Fitzgerald, Haller, and Yedid-Levi (2016) discuss that the product extensive margin accounts for 20 to 30 percent of dynamics of revenue at the market level. Therefore, I ignore this

Table 7: Impacts of indirect exporting experience on the export-to-sales ratio of new direct exporters

	— Small firms —	— Large firms —
$\frac{exp}{sales}(dir_{j,t}=1)$		
$1.(ind_{j,(t-k)})$	0.1127***	0.2217*
	(0.0091)	(0.0932)
$\log(rev_{j,(t-k)})$	0.0065*	-0.1034**
	(0.0031)	(0.0356)
$\log(emp_{j,(t-k)})$	-0.0110	0.0855
	(0.0479)	(0.0473)
$1.(owner_j)$	0.1867	-0.0226
	(0.1730)	(0.1083)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	102	50
R-squared	0.3543	0.2897

Notes: The dependent variable in each regression is export intensity of new direct exporters in period t. This means the firms that did not export directly in period $(t-k)$. $D(ind_{j,(t-k)})$ is an indicator variable that is 1 if firm exported indirectly and 0 if the firm did not export in period $(t-k)$. $\log(rev_{j,(t-k)})$ and $\log(emp_{j,(t-k)})$ are the log of total revenue and log of number of employees of firm j. The constant terms of the regressions are suppressed. Significance: $^{***}p<0.001$; $^{**}p<0.01$; $^{*}p<0.05$.

margin and in Section 3 focus on a model in which each firm only produces one variety. Thus, in the model, all the increase in the export-to-sales ratio takes place via increases in the volume of exports of the same product. In the next section, I discuss the modeling choices and assumptions in detail and explain what modeling elements are necessary to account for the empirical findings of this section.

3 Model

In this section, I develop a dynamic model of the exporting decision of firms in presence of two exporting technologies and customer accumulation. Two exporting technologies are available: exporting indirectly and exporting directly. Firms upon entry into the foreign market do not have access to the entire demand. The share of foreign market that is available to firms grows as firms export. I allow the fraction of foreign demand to grow at different rates for indirect and direct exporters. I incorporate the above assumptions in a Melitz (2003) model with a monopolistic competition framework and heterogeneous firms.

The main goal of the model is to replicate the empirical observations documented in Section 2. To match the moments of the firms of different sizes, I allow for heterogeneity

in productivity. The observation in Subsection 2.4 suggests that supply-side heterogeneity might not be sufficient for explaining the differences in the average export-to-sales ratios of direct exporters with different export history.

The key hypothesis that can explain why firms with indirect exporting experience have a better performance in international markets compared to firms without the experience is that firms start small in the new market and over time they accumulate customers and larger share of the market becomes accessible to them. Firms that are not very productive export indirectly but as their customer base grows, some of them find direct exporting to be the optimal exporting technology. I find that the model without customer accumulation is not able to generate export-to-sales ratios that are history dependent.

In this model, the world consists of the home and the foreign country. Time is discrete and denoted by t. Firms choose whether to enter or exit a particular market, how to export (directly or indirectly), and in what prices to sell in each market. I use a small open economy model setting in which Vietnam is the home country and the rest of the world is modeled as the foreign country. All features of the model are identical across the two countries except for the size of the labor force which I assume is much smaller in the home country. Following the small open economy assumption, (i) the mass of the foreign firms is not affected by home country variables. (ii) the aggregate price index and total expenditure of the foreign country are unaffected by home country variables. (iii) the shares of indirect and direct exporters in the foreign country are determined endogenously and they depend on the trade costs and the demand in the home country.

3.1 Consumers

A measure L of infinitely-lived identical consumers live in the home country. The representative consumer is endowed with one unit of labor and provides that inelastically to the labor market. She drives utility from consuming a composite final good, C_t. The utility function is given by:

$$U = E\sum_{t=0}^{+\infty} \beta^t \ln(C_t)$$

where β is the discount factor. The composite good C_t is made out of a set of differentiated varieties that are combined according to a CES aggregator:

$$C_t = \left(\int_{\omega \in \Omega_t} \left(e^{s_t(\omega)}\right)^{\frac{1}{\sigma}} c_t(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}$$

Ω_t is the set of available varieties in the home country at time t, $s_t(\omega)$ is the demand shock for variety ω, $c_t(\omega)$ is the consumption of variety ω, and σ is the elasticity of substitution across varieties.

The representative consumer provides one unit of inelastic labor to the firms, earns wage w_t, and faces the following budget constraint:

$$\int_{\omega \in \Omega_t} p_t(\omega) c_t(\omega) d\omega = Y_t \tag{3}$$

where p_t is the price of variety ω and Y_t is the aggregate spending level of the consumer and is given by $Y_t = w_t L + T_t + \Pi_t$. T_t is the tariff revenue that is reimbursed to the households in the form of lump-sum transfers. The representative consumer has shares in all of the firms of the home country and the total profit made by the firms, Π_t, is distributed among all consumers via lump-sum transfers:

$$\Pi_t = \int_{\omega \in \hat{\Omega}_t} \pi_t(\omega) d\omega$$

where $\hat{\Omega}_t$ is the set of varieties produced in the home country and can be supplied domestically and internationally. The aggregate price index that corresponds to consumption of the bundle of varieties C_t is given by P_t:

$$P_t = \left(\int_{\omega \in \Omega_t} e^{s_t(\omega)} p_t(\omega)^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}}$$

Given the utility function and prices, solving the representative consumer's problem, the demand for each variety is

$$c_t(\omega) = \frac{(w_t L + T_t + \Pi_t) e^{s_t(\omega)}}{p_t(\omega)^{\sigma} P_t^{1-\sigma}} \tag{4}$$

3.2 Firms

There is a continuum of monopolistically competitive firms in each country. Following Chaney (2008), I assume that every period there is an exogenous mass of potential entrants μ_e. Upon entry, each firm gets associated to a product variety ω and a productivity level φ. Hereafter, I drop ω and use φ to refer to a firm that produces variety ω and has productivity φ.[10] Each variety can be supplied to consumers at the country of origin and the other country. Productivity levels are observed by firms and do not vary over time. All else equal, firms with higher φ are more efficient and able to produce at lower marginal costs. The production function of the firms is constant returns to scale and only takes labor as input and utilizes it to pay a fixed cost for operating in each market and

[10] Decisions that the firms make do not depend on ω but they depend on the productivity of the firms φ. All firms with the same productivity behave the same (conditional on other state variables being the same) and all varieties enter the utility function symmetrically.

produce. To produce q units of a variety at time t, a firm with productivity φ needs to hire ℓ units of labor such that

$$\ell_{jt} = \frac{q_{jt}}{\varphi} + f_{jt} \quad j \in \{N, I, D\}$$

where f_{jt} is a fixed cost that the firm has to pay at period t before production happens. It varies depending on time, the market (domestic or foreign), and export technology chosen by the firm. In Section 3.2.1, I show that exporting indirectly and directly are two technologies that are different in terms of the fixed cost and the variable cost associated with exporting. f_{Nt}, f_{It}, and f_{Dt} are the fixed costs of producing for domestic market, exporting indirectly, and exporting directly, respectively.

The demand for each variety in the foreign country is subject to shocks. Analogously, the demand for products of foreign firms in the domestic market is subject to shocks. Demand shocks are observed by firms prior to making exporting decisions. These shock are independently and identically distributed over time and normally distributed with mean zero and variance σ_ϵ^2, $s \sim \mathcal{N}(0, \sigma_\epsilon^2)$. The *i.i.d.* shocks to the foreign demand generate more heterogeneity among firms which is necessary for matching the dynamics of indirect and direct exporters quantitatively.

3.2.1 Exporting Technologies

At the beginning of each period, firms decide whether to export to the foreign country or not based on their productivity φ, the foreign demand shock s_t, the share of the foreign demand available k_t, and the costs associated to exporting indirectly f_{It} and directly f_{Dt}. There are two exporting technologies available to the firm: exporting directly and indirectly. Each exporting technology is associated to a per period fixed cost to maintain the presence in the foreign market that needs to be financed upfront and a per-unit variable cost. The per-period fixed cost represents the cost of minimum freight and insurance charges, advertising, and market-research. Following Das, Roberts, and Tybout (2007), I allow the fixed cost of exporting indirectly and directly to vary across firms and time. More specifically, I assume the fixed cost of exporting is drawn from a lognormal distribution.

$$\ln(f_{dt}) = \rho \ln(f_{d,(t-1)}) + \epsilon_{dt} \quad \epsilon_d \sim \mathcal{N}(\psi_{df}, \sigma_f^2)$$

where $d \in \{I, D\}$. The $AR(1)$ processes that govern the cost of exporting indirectly and directly share the same persistence ρ and standard deviation σ_f but they have different mean values ψ_{If} and ψ_{Df}.

Both exporting technologies are subject to a time-invariant variable cost τ_d where $d \in \{I, D\}$. This means τ_d units of a variety must be shipped from the home country in order

for one unit of the variety to arrive to the foreign country.

3.2.2 Customer Accumulation

Upon entry into foreign markets, only a fraction of the foreign demand is available to the firms. More specifically, the aggregate effective demand increases in firms' tenure in the foreign market. This means firms cannot directly choose the share of the foreign demand available to them but by choosing to export and by choosing the exporting technology they increase the foreign demand by a specific amount. All firms that start exporting face the same fraction of market accessibility, k_0. The share of the foreign demand available to the firms at time t is represented by k_t and it follows

$$k_{t+1} = \sum_j d_{jt} k_t^{\gamma_j} + (1 - \sum_j d_{jt})(1 - \delta_c)k_t \tag{5}$$

where $j \in \{I, D\}$. Since there are two exporting technologies available, I allow for the demand to grow at different rates γ_I and γ_D. Notice that $k_t \in [k_0, 1]$ and $\sum_j d_{jt} \in \{0, 1\}$. To ensure that k increases as firms export indirectly or directly, both curves must lie above the 45 degree line. Thus, I assume $\gamma_I, \gamma_E \in [0, 1)$. The main benefit of using this functional form for expanding foreign demand is that although firms can accumulate demand at different rates depending on their exporting technology, there is no need to track the exporting history of firms. While the share of foreign demand increases implicitly with the export tenure of the firm, one does not need to follow the number of years a firm has exported or the exporting technologies it has utilized.

Each household in the international market has the same probability k of being reached by a particular firm that is independent across firms. Thus, each household purchases the same measure of varieties, although the particular varieties might be different.

3.3 The Problem of the Firm

In each period, the firm makes two decisions, one that is setting the prices at home and the foreign country and second which is whether to export or not and how to export.

3.3.1 Price Decision of the Firm

When firms observe the demand, choosing prices or quantities are equivalent. Firms set prices in domestic market and foreign market for exporting indirectly and directly. Since the goal of this paper is to focus on the export patterns of the firms, I assume that demand for each variety is subject *i.i.d.* shocks only in international market and not in

the country in which the good is produced. I further assume firms have access to the entire domestic market upon entry. Thus, firm's problem in the domestic market is

$$\begin{aligned} \pi_{Nt}(\varphi) &= \max_{p_{Nt}(\varphi)} p_{Nt}(\varphi) q_{Nt}(\varphi) - w_t\Big(\frac{q_{Nt}(\varphi)}{\varphi} + f_{Nt}\Big) \\ \text{s.t.} \quad q_{Nt}(\varphi) &= \frac{(w_t L + T_t + \Pi_t)}{p_{Nt}(\varphi)^{\sigma} P_t^{1-\sigma}} \end{aligned} \tag{6}$$

Demand for a firm's product is subject to *i.i.d.* shocks in the foreign market. Firm observes the shock prior to making exporting decision. Conditional on entry into the foreign market, firm chooses prices of exporting indirectly and directly to maximize the profit associated to each exporting technology.

Direct exporters entail a per period fixed cost f_{Dt} and per unit variable cost τ_D and choose prices $p_{Dt}(\varphi)$ to solve the following profit maximization problem

$$\begin{aligned} \pi_{Dt}(\varphi, s, k, f_D) &= \max_{p_{Dt}(\varphi)} \Big[p_{Dt}(\varphi) q_{Dt}(\varphi, s, k)(1 - \tau_{tr}^*) - w_t\big(\frac{\tau_D q_{Dt}(\varphi, s, k)}{\varphi} + f_{Dt}\big) \Big] \\ \text{s.t.} \quad q_{Dt}^*(\varphi, s, k) &= k_t \frac{(w_t^* L^* + T_t^* + \Pi_t^*) e^{s_t}}{p_{Dt}(\varphi)^{\sigma} {P_t^*}^{1-\sigma}} \end{aligned} \tag{7}$$

where τ_{tr}^* is the ad valorem tariff rate that firms of the home country pay when they choose to export. Foreign exporters are also subject to ad valorem tariff rates imposed by the home country. Tariff revenues are reimbursed to households of each country as lump-sum transfers. Firms observe s_t and draw fixed cost of exporting indirectly and directly before making the exporting decision. Solving the problem of a firm conditional on the decision to export directly, the optimal price of exporting is

$$p_{Dt}(\varphi) = \frac{\sigma \tau_D w_t}{(\sigma - 1)(1 - \tau_{tr}^*)\varphi}$$

This indicates that prices are not affected by the demand shocks or the share of the market accessible to the firms.

Analogously, firms that choose to export indirectly incur a per period fixed cost f_{It} and a per unit variable cost τ_I. Firm chooses prices to maximize the profit

$$\begin{aligned} \pi_{It}(\varphi, s, k, f_I) &= \max_{p_{It}(\varphi)} \Big[p_{It}(\varphi) q_{It}(\varphi, s, k)(1 - \tau_{tr}^*) - w_t\big(\frac{\tau_I q_{It}(\varphi, s, k)}{\varphi} + f_{It}\big) \Big] \\ \text{s.t.} \quad q_{It}^*(\varphi, s, k) &= k_t \frac{(w_t^* L^* + T_t^* + \Pi_t^*) e^{s_t}}{p_{It}(\varphi)^{\sigma} {P_t^*}^{1-\sigma}} \end{aligned} \tag{8}$$

The optimal price for a variety produced by a firm of productivity φ that chooses to export indirectly is

$$p_{It}(\varphi) = \frac{\sigma \tau_I w_t}{(\sigma - 1)(1 - \tau_{tr}^*)\varphi}$$

3.3.2 The Participation Decision of the Firm

The total value of a firm is denoted by $V_t(\varphi, s, k, f_I, f_D)$ which consists of the value of the firm in the domestic market, $V_{Nt}(\varphi)$, and the value of the firm in the foreign market, $V_{Et}(\varphi, s, k, f_I, f_D)$.

Firms enter period t with the knowledge of their productivity φ, the demand shock in the foreign market s, and the share of the foreign market accessible k. Firms draw the costs of indirect and direct exporting and given φ, s, and k decide whether to export directly, indirectly, or only produce domestically. In the domestic market, firms receive profits $\pi_{Nt}(\varphi)$ and a continuation value of $\beta(1-\delta)V_{Nt}(\varphi)$, where δ is an exogenous probability of a shock that forces the firm to exit. The value of exiting is normalized to zero.

$$V_{Nt}(\varphi) = \max\left\{\pi_{Nt}(\varphi) + \beta(1-\delta)V_{Nt}(\varphi), 0\right\}$$

The value of a firm in the foreign market is

$$\begin{aligned} V_{Et}(\varphi, s, k, f_I, f_D) = \max\big\{&V_{It}(\varphi, s, k, f_I, f_D), V_{Dt}(\varphi, s, k, f_I, f_D), \\ &\beta(1-\delta)E_{s', f_I', f_D'}V_{Et+1}(\varphi, s', (1-\delta_c)k, f_I', f_D')\big\} \end{aligned} \tag{9}$$

Where $V_{It}(\varphi, s, k, f_I, f_D)$ is the value of indirect exporting, $V_{Dt}(\varphi, s, k, f_I, f_D)$ is the value of direct exporting, and $\beta(1-\delta)E_{s', f_I', f_D'}V_{Et+1}(\varphi, s', (1-\delta_c)k, f_I', f_D')$ is the continuation value that the firm receives from not exporting in period t and having the option to start exporting in period $t+1$. Firms that choose not to export lose δ_c fraction of the foreign demand that is available to them every period until they reach the initial level k_0. Values of exporting indirectly and directly are

$$\begin{aligned} V_{It}(\varphi, s, k, f_I, f_D) &= \max\left\{\pi_{It}(\varphi, s, k, f_I) + \beta(1-\delta)E_{s', f_I', f_D'}\left[V_{Et+1}(\varphi, s', k', f_I', f_D')\right]\right\} \\ V_{Dt}(\varphi, s, k, f_I, f_D) &= \max\left\{\pi_{Dt}(\varphi, s, k, f_D) + \beta(1-\delta)E_{s', f_I', f_D'}\left[V_{Et+1}(\varphi, s', k', f_I', f_D')\right]\right\} \end{aligned}$$

Finally, the total value of a firm is the sum of its value in the domestic market and the foreign market

$$V_t(\varphi, s, k, f_I, f_D) = V_{Nt}(\varphi) + V_{Et}(\varphi, s, k, f_I, f_D)$$

3.4 Stationary Equilibrium

To study the equilibrium, I normalize the wage rate in the foreign country, w^*, to 1. I assume the two countries are identical except that the home country is much smaller than the foreign country ($L^* >> L$) and the changes at home do not impact the demand

(aggregate price index, P^*, and average profit, Π^*) in the foreign country. M and M^* denote the equilibrium mass of the operating firms in the home and foreign country. And $m(\varphi, s, k, f_I, f_D)$ and $m^*(\varphi, s, k, f_I, f_D)$ denote the mass of the firms in the state $(\varphi, s, k, f_I, f_D)$. Firms enter each period with a state $\lambda = (\varphi, k, f_I^-, f_D^-)$ and given the draws of f_I, f_D, and s decide whether to export indirectly, export directly, or only produce domestically. Assume that the state λ is described by a distribution Λ. To characterize the mass of indirect and direct exporters, first, I characterize the total mass of exporting firms and then specify the mass of indirect and direct exporters. Mass of exporters M_X is given by

$$M_X = M - M_{NX}$$
$$M_X = M - \int_\lambda \int_{-\infty}^{+\infty} \int_{f_I^*(\varphi,s,k)}^{+\infty} \int_{f_D^*(\varphi,s,k)}^{+\infty} \Lambda(\varphi, k, f_I^-, f_D^-) G_I(f_I^-, f_I) G_D(f_D^-, f_D) p(s) df_D df_I ds d\lambda$$

where M_{NX} is the mass of non-exporters and $f_I^*(\varphi, s, k)$ and $f_D^*(\varphi, s, k)$ are the costs of indirect and direct exporting such that firms with state (φ, s, k) choose not to export either directly or indirectly for draws of costs equal or greater than those. Note that f_I^- and f_D^- do not impact the cut-off costs but impact the probability of drawing costs above or below f_I^* and f_D^* in the current period.

To separate the mass of indirect and direct exporters, I consider 3 different scenarios. For each state λ and the draw of foreign demand shock s:

- $\forall f_I \leq f_I^*(\varphi, s, k)$ and $\forall f_D > f_D^*(\varphi, s, k) \rightarrow$ firms export indirectly:

$$M_{I,1} = \int_\lambda \int_{-\infty}^{+\infty} \int_0^{f_I^*(\varphi,s,k)} \int_{f_D^*(\varphi,s,k)}^{+\infty} \Lambda(\varphi, k, f_I^-, f_D^-) G_I(f_I^-, f_I) G_D(f_D^-, f_D) p(s) df_D df_I ds d\lambda$$

- $\forall f_I > f_I^*(\varphi, s, k)$ and $\forall f_D \leq f_D^*(\varphi, s, k) \rightarrow$ firms export directly:

$$M_{D,1} = \int_\lambda \int_{-\infty}^{+\infty} \int_{f_I^*(\varphi,s,k)}^{+\infty} \int_0^{f_D^*(\varphi,s,k)} \Lambda(\varphi, k, f_I^-, f_D^-) G_I(f_I^-, f_I) G_D(f_D^-, f_D) p(s) df_D df_I ds d\lambda$$

- $\forall f_I \leq f_I^*(\varphi, s, k)$ and $\forall f_D \leq f_D^*(\varphi, s, k)$
  - If $f_I \geq f_D \rightarrow$ firms export directly

$$M_{D,2} = \int_\lambda \int_{-\infty}^{+\infty} \int_0^{f_I^*(\varphi,s,k)} \int_0^{f_D^*(\varphi,s,k)} \mathbb{1}(f_I \geq f_D) \Lambda(\varphi, k, f_I^-, f_D^-) G_I(f_I^-, f_I) G_D(f_D^-, f_D) p(s) df_D df_I ds d\lambda$$

– If $f_I < f_D \rightarrow$ firms compares the value of indirect exporting to the value of direct exporting and decides:

$$M_{D,3} = \int_{\lambda}\int_{-\infty}^{+\infty}\int_{0}^{f_I^*(\varphi,s,k)}\int_{0}^{f_D^*(\varphi,s,k)} \mathbb{1}(v_I \leq v_D)\Lambda(\varphi,k,f_I^-,f_D^-)G_I(f_I^-,f_I) \\ G_D(f_D^-,f_D)p(s)df_D df_I ds d\lambda$$

$$M_{I,2} = \int_{\lambda}\int_{-\infty}^{+\infty}\int_{0}^{f_I^*(\varphi,s,k)}\int_{0}^{f_D^*(\varphi,s,k)} \mathbb{1}(v_I > v_D)\Lambda(\varphi,k,f_I^-,f_D^-)G_I(f_I^-,f_I) \\ G_D(f_D^-,f_D)p(s)df_D df_I ds d\lambda$$

The overall mass of indirect exporters is $M_I = M_{I,1} + M_{I,2}$ and the total mass of direct exporters is $M_D = M_{D,1} + M_{D,2} + M_{D,3}$. The total mass of exporters $M_X = M_I + M_D$. Since $f_N = f_N^* = 0$ all firms are active in their domestic market and thus, $M = \mu$ and $M^* = \mu^*$.

Mass of the firms in every state $(\varphi, s, k, f_I, f_D)$ evolves following:

$$m(\varphi,s',k',f_I',f_D') = (1-\delta)\int_{-\infty}^{+\infty}\int_{0}^{+\infty}\int_{0}^{+\infty} p(s')Q_I(f_I,f_I')Q_E(f_D,f_D') \\ m(\varphi,s,k,f_I,f_D)dsdf_I df_D \tag{10}$$

where $k' \in \{k^{\gamma_I}, k^{\gamma_D}, (1-\delta_c)k\}$ and depending on the exporting decision of the firm, it is equal to one of the elements of the set. The mass of entrants is given by:

$$m(\varphi,s,k_0,f_I,f_D) = \mu_e F(\varphi)H(s)\hat{G}_I(f_I)\hat{G}_D(f_D)$$

where $F(\varphi)$ is the distribution from which new entrants draw their productivity, $H(s)$ is the distribution of the *i.i.d.* shocks to foreign demand, and $\hat{G}_I$ and $\hat{G}_D$ are the long-run probabilities of G_I and G_D.

Given prices $\{p_N(\varphi), p_I(\varphi), p_D(\varphi), p_N^*(\varphi), p_I^*(\varphi), p_D^*(\varphi)\}$, aggregate price indexes, average profits, and tariff revenues $\{P, \pi, P^*, \pi^*, T, T^*\}$, and wages $\{w, w^*\}$, a stationary equilibrium is described by the probability mass function $m(\varphi, s, k, f_I, f_D)$, the domestic production, indirect, and direct exporting decisions of the firms $d_N(\varphi)$, $d_I(\varphi, s, k, f_I, f_D)$, and $d_D(\varphi, s, k, f_I, f_D)$ in the home country and analogous decisions of the firms in the foreign country; domestic quantities and indirect and direct exporting quantities $q_N(\varphi)$, $q_I(\varphi, s, k)$, and $q_D(\varphi, s, k)$ for the firms of the home country and the quantity decisions for the firms of the foreign country; and consumers consumption such that in both home and foreign country:

1. The representative consumer is maximizing her consumption: c must satisfy equation 4

2. Firms are optimizing: given equilibrium values, $p_N(\varphi), p_I(\varphi), p_D(\varphi)$ solve the firm's problem in equations 6, 7,8, and 9

3. Aggregate mass of operating firms M is equal to the total mass of the firms at the home country μ and equal to : $M = M_{NX} + M_X$

4. The mass function m satisfies the rule in equation 10

5. The labor market clears:

$$L = \int_{\varphi_{min}}^{+\infty}\int_{-\infty}^{+\infty}\int_{k_0}^{1}\int_{0}^{+\infty}\int_{0}^{+\infty} m(\varphi,s,k,f_I,f_D)\big[d_I(\varphi,s,k,f_I,f_D)\big(\tau_I q_I(\varphi,s,k)/\varphi + f_I\big)+ d_D(\varphi,s,k,f_I,f_D)\big(\tau_D q_D(\varphi,s,k)/\varphi + f_D\big) + d_N(\varphi)\big(q_N(\varphi)/\varphi + f_N\big)\big] df_D df_I dk ds d\varphi$$

6. Goods market clears: $Y = wL + T + \Pi$

7. Wage in the foreign country is normalized to 1 and wage in the home country is pinned down by balance of trade. Trade between home and foreign country balances every period:

$$\int_{\varphi_{min}}^{+\infty}\int_{-\infty}^{+\infty}\int_{k_0}^{1}\int_{0}^{+\infty}\int_{0}^{+\infty} m(\varphi,s,k,f_I,f_D)\big[d_I(\varphi,s,k,f_I,f_D)p_I(\varphi)q_I(\varphi,s,k)+ d_D(\varphi,s,k,f_I,f_D)p_D(\varphi)q_D(\varphi,s,k)\big] df_D df_I dk ds d\varphi =$$
$$\int_{\varphi_{min}}^{+\infty}\int_{-\infty}^{+\infty}\int_{k_0}^{1}\int_{0}^{+\infty}\int_{0}^{+\infty} m^*(\varphi,s,k,f_I,f_D)\big[d_I^*(\varphi,s,k,f_I,f_D)p_I^*(\varphi)q_I^*(\varphi,s,k)+ d_D^*(\varphi,s,k,f_I,f_D)p_D^*(\varphi)q_D^*(\varphi,s,k)\big] df_D df_I dk ds d\varphi$$

4 Calibration

I parameterize the model so that it replicates the empirical observations documented in Section 2. I then run a set of simulations to address some important questions: How much is the contribution of indirect exporting to the gains from trade in Vietnam? By how much do conventional trade models over/underestimate the welfare gains of trade liberalization when they do not account for indirect exporting?

I match moments of three types: average export intensities of direct exporters based on exporting history, the share of exports that is carried indirectly for large firms, and the transition probabilities of firms summarized in Table 2 and Table 3. Since each row of the transition matrix sums up to one, I target two moments from each row. Overall, I

choose 17 moments that characterize the dynamic behavior and export-to-sales ratio of small and large firms and the share of indirect exports for large firm.[11]

4.1 Parameterization

I divide the parameters of the model into two sets. A set of parameters is determined outside of the model and the other set is estimated using simulated method of moments. In this section, I discuss how I choose parameters in the former set.

Every period in the model is one year. The average real lending rate in Vietnam during 2005 to 2015 is 7.4 percent.[12] I use the producer price index to deflate the nominal lending rates. In the steady state, the real interest rate is equal to $\frac{1-\beta}{\beta}$. Thus, $\beta = 0.93$. Due to the lack of product-level data, I am unable to estimate the elasticity of substitution between varieties. Therefore, I follow Broda and Weinstein (2006) that estimate the elasticity of substitution and set $\sigma = 7.49$. The tariff rate that firms of the foreign country face is set equal to the simple average tariff on manufacturing products imported to Vietnam between 2005 and 2015.[13] While the tariff rate has been reducing over these year, the average rate is around 8.13 percent. The tariff rate that firms of the home country face when they export is set to the weighted average of the tariff rates that the top four export destination of Vietnam set on the manufacturing products that are imported to their countries. US, China, Japan, and South Korea have been the destination to nearly 50 percent of Vietnamese exports in 2015 and the weighted average of the tariff rate of these countries is around 4.67 percent.[14] Table 8 reports the value and source of the parameters that are set outside of the model.

Table 8: Parameters determined outside of the model

Parameter	Value	Source
β	0.930	Average observed interest rate between 2005 to 2015
σ	7.490	From Broda and Weinstein (2006)
τ_{tr}	0.081	Average tariff rates of Vietnam on imported manufacturing products from 2005 to 2015
τ^*_{tr}	0.047	Average tariff rates of Vietnam's 4 major export destinations on imported manufacturing products from 2005 to 2015[a]

Notes: This table summarizes the first stage of the calibration for parameters that are directly taken from the data or the literature.

[a]U.S., China, Japan, and South Korea

I discretize the productivity of the firms using the domestic sales of firms from the VES.

[11]The data has missing observations for the value of indirect exporting for small firms.
[12]It is the bank rate that meets the short- and medium-term financing needs of the private sector.
[13]I use the data provided by the WTO Tariff Analysis Online facility.
[14]The average tariff rate of each country is weighted by the Vietnamese exports share to that country.

This dataset covers the universe of registered firms in Vietnam. I pool the data from 2012 to 2015 together and divide firms into bins based on their domestic sales. Then, I use the median domestic sales in each bin and the relationship between sales and productivity in the model to compute the corresponding productivity for each bin.

4.2 Calibration Strategy

The second set of the parameters of the model is calibrated jointly. The vector of parameters is $\Gamma = (\psi_{If}, \psi_{Df}, \rho, \sigma_f, \tau_I, \tau_D, \sigma_\epsilon, \delta, \gamma_I, \gamma_D, \delta_c, k_0)$. These parameters govern the distribution of the fixed costs of direct and indirect exporting, the per-unit costs of indirect and direct exporting, the distribution of the *i.i.d.* shocks to demand, and the rates of customer accumulation of indirect and direct exporting, the customer accumulation depreciation rate, and the initial share of foreign demand available to the firms. I set the cost of operating domestically, $f_N = 0$, since the decision of producing domestically is not the primary focus of the paper.

To obtain the vector of parameters, I search the parameter space to solve the following problem

$$M(\Gamma) = \min_{\Gamma} \Big(M_m(\Gamma) - M_d\Big)' W \Big(M_m(\Gamma) - M_d\Big)$$

Γ is the vector of parameters; M_d is the vector of moments from data; $M_m(\Gamma)$ is the vector of simulated moments computed from simulating the model; and W is the weighting matrix that is set to identity matrix.

The model does not admit a one-to-one mapping of each parameter to each moment. Thus, the parameters are jointly identified in two stages. In the first stage, I do a global grid search on the parameter space using a particle swarm method to find an appropriate initial guess. In the second stage, I use a derivative-free algorithm to search the parameter space starting from the local minima found in the first stage.

Table 9 reports the values of the calibrated parameters and their interpretation. Given the estimates for ψ_{If} and ψ_{Df}, the mean of the fixed costs of indirect and direct exporting are 1.851 and 6.915, respectively.[15] Thus, the mean of the fixed cost of indirect exporting is 0.27 of that of direct exporting. The average indirect and direct exporters spend 51.2 and 29.9 percent of their revenues on the fixed cost of exporting. The variable cost of direct exporting (iceberg cost) is 1.236. The variable cost of indirect exporting is equal to 1.499 and consists of the iceberg cost plus the per-unit cost of relabeling, repackaging, assembling, and storing.

The share of foreign demand that is available to firms upon entry into foreign markets is

[15] Fixed costs are in units of labor.

$k_0 = 0.224$. This is close to the estimate in Ruhl and Willis (2017) that finds this number to be 0.258. $\delta_c = 0.624$ is the depreciation rate of the share of foreign demand that is available to a firm. Fitzgerald, Haller, and Yedid-Levi (2016) estimate this number of be 0.700 annually. This number is also in line with what is found in the advertising literature summarized in Bagwell (2007).

Table 9: Values of parameters determined by joint estimation

Parameters	Value	Interpretation
ψ_{Df}	0.894	mean of the fixed cost of direct exporting : 6.915
ψ_{If}	-0.424	mean of the fixed cost of indirect exporting : 1.851
ρ	0.941	persistence of the dist. of fixed costs
σ_f	1.442	standard dev. of the dist. of fixed costs
τ_D	1.236	ice-berg cost : 0.236
τ_I	1.499	per-unit intermediary cost : 0.263
σ_ϵ	1.898	standard dev. of the dist. of the *i.i.d.* shocks to demand
δ	0.050	share of firms that exit due to an exogenous shock
γ_I	0.650	takes ∼10 years for an indirect exporter to reach entire foreign demand
γ_D	0.385	takes ∼5 years for a direct exporter to reach entire foreign demand
k_0	0.224	initial share of foreign demand available to firms
δ_c	0.624	depreciation rate in the share of foreign demand

Notice that since γ_D is less than γ_I, foreign demand grows faster after a period of direct exporting.

5 Results

In Subsection 5.1, I show that the calibrated model generates moments that are consistent with the observations documented in Section 2. Using the model, in Subsection 5.2 and Subsection 5.3, I answer the two following questions, respectively.

- What share of the gains from trade in Vietnam is generated by indirect exporters?
- By how much do trade models mismeasure the gains from trade liberalization when they do not account for indirect exporting?

5.1 Dynamics of Indirect Exporting

Columns 2 and 3 of Table 10 report the moments from the data and the calibrated model. The model correctly captures the facts documented in Section 2. First, firms with indirect exporting experience have a higher chance of becoming direct exporters in the upcoming periods compared to non-exporting firms. For small firms, the probability of exporting directly is 0.006 and 0.089 for firms without and with indirect exporting experience, respectively. These numbers for large firms are 0.032 and 0.092 for firms

without and with indirect exporting experience, respectively. Second, among new direct exporters, firms with indirect exporting experience, on average, have a higher export-to-sales ratio compared to firms without the experience. The average export-to-sales ratio of small new direct exporters is 0.399 and 0.600 for firms that did not export and firms that exported indirectly in period $(t-k)$. The average export-to-sales ratio of large new direct exporters without and with indirect exporting experience are 0.473 and 0.549. While the model matches the dynamic moments of small and large firms and the average export intensity of small firms well, it cannot quantitatively match the average export intensity of large firms without exporting experience. However, the model still generates higher export intensities for new direct exporters with indirect exporting experience. Finally, the calibrated model implies indirect exporting is less persistent than direct exporting. The probability of remaining an indirect exporter for small firms is 0.734 and 0.811 for large firms. These probabilities increase to 0.823 and 0.854 for direct exporters.

Table 10: Baseline model fit

Moments	Target	Baseline model
Large firms		
probability of moving from domestic to indirect	0.045	0.032
probability of moving from domestic to direct	0.033	0.032
probability of remaining indirect	0.790	0.823
probability of moving from indirect to direct	0.102	0.092
probability of moving from direct to indirect	0.023	0.074
probability of remaining direct	0.936	0.854
average export intensity of domestic to direct	0.301	0.473
average export intensity of indirect to direct	0.544	0.549
share of export volume carried indirectly	0.118	0.125
Small firms		
probability of moving from domestic to indirect	0.007	0.008
probability of moving from domestic to direct	0.005	0.006
probability of remaining indirect	0.726	0.734
probability of moving from indirect to direct	0.074	0.089
probability of moving from direct to indirect	0.067	0.075
probability of remaining direct	0.835	0.811
average export intensity of domestic to direct	0.388	0.399
average export intensity of indirect to direct	0.556	0.600

Notes: The data statistics are computed using Vietnamese SME and WB Surveys.

Furthermore, Table 11 summarizes the long-run behavior of the transition probabilities. The share of indirect exporters is lower than the share of direct exporters for both small and large firms. Matching the long-run shares of firms in each exporting mode quantitatively requires very small differences between the transition matrices computed from the data and the calibrated model. While the model can generate lower shares of in-

direct exporters for small and large firms and predicts the share of small firms in each exporting mode well, for large firms it underestimates the share of direct exporters in the long-run.

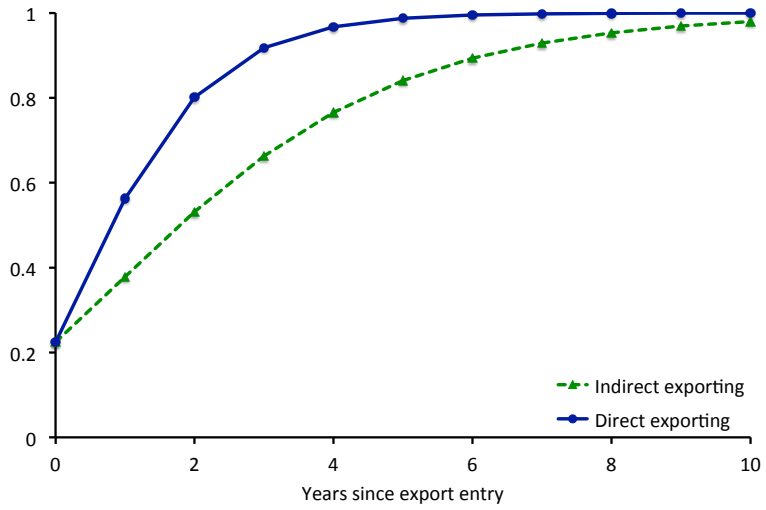
Table 11: Long-run behavior of transition matrices

	Domestic Only	Indirect exporting only	Direct exporting
Small firms	0.923/0.915	0.034/0.037	0.043/0.048
Large firms	0.423/0.549	0.139/0.203	0.439/0.248

The statistics from the data are in black and those of the model are in blue.

Figure 2 plots the evolution of the share of the foreign demand available to the exporters. The blue solid line depicts the share of foreign market accessibility for a firm that remains a direct exporter for 10 years in a row. The dashed green line illustrates the same statistic for a firm that exports indirectly for 10 years in a row. Direct exporting expands the share of foreign demand available to firms at higher rates compared to indirect exporting. After five years, nearly, the entire foreign demand becomes available to direct exporters. This result is in line with the empirical finding of Ruhl and Willis (2017) that document the export-to-sales ratio of new exporters grows for five years before reaching its average value. Indirect exporters, however, must export for ten years to gain access to the entire foreign demand. Demand for firms that switch between indirect and direct exporting grows at rates between the blue and the green lines. Independent of the exporting technology chosen in each year, the evolution of foreign demand is strictly increasing.

Figure 2: Share of foreign demand available to indirect and direct exporters



In Tables 12, I compare the impact of indirect exporting on the probability of direct exporting in the model and the data. Since the model does not feature ownership type, different industries, or aggregate shocks, I only control for the size of the firms (notice that in the model the revenue in the domestic market is only a function of the productivity of the firm). The model performs relatively well in matching the impact of indirect exporting

in period $(t-k)$ on the probability of exporting directly in period t. The coefficients of indirect exporting in the data and in the model for small firms are 0.081 and 0.108, and for large firms are 0.110 and 0.163, respectively.

Table 12: Regressions in the model and data

	— Small firms —		— Large firms —	
$P(\text{D}(\text{dir}_{j,t})=1)$	Data	Model	Data	Model
$1.(ind_{j,(t-k)})$	0.0806***	0.1080***	0.1103*	0.1631***
	(0.0070)	(0.0020)	(0.0550)	(0.0003)
$\log(emp_{j,(t-k)})$	0.0170***	0.0002	0.0549**	0.0497***
	(0.0010)	(0.0001)	(0.0167)	(0.0006)
Observations	10,358	2,499,576	308	1,690,778
R-Squared	0.1112	0.0982	0.3635	0.1493

Notes: The dependent variable is a dummy that takes the value 1 if firm j is a direct exporter in period t and 0 otherwise. $D(ind_{j,(t-k)})$ is an indicator variable that is 1 if firm exported indirectly and 0 if the firm did not export in period $(t-k)$. $\log(emp_{j,(t-k)})$ is the log of number of employees of firm j. The constant for each regression is suppressed. Significance: $^{***}p<0.001$; $^{**}p<0.01$; $^{*}p<0.05$.

Table 13 reports the impact of indirect exporting experience on the export-to-sales ratio of new direct exporters. For small firms, the model performs well (0.147 in the data versus 0.152 in the model). On the other hand, the model underestimates the impact of indirect exporting on the export intensity of new, large direct exporters. This is mainly because the model cannot generate low enough export-to-sales ratio for new direct exporters without any exporting experience. Thus, the difference between direct exporters with and without indirect exporting experience becomes smaller than the value observed in the data.

Table 13: Regressions in the model and data

	— Small firms —		— Large firms —	
$\frac{\text{exp}}{\text{sales}}_{j,t}\|\{\text{D}(\text{dir}_{j,t})=1\}$	Data	Model	Data	Model
$1.(ind_{j,(t-k)})$	0.1465***	0.1522***	0.2561*	0.0647***
	(0.0084)	(0.0150)	(0.1088)	(0.0075)
$\log(emp_{j,(t-k)})$	-0.0114	0.0423	-0.0188	0.1832***
	(0.0383)	(0.0524)	(0.0335)	(0.0095)
Observations	102	4,575	51	35,529
R-Squared	0.3514	0.1384	0.3451	0.1010

Notes: The dependent variable is the export intensity of new direct exporters. $D(ind_{j,(t-k)})$ is an indicator variable that is 1 if firm exported indirectly and 0 if the firm did not export in period $(t-k)$. $\log(emp_{j,(t-k)})$ is the log of number of employees of firm j. The constant for each regression is suppressed. Significance: $^{***}p<0.001$; $^{**}p<0.01$; $^{*}p<0.05$.

The main force in the model that generates patterns consistent with the empirical findings is customer accumulation. This mechanism aims to explain why indirect exporters have

a better performance in subsequent years in foreign markets compared to non-exporters. Customer accumulation implies that new exporters do not have access to the entire foreign market initially and the fraction of the market available to them grows over time. Thus, firms that do not have high productivity and cannot afford the high fixed cost of direct exporting start selling in international markets by exporting indirectly and, as the share of foreign demand available to them grows, some eventually find it optimal to export directly. In Appendix D, I investigate the implications of a model without customer accumulation that features persistent foreign demand shocks. I find that the model cannot match the increase in the probability of exporting directly for firms with indirect exporting experience. Furthermore, the model cannot generate any difference between the average export intensity of new direct exporters with and without indirect exporting experience.[16]

5.2 Gains from Indirect Exporting

In this subsection, I investigate the importance of the availability of indirect exporting on the welfare, the share of exporters, and the export volume. To do so, I set the fixed cost of indirect exporting to an arbitrary high number. Since the fixed and the variable costs of indirect exporting are now both higher than those of direct exporting, indirect exporting is strongly dominated by direct exporting and no firm chooses to utilize this exporting technology. In this scenario, some firms that were indirect exporters switch to direct exporting and the rest only produce for domestic markets. Thus, the share of exporters drops compared to the baseline model (0.156 versus 0.261). The export volume drops by 11.1 percent. Finally, the welfare which is computed as the real income of the representative household contracts by 1.3 percent. When indirect exporting is not utilized, the export volume shrinks and the demand for labor declines. Thus, wages in the home country decrease. Lower share of exporters reduces the average profits made by the firms in the foreign market. Therefore, in absence of indirect exporting, the real income of the households decreases. Note that the gain from indirect exporting computed above is a lower bound because I consider firms that export both indirectly and directly as direct exporters in Section 2. The second column of Table 14 summarizes the implications of unavailability of the indirect exporting channel.

The third of column of Table 14 represents the analogous result when direct exporting is unavailable. Therefore, the share of gains from trade that can be attributed to indirect

[16]The model that utilizes a Bayesian learning mechanism cannot generate patterns consistent with the empirical findings. In this alternative model, firms learn about their true (unobserved) foreign demand quickly and do not change their exporting mode as they gain exporting experience. The calibration results for this model is available upon request.

exporting is 17.8 percent.[17] Note that this is the lower bar for the gains from indirect exporting since the firms that export indirectly and directly in the same year are marked as direct exporters. To measure the total gains from trade, I set the fixed costs of indirect and direct exporting to arbitrary large numbers. Thus, the home and the foreign country do not trade anymore. The real income of the Vietnamese household would be 7.80 percent lower in absence of trade between the two countries.

Table 14: Implications of unavailability of the indirect and direct exporting channels

	No Indirect Exporting	No Direct Exporting	No Exporting
Share of exporters (pp.)	−10.5	−10.5	−26.1
Export volume	−11.1%	−74.1%	−100.0%
Real income	−1.3%	−6.0%	−7.8%

Note: The change in the share of exporters is reported in percentage points.

5.3 Welfare Gains from Bilateral Trade Liberalization

In this section, I measure the welfare gains from a bilateral trade liberalization between the home and the foreign country. I assume that both countries lower the tariff rates to zero. Further, I compare the implications of trade liberalization in the baseline model to a dynamic model without indirect exporting and find that a model without indirect exporting overstates the welfare gains from trade liberalization.

5.3.1 Welfare Gains from Trade Liberalization in the Baseline Model

The welfare is computed as the real income of the representative household of the home country. Using the budget constraint in Equation 3:

$$C_t = \frac{Y_t}{P_t} = \frac{w_t L + T_t + \Pi_t}{\left(\int_{\Omega_t} e^{s_t} p_t(\varphi)^{1-\sigma} d\varphi \right)^{\frac{1}{1-\sigma}}}$$

As a result of a bilateral trade liberalization, the tariff revenues reimbursed to the households drop to zero. On the other hand, incumbent exporters export more and new firms start to export. The share of exports in total production increases and wage in the home country increases. Removing the tariff barriers lowers the prices of all imported products, increases the set of available products, and lowers aggregate price index in the home country. Prices of the domestic goods increase due to higher wage and the share of expenditure on domestic products decreases. Taken together, the total nominal income

[17] While the total gains from trade is higher than the sum of the gains from indirect and direct exporting, I use the latter two values to compute the share of gains from trade that can be attributed to indirect exporting.

of the representative household decreases due to elimination of tariff revenues and lower average profits. However, aggregate prices index drops more and thus the real income increases. Table 15 summarizes the results.[18,19]

Table 15: Implications of a Bilateral Trade Liberalization in the Home Country

	Changes in the model
Share of indirect exporters (pp)	0.96
Share of direct exporters (pp)	1.04
Share of exporters (pp)	2.01
Total export volume	35.02%
Relative wage	0.50%
Aggregate price index	−3.69%
Wage+profit+tariff revenue	−2.77%
Real income	0.96%

Notes: The first three rows report the percentage points change in the share of exporters.

5.3.2 Welfare Gains from Trade Liberalization in a Dynamic Model without Indirect Exporting

When indirect exporting is not considered as an exporting channel, firms that utilize this exporting technology are either misidentified as direct exporters or non-exporters. To be more precise, customs data records the exporting activity of the firms that appear at the borders of a country. However, indirect exporters are firms that sell their products domestically to trade intermediaries that ultimately export the products on their behalf. This means indirect exporters do not show up in customs data. Thus, the customs data contains direct exporters and the exporting intermediaries but classifies indirect exporters as non-exporters. On the other hand, datasets similar to the VES that record the exporting activities of all firms above a certain size, identify indirect exporters as exporters but classify them as direct exporters. That is because, in these surveys, firms are not asked about how they export. Notice that, no matter whether indirect exporters are misidentified or not, the export volume does not change and is perfectly observed.

Since customs data is the formal dataset of each country that records all export and import transactions, I compare the welfare implications of trade liberalization in the baseline model to a model that uses only customs data and, hence, misidentifies indirect

[18]This model departs from Arkolakis, Costinot, and Rodríguez-Clare (2012) since it allows for tariff revenues to be reimbursed to the households and firms' productivity does not have a Pareto distribution. This is however independent of mismeasuring the gains from trade liberalization.

[19]This model follows Chaney (2008) and assumes a fixed mass of firms enters every period. This means the average profit is non-zero, trade liberalization does not generate any entry and exit, and the aggregate productivity does not increase due to the reallocation of resources.

exporters as non-exporters. I revisit the SME and WB Surveys and I measure moments that represent the dynamic behavior of firms when indirect exporters are misidentified as non-exporters. Table 16 reports the transition matrices and average export-to-sales ratio of the large and small firms if only direct exporters are considered to be exporters.

Table 16: Transition matrix: Indirect exporters are considered to be non-exporters

	— Large firms —			— Small firms —		
$(t-1)/t$	Domestic	Exporting	Exp/Sales	Domestic	Exporting	Exp/Sales
Domestic	0.954	0.046	0.369	0.993	0.007	0.445
Exporting	0.065	0.935	0.708	0.162	0.838	0.645

Notes: Exporters are the set of firms that export their products directly to the destination country. Indirect exporters are considered to be non-exporters. Columns 2 to 4 report the export dynamics and average export intensity of large firms and columns 5 to 7 report those of small firms.

To study the implications of a trade liberalization, I eliminate the indirect exporting channel in the model and re-calibrate it to the moments in Table 16. In this scenario, the total export volume is still realized perfectly. The share of the exporting firms, however, is underestimated and is equal to the share of direct exporters in the baseline model. To ensure that the welfare estimates of the two models are comparable, I add the export volume and the share of direct exporters in the baseline model (prior to trade liberalization) as the moments to match in the model without indirect exporting. Table 17 summarizes the calibration results of the model without indirect exporting.

Table 17: Calibration results of the model with no indirect exporting technology

Moments	Target	Model	Parameters	Value
Large firms				
probability of remaining a non-exporter	0.954	0.961	ψ_f	1.225
probability of remaining an exporter	0.935	0.898	ρ	0.937
average export intensity of new exporters	0.369	0.578	σ_f	1.540
average export intensity of existing exporters	0.708	0.589	τ	1.096
Small firms				
probability of remaining a non-exporter	0.993	0.991	σ_ϵ	1.312
probability of remaining an exporter	0.838	0.818	γ	0.666
average export intensity of new exporters	0.445	0.490	k_0	0.191
average export intensity of existing exporters	0.645	0.585	δ_c	0.321
Baseline model				
share of exporters	0.143	0.148	δ	0.066
export volume	0.485	0.480		

Note: This table reports the moments computed from the data and the fit of the model without indirect exporting. The last two columns summarize the jointly calibrated parameters.

In the model without indirect exporting, a smaller share of exporters export the same

volume as in the baseline model. Thus, the per-unit cost of exporting, τ, is lower than the per-unit cost of direct exporting τ_D in the baseline model (1.096 versus 1.236).

In both models, due to trade liberalization, the real income of the representative household increases, but not equally. In the model without indirect exporting, the variable cost of exporting is estimated to be significantly lower than that of the baseline model. In Appendix E, I show that, under a few simplifying assumptions, the aggregate price index is non-decreasing and concave in variable costs of exporting. This means x percentage points drop in the variable costs of exporting results in a larger drop in the aggregate price index for lower levels of τ. Therefore, trade liberalization of the same size, lowers the aggregate price index more in the dynamic model without indirect exporting. While the total income of the household drops in both models, the larger drop in the aggregate price index in the model without indirect exporting results in higher welfare gains. Table 18 summarizes the results.

The curvature of the aggregate price index with respect to the variable cost of exporting matters for the size of the mismeasurement. Equation 14 shows that elasticity of substitution between varieties, σ, plays a crucial role in the size of the second derivative of the aggregate price index with respect to variable costs of exporting. In Section 5.4, I evaluate the impact of different values of σ on the welfare gains from trade liberalization in the models with and without indirect exporting.

Table 18: Implication of trade liberalization in the baseline model and a model without indirect exporting

	Baseline model	No indirect exporting
Share of exporters (pp)	2.01	1.29
Value of total exports	35.02%	30.42%
Aggregate price index	−3.69%	−4.06%
Wage+profits+tariff rev.	−2.77%	−2.25%
Real income	0.96%	1.88%

Notes: The table compares the steady states prior and after trade liberalization in the two models. The change in the share of exporters is reported in percentage points.

5.4 Robustness Checks

5.4.1 Persistence of the Fixed Cost Distributions

In the baseline model, I assume the distribution of the fixed cost of indirect and direct exporting have equal persistence. Thus, I cannot match the persistence of direct exporting very well. To insure that underestimating the persistence of direct exporting does not impact the welfare estimates, I re-calibrate the baseline model and allow the $AR(1)$

processes from which the fixed costs of indirect and direct exporting are drawn to have different persistence. Table 19 summarizes the performance of the model. This model performs better than the baseline model is matching the probability of remaining in indirect and direct exporters for small and large firms. The persistence of the fixed cost of indirect and direct exporting are estimated to be 0.927 and 0.944, respectively. The variable costs and mean of the processes of fixed costs of indirect and direct exporting are very similar to the estimates from the baseline model.

Given the new set of parameters, I study the welfare gains from trade liberalization. In this model, the real income of the representative household increase by 0.90 percent which is close to the estimates from the baseline model (0.96 percent). This exercise shows that while adding extra parameters enhances the quantitative performance of the model, the impact on estimating the welfare gains is negligible.

Table 19: Fit of the model with different persistence for the fixed costs of indirect and direct exporting

Moments	Target	model	Parameters	Value
Large firms				
probability of moving from domestic to indirect	0.045	0.039	ψ_{Df}	0.900
probability of moving from domestic to direct	0.033	0.028	ψ_{If}	-0.509
probability of remaining indirect	0.790	0.807	ρ_{Df}	0.944
probability of moving from indirect to direct	0.102	0.083	ρ_{If}	0.927
probability of moving from direct to indirect	0.023	0.061	σ_f	1.545
probability of remaining direct	0.936	0.876	τ_D	1.450
average export intensity of domestic to direct	0.301	0.503	τ_I	1.189
average export intensity of indirect to direct	0.544	0.544	σ_ϵ	1.455
share of export volume carried indirectly	0.118	0.125	δ	0.058
			γ_D	0.556
Small firms			γ_I	0.423
probability of moving from domestic to indirect	0.007	0.008	k_0	0.237
probability of moving from domestic to direct	0.005	0.007	δ_c	0.563
probability of remaining indirect	0.726	0.718		
probability of moving from indirect to direct	0.074	0.073		
probability of moving from direct to indirect	0.067	0.050		
probability of remaining direct	0.835	0.853		
average export intensity of domestic to direct	0.388	0.421		
average export intensity of indirect to direct	0.556	0.542		

Notes: The data statistics are computed using Vietnamese SME and WB Surveys. The last two columns report the jointly estimated parameters.

5.4.2 Elasticity of Substitution

The elasticity of substitution between varieties impacts the welfare gains from trade liberalization. As σ becomes smaller, the curvature of the aggregate price index with respect to variable cost of exporting reduces and mismeasuring the variable costs of exporting becomes less important in estimating the welfare gains from trade liberalization.

In the baseline model, I use the estimates of Broda and Weinstein (2006) and set $\sigma = 7.49$. In this exercise, I investigate the mismeasurement in welfare gains at $\sigma = 4$. Results summarized in Table 20 demonstrate that although the welfare gains from trade liberalization are still overestimated in the model without indirect exporting, the size of mismeasurement has dropped.

Note that the gains from trade liberalization are higher at lower elasticity of substitution. That is mainly because households value having access to a higher number of varieties more when varieties are not highly substitutable.

Table 20: Implication of trade liberalization at lower level of elasticity of substitution

	Baseline model	No indirect exporting
Share of exporters (pp)	1.67	3.47
Value of total exports	11.95%	13.00%
Aggregate price index	−4.16%	−4.23%
Wage+profits+tariff rev.	−2.36%	−1.96%
Real income	1.81%	2.36%

Notes: The table compares the two steady states prior and after trade liberalization for $\sigma = 4$. The change in the share of exporters is reported in percentage points.

6 Counterfactual Experiments

In this section, I conduct two counterfactual experiments. In the first experiment, I explore the potential welfare implications if the government in Vietnam reinstates the export license requirement. The second experiment studies the welfare gains of subsidizing the fixed cost of indirect exporting in the presence of economies of scope in the indirect exporting technology.

6.1 Trading License Requirement

Prior to 1990, Vietnam required firms to have trade licenses if they wanted to engage in direct exporting and importing. As a result, only a small number of state-owned enterprises could access foreign markets directly. The only way for firms without licenses

to engage in trade activities was to utilize these state-owned enterprises as export and import intermediaries. This means, simply, direct exporting and importing was not an option for most of Vietnamese firms. Between 1990 and 2000, the Vietnamese government issued a series of decrees and extended the right to engage in trade activities to all firms.[20] In this experiment, I study the hypothetical scenario in which the Vietnamese government reinstates the trade license requirement. I use the calibrated model and eliminate the direct exporting channel and investigate its implications.[21]

In this scenario, firms must re-optimize their export participation problem. Not only is one exporting technology eliminated, but the continuation value of indirect exporting has dropped significantly. Previously, firms could grow large enough to switch to direct exporting. Eliminating this exporting technology limits firms to use indirect exporting which, for highly productive firms or firms with high demand, is the inferior exporting technology.

I simulate the model and find that, in absence of direct exporting, the share of exporters drops from 0.261 to 0.156. Moreover, export volume declines by 74.1 percent. The reason behind this sharp decline is that firms that were direct exporters and could benefit from low per-unit cost technology, now must export using indirect technology which has a high variable cost. When variable cost increases, the price of the variety goes up, and the demand for it reduces. Finally, the real income declines by 6.0 percent. Second column of Table 14 summarizes the impact of eliminating the direct exporting channel.

6.2 Economies of Scope

Most countries tend to promote exports among SMEs. While these export promotion policies are very common, it is not obvious if these promotions are, in fact, optimal policies. In models without any source of inefficiency, government interventions are unambiguously welfare reducing. More recently, a few studies have provided evidence that the technology that wholesalers utilize exhibits economies of scope. This means, on average, wholesalers export a higher number of products compared to manufacturing exporters. For example, see Akerman (2010).[22]

This exercise investigates the welfare implications of government export promotion policies when indirect exporting technology exhibits economies of scope. I assume the fixed

[20] This was also due to the US trade embargo against Vietnam that was lifted in 1994. What matters for this exercise is that firms did not have access to direct exporting.

[21] This experiment is different from the experiment that studies how much the welfare would be lower if Vietnam had never removed the trade license requirement in the first place.

[22] In VES, I observe the value of export of wholesalers but I do not observe it at the product-level. Thus, I am unable to separate the scale and the scope of wholesalers' exports.

cost paid by an indirect exporter, $\hat{f}_I$, is a function of the share of indirect exporters. Notice that, each firm only produces one product and each product is only produced by one firm. Thus, the share of exporting firms is equal to the scope of the products. I assume the cost paid by an indirect exporter is

$$\hat{f}_I = \frac{f_I}{(1+m_I)^\kappa}$$

where m_I is the share of indirect exporters. I re-calibrate the model and include κ as a new parameter to the set of jointly calibrated parameters.[23]

When firms make their export participation decision, they do not internalize the impact of exporting indirectly on lowering the fixed cost associated with this exporting technology. This is because each firm is of a measure zero. This implies that government subsidies to the fixed cost of indirect exporting can be welfare improving. These subsidies encourage more firms to export indirectly and, thus, the fixed cost of indirect exporting drops.

I find that under this policy, the share of indirect exporters, demand for labor, and the wage at the home country increase. Although the wage increases the impact on the labor income depends on the tax rate needed to finance the subsidies. The policy is welfare improving at low subsidy rate but it becomes welfare reducing at higher subsidy rates. This is mainly because as subsidy rates increase, labor income tax rates rise and the less productive firms start exporting indirectly but they cannot make high profits. Thus, the real income of the representative household decreases.

Given the new calibration of the model, I find that while the policy can be welfare improving, the welfare gains are negligible. The optimal subsidy rate is 0.30 which increases the real income of the representative household by only 0.01 percent.

7 Conclusion

In this paper, I use firm-level data to investigate the dynamic characteristics of indirect exporters. Then, using a dynamic trade model, I decompose the gains from trade to the gains from direct exporting and indirect exporting. I further evaluate by how much dynamic trade models that do not allow for indirect exporting mismeasure the welfare gains from trade liberalization.

First, I use Vietnamese firm-level data to document three findings about the dynamics of indirect exporting. First, I show that indirect exporting is less persistent than direct exporting. Second, indirect exporters have a higher chance of exporting directly in

[23] The calibration results are available upon request.

subsequent years compared to non-exporters. Finally, new direct exporters with indirect exporting experience have a higher average export-to-sales ratio compared to new direct exporters without the experience.

To account for these facts, I develop a dynamic trade model with heterogeneous firms, customer accumulation, and two different exporting technologies. Customer accumulation is the main mechanism that generates patterns consistent with the empirical findings of the paper. Upon entry, only a fraction of the foreign demand is accessible to the firms. As firms export, the share of the foreign market available to them grows. Thus, firms that do not have high productivity to start exporting directly, utilize indirect exporting as a means of growing demand at lower costs. Some of these firms grow large enough to export directly after a few years. The rest of the firms remain indirect exporters since they find indirect exporting to be the optimal exporting mode even after they gain access to a large fraction of the foreign demand.

I calibrate the model to the moments taken from the data and find that the mean of the fixed cost of indirect exporting is 0.27 of the mean of the fixed cost of direct exporting. Moreover, the share of foreign demand that is available to the firm grows more slowly under indirect exporting compared to direct exporting. It takes nearly 10 years to gain access to the entire foreign demand for an indirect exporter while this number is as low as 5 years for a direct exporter.

Using the calibrated model, I decompse the gains from trade to the gains from indirect and direct exporting. I find that in Vietnam, nearly 18 percent of the gains from trade are generated by indirect exporters. Furthermore, I estimate the welfare implications of bilateral trade liberalization and compare it to the estimates of a model without indirect exporting. The model without indirect exporting overestimates the welfare gains (1.88 percent versus 0.96). I find that the main source of the mismeasurement is underestimating the variable cost of exporting.

Finally, I run two counterfactual experiments. In the first one, I find that if the trade license requirement is reinstated by the Vietnamese government (this means direct exporting and importing become unavailable to nearly all firms), the share of exporters reduces by 11 percentage points; export volume drops by 74 percent; and welfare reduces by 6 percent. Finally, I show that if indirect exporting features economies of scope technology, government subsidies to the fixed cost of indirect exporting (that are financed through taxing labor income) could potentially improve welfare. However, the welfare gains are negligible.

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A Data Appendix

In this appendix, I introduce the three Vietnamese firm-level datasets that I utilize to document the empirical findings of the paper.

A.1 Small- and Medium-Sized Enterprise Survey

The first dataset I utilize is the Survey of Small and Medium Scale Manufacturing Enterprises (SMEs) in Vietnam.[24] The survey is conducted biannually from 2005 to 2015 by a collaborative effort of the Central Institute for Economic Management (CIEM), the Institute of Labor Science and Social Affairs (ILSSA) in the Ministry of Labor, Invalids, and Social Affairs (MOLISA), the Development Economics Research Group (DERG) at the Department of Economics of the University of Copenhagen, and UNU-WIDER with funding from DANIDA. This survey focuses on domestically-owned manufacturing firms that do not have more than 50 percent state capital and have no more than 300 employees. SMEs play an important role in Vietnam's economy. In 2011, SMEs accounted for 98 percent of the number of the active businesses, they hired 77 percent of the workforce, and they produced over 40 percent of the GDP in Vietnam.

The dataset consists of questions regarding the identification of the firms, general characteristics, enterprise history, owner/manager characteristics, production characteristics, sales structure and export, costs of raw materials and services, fees, taxes, and informal payments, employment, investments, networks, economic environment, and accounting information of the firms. This survey provides a better representation of unregistered and household enterprises since it covers unregistered firms as well. The most important feature of the dataset for this paper is the information about the export mode (that is indirect or direct). This survey is only conducted on the manufacturing firms and does not provide any information about the wholesale and retail sectors.

Table 21 contains the number of firms with different types of ownership that participated in each round of the survey. Around 65 percent of the firms in the survey are household-owned and only 1 percent of these firms export. Private firms account for 35 percent of the sample and 16 percent of them engage in exporting to foreign markets. Only 0.3 percent of the firms are owned by the state. The total share of exporting firms is between 6 to 7 percent over time.

Table 22 summarizes general statistics about the survey of SMEs. Compared to the universe of the firms in Vietnam, firms in the SME Survey are smaller (as expected), less

[24] Small- and Medium-Sized Enterprise Survey (2005-2015)

Table 21: Total number of firms, types of ownership, and the share of exporting firms

	Sample size	Private	Household	State-owned	Share of Exporters
2005	2,821	793	1,926	9	0.07
2007	2,635	738	1,791	14	0.06
2009	2,659	844	1,734	3	0.06
2011	2,547	839	1,635	4	0.06
2013	2,575	900	1,612	7	0.06
2015	2,649	924	1,665	10	0.07

Notes: Private firms are domestically-owned private enterprises that are registered; household firms are unregistered domestically-owned enterprises; and firms are defined to be state-owned if at least 50 percent of their capital is owned by local or central state. Share of the exporters is the sum of direct and indirect exporters.

active in the international markets, face a higher exit rates, and have higher export intensities. Among exporters, 3, 3, and 1 percent of the firms report that they have exported directly, indirectly, and both, respectively. These numbers suggest that 57 percent of the small- and medium-sized exporters have positive values of indirect exporting. Mean export-to-sales ratio for indirect exporters is lower than that of direct exporters. Finally, in line with the observations documented in the literature, indirect exporters are smaller than direct exporters in terms of the average number of employees.

Table 22: Summary statistics: averages 2005-2015

Mean number of firms per year	2,648
Mean number of employees	18
Mean age (years)	14
Share of firms that export directly	0.04
Share of firms that only export indirectly	0.03
Probability of entry into exporting	0.03
Probability of exit from exporting	0.15
Mean of direct exporting intensity conditional on exporting	0.62
Mean of indirect exporting intensity conditional on exporting	0.47
Mean direct exporter size (employee)	107
Mean indirect exporter size (employee)	47

Notes: Statistics are calculated by the author for the cleaned dataset of Vietnamese SMEs. Export intensity is computed as the total export value over total sales of the firm.

In the data, some firms report that they export directly and indirectly simultaneously. In this paper, I classify these firms as direct exporters. In appendix B, I compare the performance of these firms to firms that export only directly or indirectly and conclude that firms that report direct and indirect exporting are on average larger than direct exporters in terms of the number of employees and they have higher sales values.

A.2 World Bank Enterprise Survey

The second dataset that I use is the EBRD/World Bank Business Environment and Enterprise Performance Survey (BEEPS).[25] This panel dataset is conducted in 2005, 2009, and 2015 and contains samples of Vietnamese firms of all sizes active in different sectors. The survey includes questions about the characteristics of the firm, general information about the manager/owner, infrastructure of the firm, sales and supplies, degree of competition, crime and unofficial payments, finances, relationship with the government, labor and employment, and the performance of the firm. The major benefit of this dataset is that export mode (that is direct or indirect) of the firms is recorded and the export value for each mode is provided. Moreover, the dataset provides a better representation of large firms in the economy compared to the SME dataset. However, there are large gaps between the years in which the survey is conducted.

Average sample size, ownership type, and the share of exporting firms in the manufacturing sector of the WB Survey are reported in Table 23. Almost 81 percent of the firms are private domestically-owned and 35 percent of them export to foreign markets. Foreign-owned and state-owned firms account for 10 and 9 percent of the firms in the survey and 78 and 58 percent of these firms engage in exporting activities, respectively.

Table 23: Total number of firms, types of ownership, and the share of exporting firms in the manufacturing sector in the World Bank Survey

	Sample size	Private	Foreign	State-owned	Share of Exporters
2005	1,074	748	102	224	0.50
2009	772	631	109	32	0.41
2015	694	619	63	12	0.32

Notes: In WB Survey, firms report the percentage of the firm that is owned by domestic and foreign individuals or companies and government. Share of the exporters is the sum of direct and indirect exporters.

Table 24 provides a brief description of the characteristics of the firms in the manufacturing and wholesale sectors. Manufacturing firms tend to be larger, older, and more engaged in export activities compared to their counterparts in the wholesale sector. The summary statistics confirm that direct exporters are on average larger than indirect exporters and their export-to-sales ratios are higher. Furthermore, while 37 percent of the firms report that they have positive values of indirect exporting, only 10 percent of the total value of export has been intermediated. Thus, compared to the statistics from SME Survey smaller share of large firms use intermediaries to get access to global markets.

[25] World Bank Enterprise Survey (2005, 2009, and 2015)

Table 24: Summary statistics: Firms and exports, averages of 2005, 2009, and 2015

	Manufacturing	Wholesale
Mean number of firms per year	847	162
Mean number of employees	304	38
Mean age (years)	13	10
Share of firms that export directly	0.35	0.08
Share of firms that only export indirectly	0.11	0.04
Mean of direct exporting intensity conditional on exporting	0.67	0.48
Mean of indirect exporting intensity conditional on exporting	0.59	0.19
Share of total value of exports carried indirectly	0.10	0.29
Mean direct exporter size (employee)	630	73
Mean indirect exporter size (employee)	185	41

Notes: Statistics are calculated by the author for the cleaned WB Survey of Vietnamese firms. Firms are marked as exporters if they report positive values for share of sales that is exported directly or indirectly. Indirect and direct exporting intensities are directly reported by the firms.

A.3 Vietnamese Enterprise Survey

The last dataset I use is the Vietnamese Enterprises Survey (VES) from 2012 to 2015. The data is collected by the General Statistics Office (GSO) of the Ministry of Planning and Investment of Vietnam. This dataset covers registered firms operating in manufacturing, agriculture, construction, wholesale, retail, and services. The survey is conducted on the second or third quarter of each year and includes firms that were operating on December 31st of the previous year.

All state owned firms, firms with more than 50 percent of state capital, and firms with foreign capital investment are included in the dataset without any size restriction. While all domestic private enterprises with more than 20 employees are interviewed, the ones with less than 20 workers are chosen by random sampling. These firms are divided based on the 4 digit SIC code of their main activity and 20 percent of each group is sampled. Moreover, household businesses and unregistered enterprises are not covered in this survey.

The survey includes information about the identification of the firms, their type of ownership, number of employees, assets, liabilities, capital stock, investment decisions, sales, export and import, the location of the firm, the industry the firm belongs to, tax payments, and etc. In VES, firms do not indicate whether they are exporting their products directly or indirectly. Nonetheless, I use this dataset to estimate the productivity of the firms (output per worker) and compute aggregate variables such as the share of exporting firms and the average export to sales ratio of manufacturing firms. Moreover, I utilize this dataset to evaluate the representativeness of the SME and WB surveys.

I construct a panel dataset and restrict the sample to the firms active in manufacturing

and wholesale sector. Table 25 summarizes the sample size, type of ownership, and share of exporters for manufacturing firms across years. Across years, 74 percent of the firms in the sample are private firms that are owned domestically and 16 percent of these firms engage in export. 21 percent of the firms in the survey are firms with foreign capital investment. In line with what trade literature has documented, firms with foreign capital investment tend to export more than firms with domestic capital. In VES dataset, 71 percent of these firms export to foreign markets. State-owned and collectively-owned firms account for 5 percent of the firms in the data and 34 percent of them export. Share of manufacturing firms that export in the sample increases 17.86 percent, on average, per year, which sheds light on the high growth of the exporting patterns in Vietnam.

In the wholesale and retail sector, 95 percent of the firms are domestic private firms, 3 percent are firms with foreign capital, and 2 percent are state-owned. Moreover, only 4 percent of wholesalers export to foreign markets.

Table 25: Sample size, type of ownership, and share of exporters in manufacturing sector

	Sample Size	Private	Foreign Capital	State-owned	Share of Exporters
2012	31,805	25,258	5,069	1,478	0.22
2013	26,399	19,688	5,373	1,338	0.27
2014	24,533	17,887	5,518	1,128	0.29
2015	20,387	13,763	5,732	892	0.36

Notes: Private firms are domestically-owned private enterprises or joint stock companies with less than 50 percent of state capital; foreign capital firms are firms with 100 percent foreign capital or they are joint venture between domestic and foreign owners; and firms are defined to be state-owned if at least 50 percent of their capital is owned by local or central state.

Table 26 depicts statistics related to the data from VES. Firms in the manufacturing sector compared to those in wholesale sector are on average larger, higher share of them has foreign capital, and the overall performance of them in foreign markets in the extensive and intensive margin is better.

Table 27 summarizes the share of non-exporters, indirect exporters, and direct exporters in different sectors among large firms in Vietnam. Manufacturing of other transport equipment, manufacturing of food products and beverages, and manufacturing of chemicals and chemical products are the sectors with the lowest share of indirect exporters to total exporters. On the other hand, manufacturing of paper and paper products, manufacturing of rubber and plastic products, and manufacturing of other non-metallic mineral products are the sectors with highest share of indirect exporters to total exporters.

Table 26: Summary statistics: averages 2012-2015

	Manufacturing	Wholesale
Mean number of firms per year	25,781	28,652
Mean number of employees	191	24
Mean age (years)	8	6
Share of firms with foreign capital	0.21	0.03
Share of exporting firms	0.28	0.04
Probability of entry into exporting	0.07	0.03
Probability of exit from exporting	0.09	0.13
Mean export intensity conditional on exporting	0.41	0.32
Mean exporter size (employee)	510	93

Notes: Statistics are calculated by the author for the cleaned VES dataset. Age of the firm is computed as the difference between the year in which the survey was conducted and the reported starting year of the business. Firms are considered to be exporters if they have reported positive export values. Export intensity is computed as the total export value over total sales of the firm. Values greater than 1 and less than 1.05 are replaced by 1. Observations with export intensity greater than 1.05 are dropped.

Table 27: Share of indirect and direct exporters in different sectors

	Non-exp.	Indirect Exp.	Direct Exp.
Manufacture of food products and beverages	0.53	0.07	0.40
Manufacture of textiles	0.47	0.13	0.40
Manufacture of wearing apparel	0.28	0.18	0.54
Manufacture of leather products	0.18	0.19	0.63
Manufacture of wood and of products of wood	0.53	0.12	0.35
Manufacture of paper and paper products	0.73	0.14	0.13
Manufacture of chemicals and chemical products	0.68	0.06	0.26
Manufacture of rubber and plastics products	0.56	0.14	0.30
Manufacture of other non-metallic mineral products	0.67	0.10	0.23
Manufacture of basic metals	0.72	0.07	0.21
Manufacture of fabricated metal products	0.71	0.07	0.22
Manufacture of machinery and equipment	0.63	0.09	0.28
Manufacture of electrical machinery	0.53	0.09	0.38
Manufacture of other transport equipment	0.68	0.00	0.32
Manufacture of furniture	0.30	0.16	0.54

Notes: Statistics are calculated by the author for the cleaned WB Survey of Vietnamese firms. Sectors with less than 20 observations are not shown in the table.

B Exporting Directly and Indirectly Simultaneously

In the SME and WB Surveys, there are firms that report simultaneous direct and indirect exporting in one year. For empirical purposes, I classified these firms as direct exporters.

In this appendix, I compare these firms to firms that export only indirectly and only directly in terms of size and performance in the domestic and foreign markets and show that on average these firms are larger than both indirect and direct exporters and have higher sales values.

A firm might choose to export both directly and indirectly in the same year due to different reasons. For example, time aggregation can explain why this phenomenon happens. Since firms report their exporting activity of a whole year, some firms use one exporting technology for a part of the year and switch to the other technology for the remaining of the year; Or firms could export the same product to a market directly and to another market indirectly; Or firms could be exporting different products to the same market directly and indirectly. Since neither of the datasets specify exports in product-level, I am not able to distinguish between these scenarios. However, I hypothesize that firms that export indirectly for part of a year and directly for the rest of that year, on average, should be larger than indirect exporters and smaller than direct exporters. Next, I compare the characteristics and performance of firms that export both directly and indirectly to those that export using one of the two technologies.

Table 28 summarizes the share of firms based on the exporting technology they used in each year. Among large exporting firms, the share that exports directly and indirectly in a given year is between 0.11 to 0.14. For small exporting firms, the share varies between 0.08 to 0.28. These shares are non-trivial.

Table 28: Share of firms by exporting mode

	— Large firms —			— Small firms —		
	Indirect	Direct	Indirect & direct	Indirect	Direct	Indirect & direct
2005	0.107	0.339	0.054	0.021	0.026	0.018
2007	.	.	.	0.016	0.035	0.008
2009	0.111	0.293	0.068	0.018	0.029	0.011
2011	.	.	.	0.033	0.023	0.005
2013	.	.	.	0.033	0.024	0.007
2015	0.108	0.217	0.044	0.026	0.030	0.014

Notes: In the SME dataset firms indicate if they exported directly, indirectly, or both. WB Survey divides the total sales of each firm into national sales, indirect exports, and direct exports.

To compare the size of the firms that use both exporting technologies in the same year to other exporters, I estimate, by OLS

$$log(emp_{j,t}) = \beta_0 D(ind_{j,t}) + \beta_1 D(dir_{j,t}) + \beta_2 D(both_{j,t}) + \alpha_t + \alpha_j + \epsilon_{j,t} \tag{11}$$

Table 29: Size and sales of firms by exporting mode

	— Large firms —		— Small firms —	
$1.(ind_{j,t})$	0.137	0.261	0.170***	0.246***
	(0.095)	(0.144)	(0.035)	(0.055)
$1.(dir_{j,t})$	0.343***	0.292*	0.338***	0.311***
	(0.102)	(0.129)	(0.042)	(0.066)
$1.(both_{j,t})$	0.320**	0.523*	0.371***	0.411***
	(0.139)	(0.225)	(0.052)	(0.083)
Year FE	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes
Observations	2,534	2,495	15,867	15,807
R-squared	0.276	0.013	0.099	0.084

Notes: The dependent variable in Columns 2 and 4 is log of number of employees and in Columns 3 and 5 is the log of total sales of firms. *ind*, *dir*, and *both* are dummy variables equal to one if firm exports only indirectly, only directly, indirectly and directly, and zero otherwise. Standard errors, clustered at the firm-level, are in parentheses. $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

where $log(emp_{j,t})$ is the log of total employment of firm j in year t, $D(ind_{j,t})$ is a dummy variable equal to one if the firm exports indirectly and zero otherwise. Similarly, $D(dir_{j,t})$ and $D(both_{j,t})$ are dummy variables that take value one if firm exports directly and both directly and indirectly and zero otherwise. α_t and α_j are year and firm fixed effects.

Analogously, to compare the performance of exporting firms, I estimate

$$log(sale_{j,t}) = \beta_0 D(ind_{j,t}) + \beta_1 D(dir_{j,t}) + \beta_2 D(both_{j,t}) + \alpha_t + \alpha_j + \epsilon_{j,t} \tag{12}$$

where $log(sale_{j,t})$ is log of sales of firm j in year t. Table 29 reports the regression results. Columns 2 and 4 estimate equation 11 and columns 3 and 5 estimate equation 12 for large and small firms.

The regression results suggest that the large firms that export directly and indirectly are slightly smaller than firms that export directly but have higher sales. These firms are drastically larger and sell more when compared to indirect exporters. Among small firms, these patterns are stronger. Firms that export using both technologies are larger and sell more than direct exporters. As expected, indirect exporters are the smallest among exporters. This evidence suggests that firms that export indirectly and directly are exporting through trade intermediaries to destinations that are far from Vietnam or not easily accessible (see Ahn, Khandelwal, and Wei (2011)). This pattern can also be justified by firms that export some products directly to a destination but use intermediaries for other products.

In this paper, I limit the number of products that each firm produces to one, assume that there are only two countries in the world (home and foreign), and allow firms to choose

one exporting technology per period.

C Impact of Indirect Exporting on the Domestic Sales of the New Direct Exporters

In Section 2.4, I find that new direct exporters with indirect exporting experience have a higher average export-to-sales ratio compared to new direct exporters without exporting experience. However, this higher export-to-sales ratio can be due to lower values of domestic sales. In this section, I investigate whether indirect exporting experience impacts the domestic sales of new direct exporters. Table 30 illustrates that the impact of indirect exporting on the domestic sales of new direct exporters is not significant. Thus, the higher average export-to-sales ratio of new direct exporters with indirect exporting experience is not due to their lower domestic sales.

Table 30: Impacts of indirect exporting on the domestic sales of new direct exporters

	— Small firms —	— Large firms —
$1.(ind_{j,(t-k)})$	-0.1236	-0.6783
	(0.3005)	(0.3917)
$\log(rev_{j,(t-k)})$	0.7377***	0.9040***
	(0.1173)	(0.1605)
$\log(emp_{j,(t-k)})$	-0.0134	-0.2104
	(0.1645)	(0.2261)
$1.(owner_j)$	0.1298	-0.1378
	(0.5822)	(0.4316)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	89	41
R-squared	0.5515	0.6515

Notes: The dependent variable in each regression is log value of the domestic sales of new direct exporters in period t. This means the firms that did not export directly in period $(t-k)$. $D(ind_{j,(t-k)})$ is an indicator variable that is 1 if firm exported indirectly and 0 if the firm did not export in period $(t-k)$. The constant terms of the regressions are suppressed. Significance: $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$.

D Alternative Model: Persistent Shocks to Demand

In absence of customer accumulation in the baseline model, there is no force present in the model to generate higher probability of exporting directly for firms with indirect exporting experience or higher average export-to-sales ratio for new direct exporters with

indirect exporting experience. In this appendix, I investigate if making the foreign demand shocks to be persistent over time delivers results similar to those in presence of customer accumulation.

The model mimics the baseline model very closely. Customer accumulation is removed and firms upon entry into foreign markets have access to the entire demand. Shocks to demand in the foreign market are persistent. Analogously, firms of the foreign country face persistent shocks to the demand in the home country.

Table 31 reports the calibration results of this model. The comparison of the moments from the data and the model shows that the probability of exporting directly for firms with indirect exporting experience and firms without exporting experience is very similar. For example, for small firms the probability of exporting directly for firms without exporting experience is 0.024 and for the firms with indirect exporting experience is 0.029. Moreover, this model cannot generate higher average export-to-sales ratio for new direct exporters with indirect exporting experience. Average export intensities are the same for new direct exporters with and without indirect exporting experience (0.508 versus 0.509 for small firms). This shortcoming is not surprising. Firms start exporting indirectly or directly when they receive favorable demand shocks. While the shocks are persistent, on average, they do not become more favorable over time. This means even if indirect exporters have a good draw of fixed cost of direct exporting and switch from indirect exporting to direct exporting, the foreign demand shock, on average, does not improve. Thus, export-to-sales ratio does not increase with indirect exporting experience.

E The Relationship between the Aggregate Price Index and the Variable Costs of Exporting

In this appendix, I study how changes in the variable costs of exporting (such as trade liberalization) impact the aggregate price index. Investigating how the aggregate price index varies as a result of changes in variable costs of exporting is crucial for estimating the welfare gains from trade liberalization. For analytical simplicity, I evaluate the changes in the aggregate price index abstracting from the changes in the relative wage and the extensive margin of exporting.

$$P = \left[\int_{\Omega} e^{s} p(\varphi)^{1-\sigma} dF(\varphi)\right]^{\frac{1}{1-\sigma}} = \left[\int_{\Omega_H} p_N(\varphi)^{1-\sigma} dF(\varphi) + \int_{\Omega_F} e^{s} p_j(\varphi)^{1-\sigma} dF(\varphi)\right]^{\frac{1}{1-\sigma}} \quad (13)$$

Table 31: Fit of the model without customer accumulation

Moments	Target	Model	Parameters	Value
Large firms				
prob.of domestic to indirect	0.045	0.034	ψ_{Df}	-0.894
prob. of domestic to direct	0.033	0.043	ψ_{If}	-0.166
prob. of remaining indirect	0.790	0.816	ρ	0.909
prob. of indirect to direct	0.102	0.068	σ_f	2.288
prob. of direct to indirect	0.023	0.035	τ_D	1.145
prob. of remaining direct	0.936	0.891	τ_I	1.443
exp. intensity of domestic to direct	0.301	0.509	ρ_ϵ	0.840
exp. intensity of indirect to direct	0.544	0.510	σ_ϵ	1.553
share of indirect exports	0.118	0.096	δ	0.062
Small firms				
prob. of domestic to indirect	0.007	0.025		
prob. of domestic to direct	0.005	0.024		
prob. of remaining indirect	0.726	0.776		
prob. of indirect to direct	0.074	0.029		
prob. of direct to indirect	0.067	0.023		
prob. of remaining direct	0.835	0.835		
exp. intensity of domestic to direct	0.388	0.508		
exp. intensity of indirect to direct	0.556	0.509		

Notes: The moments summarize the share of export volume carried by indirect exporters for large firms, transition probability of large and small firms across different exporting modes, and the average export intensity of new direct exporters based on export history. The fourth and the fifth columns report the jointly estimated parameters and their values.

where $j \in \{I, D\}$. Ω is the set of varieties available in the home country; Ω_H is the subset of those varieties available that are produced domestically; and Ω_F is the subset of the varieties available that are imported. Note that in this model, the demand for the varieties that are produced domestically is not subject to shocks.

Rewrite Equation 13

$$P = \Bigg[\int_{\varphi_{min}}^{+\infty} m_H(\varphi) p_N(\varphi)^{1-\sigma} d\varphi + \int_{\varphi_{min}}^{+\infty} \int_{-\infty}^{+\infty} \int_{k_0}^{1} \int_{0}^{+\infty} \int_{0}^{+\infty} m_I(\varphi, s, k, f_I, f_D) e^s p_I(\varphi)^{1-\sigma} df_D df_I dk ds d\varphi + \int_{\varphi_{min}}^{+\infty} \int_{-\infty}^{+\infty} \int_{k_0}^{1} \int_{0}^{+\infty} \int_{0}^{+\infty} m_D(\varphi, s, k, f_I, f_D) e^s p_D(\varphi)^{1-\sigma} df_D df_I dk ds d\varphi \Bigg]^{\frac{1}{1-\sigma}}$$

$$P = \Bigg[\underbrace{\int_{\varphi_{min}}^{+\infty} m_H(\varphi) \left(\frac{w_H \sigma}{(\sigma-1)\varphi} \right)^{1-\sigma} d\varphi}_{\text{A}} + \underbrace{\int_{\varphi_{min}}^{+\infty} \int_{-\infty}^{+\infty} \int_{k_0}^{1} \int_{0}^{+\infty} \int_{0}^{+\infty} m_I(\varphi, s, k, f_I, f_D) e^s \left(\frac{w_F \hat{\tau}_I \sigma}{(\sigma-1)\varphi} \right)^{1-\sigma} df_D df_I dk ds d\varphi}_{\text{B}} + \underbrace{\int_{\varphi_{min}}^{+\infty} \int_{-\infty}^{+\infty} \int_{k_0}^{1} \int_{0}^{+\infty} \int_{0}^{+\infty} m_D(\varphi, s, k, f_I, f_D) e^s \left(\frac{w_F \hat{\tau}_D \sigma}{(\sigma-1)\varphi} \right)^{1-\sigma} df_D df_I dk ds d\varphi}_{\text{C}} \Bigg]^{\frac{1}{1-\sigma}}$$

where $\hat{\tau}_I = \frac{\tau_I}{(1-\tau_{tr}^*)}$ and $\hat{\tau}_D = \frac{\tau_D}{(1-\tau_{tr}^*)}$. As both countries lower the tariff rates, the variable costs of indirect and direct exporting decline. The first derivative of the aggregate price index with respect to variable cost of exporting[26]

$$\begin{aligned} \frac{dP}{d\hat{\tau}_I} &= \hat{\tau}_I^{-1} \Big[A + B + C \Big]^{\frac{\sigma}{1-\sigma}} B \geq 0 \\ \frac{dP}{d\hat{\tau}_D} &= \hat{\tau}_D^{-1} \Big[A + B + C \Big]^{\frac{\sigma}{1-\sigma}} C \geq 0 \end{aligned}$$

Thus, aggregate price index is weakly increasing in the variable costs of indirect and direct exporting. The second derivative of the aggregate price index with respect to variable cost of indirect exporting

$$\begin{aligned} \frac{d^2P}{d\hat{\tau}_I^2} &= -\sigma \hat{\tau}_I^{-2} \Big[A + B + C \Big]^{\frac{2\sigma-1}{1-\sigma}} B(A + C) \leq 0 \\ \frac{d^2P}{d\hat{\tau}_D^2} &= -\sigma \hat{\tau}_D^{-2} \Big[A + B + C \Big]^{\frac{2\sigma-1}{1-\sigma}} C(A + B) \leq 0 \end{aligned} \tag{14}$$

The second derivative is equal to or less than zero. This means, at higher levels $\hat{\tau}$, a drop of x percentage points in $\hat{\tau}$ results in a smaller drop in aggregate price index compared to x percentage points drop in $\hat{\tau}$ at a lower level of $\hat{\tau}$.

[26]Note that I am abstracting from the impact of the changes in the variable costs of exporting on the mass of indirect and direct exporters and the wage at home (foreign wage normalized to one). This assumption implies that the direct impact of changing the variable costs of exporting on the aggregate price index dominates the indirect effects that appear through changes in the relative wage and the mass of exporters.