

Intermediaries, Firm Heterogeneity, and Exporting Behavior

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Abstract

In this paper, we present one of the first work on the relation between firm productivity and exporting behavior in the presence of intermediaries. Using a standard trade framework à la Melitz (2003) and Chaney (2009), we find that the most productive firms have sales in the home country and also exporting directly to foreign countries, followed by firms with sales in the home country and exporting both directly and through intermediaries, by firms with sales in the home country and exporting through intermediaries, and finally by firms with sales in the home country only. These theoretical predictions are borne out in a data set of 12,679 firms in 29 developing economies during the 2002-2006 period.

Keywords: Intermediaries, Exporting Behavior, Firm Heterogeneity

JEL Codes: F12, F23, L22, D24

1 Introduction

The new new trade literature has uncovered the importance of firm-level variations, particularly firm productivity, in determining exporting behavior. A dominant theoretical explanation for exporters being generally more productive than non-exporters in this literature is the assumption of a fixed cost of exporting, under which the more productive firms self-select to become exporters.¹ What is implicitly assumed in this literature is that firms export directly by themselves to foreign countries. In reality, however, many firms, especially those in developing economies, export through intermediaries,² which may significantly reduce the costs of exporting and consequently have radical implications for the predictions of the new new trade theory.

Recently, intensive effort has been made to investigate the role of intermediaries. While much understanding has been gained regarding how intermediaries facilitate trade (e.g., Feenstra and Hanson, 2004; Antras and Costinot, 2010) and how they differ from direct exporters (e.g., Rauch and Watson, 2004; Ahn, Khandelwal, and Wei, 2011), a fundamental question remains unanswered, that is, what types of firms export through intermediaries and what types of firms export directly by themselves. This paper fills in the gap by offering a theoretical analysis of exporting behavior in the presence of export intermediaries and firm heterogeneity. Furthermore, this paper, among the first few studies, provides direct evidence on the relation between firm productivity and methods of exporting.³

Our theoretical analysis is built upon a standard trade framework: a home country plus N foreign countries, two sectors (i.e., a homogeneous good and a continuum of differentiated goods), and one production factor (i.e., labor). Production takes place in the home country, and firms can directly export to N foreign countries by incurring a fixed cost (Melitz, 2003). As in Chaney (2009), we assume that the fixed cost of direct exporting differs across foreign countries.

The departure of our model from the literature is that firms can also use intermediaries to export to foreign countries. Intermediaries can facilitate trade by helping firms search for their trading partners and by alleviating the problem of information asymmetries between the trading parties (Rubinstein and Wolinsky, 1987; Biglaiser, 1993). In this paper, we focus on how firms make exporting decision in the presence of intermediaries, instead of how intermediaries work, which has been studied in the literature (for a survey

¹For empirical evidence, see Bernard and Jensen (1995, 1999, 2004), Bernard and Wagner (1997), Clerides, Lach, and Tybout (1998), etc; for theoretical analysis, see Melitz (2003), Bernard, Eaton, Jensen, and Kortum (2003), etc.

²For example, about 80% of Japanese export and import in the early 1980s was handled by 300 trade intermediaries (Rossman, 1984). In China, at least 22% and 18% of its exports and imports, respectively, in 2005 flew through intermediaries (Ahn, Khandelwal, and Wei, 2010). In Sweden, about 15% of export came through intermediaries in 2005 (Akerman, 2010).

³The two exceptions are McCann (2013) and Abel-Koch (2011) which use firm-level data sets from the Eastern Europe and Turkey, respectively.

of this literature, see, for example, Spulber, 1996). Following Rauch and Watson (2004) and Ahn, Khandelwal, and Wei (2011), we assume that when using intermediaries to export, firms need to share a portion of their exporting revenue with intermediaries. Meanwhile, based on the findings of Blum, Claro, and Horstmann (2009), we assume that when using intermediaries to export, firms do not need to incur the fixed cost of direct exporting but a lower fixed cost of dealing with the intermediaries.⁴

Under this model setup, we can show that as a firm's productivity increases, it switches from having sales in the home country only to having both sales in the home country and exporting. Regarding the methods of exporting, as a firm's productivity increases, it starts with exporting through intermediaries, then proceeds to both direct exporting and exporting through intermediaries, and finally, to direct exporting. Moreover, as a firm's productivity increases, it starts with exporting to some foreign countries, and finally, to all foreign countries.

Next, we empirically investigate the relation between firm productivity and exporting behavior. The data comes from *Private Enterprise Survey of Productivity and the Investment Climate* (PESPIC), which is a standardized data based on a series of *The World Bank Enterprise Surveys* (WBESs) conducted by the Enterprise Analysis Unit of the World Bank. There are a total of 12,679 firms in 29 developing economies during the period of 2002-2006. PESPIC contains unique information about firms' methods of exporting, including direct exporting, exporting through intermediaries, and both. It is found that 27% of exporters use intermediaries and 11% of exporters export both directly and through intermediaries, which indicate the importance of intermediaries for exporting.

To uncover what types of firms use which exporting methods, we first compare firms along six dimensions (that is, output, employment, capital, output per worker, capital per worker, and total factor productivity). It is found that firms with both sales in the home country and direct exporting always have the highest mean value, followed by those with sales in the home country and exporting both directly and through intermediaries, then those with sales in the home country and exporting through intermediaries, and finally, those with sales in the home country only. These preliminary results are consistent with our theoretical predictions.

To further establish the relation between firm productivity and methods of exporting, we conduct a regression analysis. It is found that along with the increase in productivity, a firm switches from having sales in the home country only to having sales in the home country and exporting through intermediaries, then to having sales in the home country and exporting both directly and through intermediaries, and finally to having sales in the

⁴We also discuss alternative arrangements between exporters and intermediaries, but find that the resulting theoretical predictions regarding the relation between firm productivity and methods of exporting are not supported by the empirical regularities. See the Appendix for details.

home country and direct exporting. These findings are consistent with our theoretical prediction.

To conclude that our empirical findings are not biased due to some estimation problems, we conduct a series of robustness checks, such as addressing the endogeneity of firm productivity, focusing on a sub-sample of domestic firms only, focusing on a sub-sample of manufacturing firms only, using alternative estimation methods, and analyzing different sub-samples of countries. In all of these exercises, we find our results remain robust.

The remainder of this paper is structured as follows. The literature review is presented in Section 2. We offer a theoretical analysis of exporting behavior in the presence of intermediaries in Section 3, while in Section 4 we present empirical evidence on the relation between firm productivity and methods of exporting. The paper concludes with Section 5.

2 Literature Review

Our paper is related to an emerging literature on intermediaries and international trade.

Some studies focus on how intermediaries can facilitate international trade by helping firms search for their trading partners or by alleviating the problem of information asymmetries between the trading parties (Feenstra and Hanson, 2004; Antras and Costinot, 2011). The focus of this paper is exporting behavior in the presence of intermediaries, rather than how intermediaries work.

Rauch and Watson (2004) examine the supply of intermediaries in international trade and find that agents endowed with a large size of network become intermediaries, whereas those with a small network choose to be producers. Ahn, Khandelwal, and Wei (2011) compare the exporting behavior of intermediaries and producers who directly export to international markets, and find that in the context of China, the share of export by intermediaries to an international market is bigger when that market is more distant, smaller, or has more regulatory barriers to trade. Similar results are also found for the case of Sweden (Akerman, 2010). Meanwhile, Bernard, Jensen, Redding, and Schott (2010) use U.S. data to compare intermediaries, producers, and mixed types, and find that they specialize in different sets of goods and markets. Our paper departs from these studies by investigating what types of producers export directly and what types of producers use intermediaries for exporting, rather than comparing producers with intermediaries.

Felbermayr and Jung (2011) study the trade-off between saving the fixed costs of exporting and facing the holdup risks when using intermediaries to export. However, due to data limitation, they could only use sectorial data to examine the prevalence of exporting by intermediaries into different international markets and for different types of goods. Using Chilean exporter-Colombian importer pair data, Blum, Claro, and Horstmann (2009)

find that at least one of the trading parties is large. To explain this finding, they present a model in which there is an economy of scale in international trade and show that in equilibrium, large producers export directly, while small producers resort to intermediaries for exporting. To the best of our knowledge, this paper is among the first few studies presenting direct evidence on the relation between firm productivity and methods of exporting. Specifically, like ours, both McCann (2013) and Abel-Koch (2011) find that, as a firm’s productivity (size) increases, it switches from non-exporting to exporting through intermediaries, and finally to direct exporting. Unlike McCann (2013) and Abel-Koch (2011), we consider the possibility of a firm using both direct and indirect exporting. Meanwhile, we focus on a sample of 29 developing economies while McCann (2013) investigates the case of Eastern European countries and Abel-Koch (2011) focuses on the case of Turkey. Moreover, we present a model à la Melitz (2003) and Chaney (2009) to investigate how firm heterogeneity (in terms of productivity) influences the choice among the three types of arrangement for exporting (i.e., direct exporting only, direct exporting and exporting through intermediaries, and exporting through intermediaries only).

3 Theoretical Analysis

3.1 Model Setup

Consider the following standard trade model: $N + 1$ countries (i.e., a home country and N foreign countries), two sectors (i.e., a homogeneous good (X) produced with a constant returns to scale technology and a continuum of differentiated goods (Y) produced with an increasing returns to scale technology), and one production factor (i.e., labor).

- **Demand.** Following the literature, we take the homogeneous good (X) as a numéraire and assume the utility function for the differentiated goods (Y) to be a constant elasticity of substitution function. Then the demand function for any variety of the differentiated goods Y in country l can be derived as

$$y_l = \alpha^{\frac{-\alpha}{1-\alpha}} I_l(p_l)^{\frac{-1}{1-\alpha}} \tag{1}$$

where $l \in \{0, i\}$ is the country index, with 0 indicating the home country and $i \in \{1, \dots, N\}$ indicating a foreign country; I_l is the measure of market size in country l ; and p_l is the variety price in country l .

- **Production.** The production of the differentiated goods (Y) takes place only in the home country (Melitz, 2003). The fixed cost of production is given by f . The unit production cost is given by w/θ , where w is the wage rate in the home country and normalized to 1 hereon, and $\theta \in [0, \theta^{\max})$ is the firm-specific productivity measure drawn from a common distribution $g(\theta)$ and a cumulative distribution $G(\theta)$.

- **Domestic Sales and Exporting.** As in Melitz (2003), sales in the home country does not involve any fixed cost so that any firms with positive production always sell in the home country. Meanwhile, firms can choose to export to foreign country i either directly by themselves or through intermediaries. For the case of direct exporting, we assume that there is a fixed cost of exporting to each of the foreign countries, denoted by f_i where $i \in \{1, \dots, N\}$, as in Chaney (2009).

For the case of exporting through intermediaries, firms do not need to incur the fixed cost of direct exporting (f_i). However, it is assumed that in this case firms have to share a portion (denoted by $1 - \beta_i$, where $\beta_i \in (0, 1)$) of their exporting revenue with intermediaries.⁵ Meanwhile, there is a fixed cost of dealing with the intermediaries, which is assumed to be lower than the fixed cost of direct exporting.⁶ For ease of exposition, the fixed cost of dealing with the intermediaries is written as $\gamma_i f_i$ where $\gamma_i \in (0, 1)$.⁷ While our main analysis below is carried out under the above cost structure of using intermediaries for exporting (i.e., $\beta_i \in (0, 1)$ and $\gamma_i \in (0, 1)$), other possible cost structures will be considered in the Appendix as a robustness check.

Moreover, the transport cost for exporting the differentiated goods to a foreign country i takes the form of an iceberg cost, that is, one needs $t_i > 1$ units of final product in order to ship 1 unit to the foreign country i .

- **Firm Entry and Exit.** As in Melitz (2003), there is a large pool of potential entrants into the differentiated goods sector. While firms are ex ante identical, they will draw their productivity levels from the common distribution $g(\cdot)$ after paying a fixed cost of entry f_e , and decide whether to produce or exit. If they decide to produce, in every period, there is a probability δ that firms are forced to exit.

3.2 Equilibrium Analysis

The profit from serving the home country can be shown as

$$\pi_0 = (1 - \alpha)I_0\Theta - f, \quad (2)$$

⁵The share of exporting revenue for the intermediaries can be a result of the negotiation between firms and intermediaries as in Rauch and Watson (2004). It can also be interpreted as the forwarding charges by the intermediaries as in Ahn, Khandelwal, and Wei (2011).

⁶The lower fixed costs of dealing with the intermediaries relative to those of direct exporting can be due to the economy of scale in exporting enjoyed by the intermediaries as documented and modeled by Blum, Claro, and Horstmann (2009).

⁷Here, we do not explicitly model how intermediaries work, because the focus of this study is on how firms make exporting decisions in the presence of intermediaries. For the modeling of intermediaries, see, for example, Rubinstein and Wolinsky (1987), Biglaiser (1993), and Antras and Costinot (2011).

where $\Theta \equiv \theta^{\frac{\alpha}{1-\alpha}}$ is a monotonic transform of productivity θ . Therefore, the cutoff point of productivity is given as

$$\Theta_0 = \frac{f}{(1-\alpha)I_0}, \quad (3)$$

where firms with $\Theta \geq \Theta_0$ have positive production and sales in the home country.

To serve foreign country i , a firm can export either directly by itself or through intermediaries. The profit from direct exporting to foreign country i can be derived as

$$\pi_i^{dx} = \frac{(1-\alpha)I_i}{T_i}\Theta - f_i, \quad (4)$$

where $T_i \equiv t_i^{\frac{\alpha}{1-\alpha}}$ is a monotonic transform of transport cost t_i , whereas the profit from exporting to foreign country i through intermediaries is

$$\pi_i^{ix} = \beta_i \frac{(1-\alpha)I_i}{T_i}\Theta - \gamma_i f_i. \quad (5)$$

Denote Θ_i^{ix} as the cutoff point of productivity that $\pi_i^{ix}(\Theta_i^{ix}) = 0$ and Θ_i^x as the cutoff point of productivity that $\pi_i^{dx}(\Theta_i^x) = \pi_i^{ix}(\Theta_i^x)$.⁸ It is further assumed that:⁹

$$\beta_i > \gamma_i. \quad (\text{A.2})$$

The optimal choice for firms to serve foreign country i can be summarized in the following Lemma.

Lemma: Firms with productivity $\Theta \geq \Theta_i^x$ use direct exporting, firms with productivity $\Theta_i^x > \Theta \geq \Theta_i^{ix}$ use exporting through intermediaries, and firms with productivity $\Theta < \Theta_i^{ix}$ do not export.

Proof: See the Appendix.

⁸It is assumed that

$$\min \{\Theta_i^x, \Theta_i^{ix}; i \in \{1, \dots, N\}\} > \Theta_0. \quad (\text{A.1})$$

Note that if this condition is not satisfied, any firms with positive production will always have positive export (either directly by itself or through intermediaries) and sales in the home market. This contradicts the empirical observation that majority of firms only serve the home country and only a small portion of firms have both sales in the home country and export (Bernard, Jensen, Redding, and Schott, 2007, for the case of the United States; and Mayer and Ottaviano, 2008, for the case of seven European countries).

⁹Assumption (A.2) basically imposes an upper limit on the costs for using intermediaries to export. Intuitively, with exporting through intermediaries, firms need to give away $1 - \beta_i$ share of exporting revenue but saves $1 - \gamma_i$ fraction of the fixed cost. As long as the saving in the fixed cost outweighs the loss of exporting revenue (i.e., $1 - \gamma_i > 1 - \beta_i$ or $\beta_i > \gamma_i$), exporting through intermediaries becomes a viable choice. Otherwise, exporting through intermediaries is always dominated by direct exporting. Henceforth, we focus on the case of $\beta_i > \gamma_i$. In the Appendix, we show that our main results remain robust as long as Assumption (A.2) holds for some of the foreign countries.

To examine the exporting behavior of firms in the setting of one home country and N foreign countries, for simplicity of analysis, we assume that the ranking of Θ_i^{ix} across N foreign countries is the same as that of Θ_i^x , that is,

$$\begin{cases} \Theta_1^{ix} \leq \Theta_2^{ix} \leq \dots \leq \Theta_N^{ix} \\ \Theta_1^x \leq \Theta_2^x \leq \dots \leq \Theta_N^x \end{cases} . \quad (6)$$

In the Appendix, we relax assumption (6), that is, the ranking of Θ_i^{ix} across N foreign countries differs from that of Θ_i^x , and find that all of our results still hold.

It can be shown that as a firm's productivity increases, the firm moves from having sales in the home country only to having both sales in the home country and exporting. Meanwhile, regarding the methods for exporting, as a firm's productivity increases, it starts with exporting through intermediaries, then having both direct exporting and exporting through intermediaries (more specifically, the firm directly exports to some foreign countries and uses intermediaries to export to some other foreign countries), and finally direct exporting. Moreover, as a firm's productivity increases, it starts with exporting to some foreign countries, and finally to all foreign countries.

To summarize, we have the following proposition.

Proposition: *The most productive firms (with productivity $\Theta \geq \Theta_N^x$) have sales in the home country and also exports directly to foreign countries, followed by those (with productivity $\Theta_N^x > \Theta \geq \Theta_1^x$) having sales in the home country and exports both directly and through intermediaries, then those (with productivity $\Theta_1^x > \Theta \geq \Theta_1^{ix}$) having sales in the home country and exports through intermediaries, and finally those (with productivity $\Theta_1^{ix} > \Theta$) having sales in the home country only.*

Proof: See the Appendix.

Finally, we consider the entry decision by a representative firm. The free entry condition requires that the present value of expected profit should be equal to the fixed cost of entry (f_e), that is,

$$V \equiv \frac{E(\pi)}{\delta} = f_e, \quad (7)$$

where

$$E(\pi) = [1 - G(\Theta_0)] [\bar{\pi}_H + \chi_{IX} \bar{\pi}_{IX} + \chi_{DIX} \bar{\pi}_{DIX} + \chi_{DX} \bar{\pi}_{DX}]$$

and $\bar{\pi}_H$ is the average profit across firms from serving the home country; $\bar{\pi}_{IX}$ is the average profit from exporting through intermediaries; $\bar{\pi}_{DIX}$ is the average profit from

exporting directly and through intermediaries; and $\bar{\pi}_{DX}$ is the average profit from exporting directly. χ_{IX} is the probability of exporting through intermediaries conditional on successful entry; χ_{DIX} is the probability of exporting both directly and through intermediaries conditional on successful entry; and χ_{DX} is the probability of exporting directly conditional on successful entry.

4 Empirical Analysis

4.1 Data

Our empirical study draws on a data from the *Private Enterprise Survey of Productivity and the Investment Climate* (PESPIC). It is a standardized data based on a series of *The World Bank Enterprise Surveys* (WBESs) conducted by the Enterprise Analysis Unit of the World Bank in cooperation with local business organizations and government agencies in 68 developing economies during the period of 2002-2006.

The PESPIC is a cross-sectional data with limited time-series aspects. It is composed of two parts. One is a general questionnaire directed at the senior management seeking information about the firm, sales and suppliers, investment climate constraints, infrastructure and services, finance, business-government relations, conflict resolution and legal environment, crime, capacity and innovation, and labor relations. The other questionnaire is directed at the accounting manager, and covers various financial measures such as production, sales, expenses, total assets, and total liabilities.¹⁰

Of particular interest to our study is that this data contains information about methods of exporting, including specifically direct exporting and exporting through intermediaries, which allows us to uncover the relation between firm productivity and methods of exporting. However, as the PESPIC was compiled from a series of WBESs, which used different questionnaire designs and survey methodologies in different countries, the information about methods of exporting is only available in 29 countries. After deleting observations without valid information about the exporting method, we have a final sample of 12,679 firms in 29 developing countries (see Table A.1 for a list of the countries covered in the sample).

As shown in Table 1, 71.05% of firms sell only in the home country, 4.60% of firms have both sales in the home country and exporting through intermediaries, 3.32% of firms have sales in the home country and exporting both directly and through intermediaries, and 21.03% of firms have sales in the home country and direct exporting.

¹⁰More information about the data set can be found at <http://www.enterprisesurveys.org/>

4.2 Estimation Strategy

According to the Proposition, there are three cutoff points of productivity (i.e., $\Theta_1^{ix} < \Theta_1^x < \Theta_N^x$), and firms choose its exporting methods as follows:

$$\left\{ \begin{array}{ll} \text{do not export} & \text{if } \Theta \leq \Theta_1^{ix} \\ \text{export through intermediaries} & \text{if } \Theta_1^{ix} < \Theta \leq \Theta_1^x \\ \text{export both directly and through intermediaries} & \text{if } \Theta_1^x < \Theta \leq \Theta_N^x \\ \text{export directly} & \text{if } \Theta_N^x < \Theta \end{array} \right. \quad (8)$$

Given the heterogeneity across countries, industries and firms, we control for country-industry dummies and a set of firm characteristics in the regression. Hence, the *adjusted*-productivity is

$$\Theta_{fic}^* = \Theta_{fic} + \mathbf{X}_{fic} + \delta_{ic}, \quad (9)$$

where f , i , and c represent firm, industry,¹¹ and country, respectively; δ_{ic} is the country-industry fixed effect, controlling for any country-industry omitted factors that may bias the estimates; and \mathbf{X}_{fic} include firm age (in log), an indicator for whether the largest shareholder is a foreign company, an indicator for whether the largest shareholder is government or government agency, and financial constraints.¹²

The PESPIC contains a question: "what percent of your establishment's sales are: i) sold domestically; ii) exported directly; and iii) exported indirectly (through an intermediary)". From the reply to this question, we construct a new variable, called *Exporting Behavior*, which takes a value of 0 if a firm has sales in the home country only (i.e., 100% of the firm's sales are sold domestically), a value of 1 if a firm has sales in the home country and exporting through intermediaries (i.e., some of the firm's sales are sold domestically and the remaining are exported indirectly), a value of 2 if a firm has sales in the home country and exporting both directly and through intermediaries (i.e., some of the firm's sales are sold domestically, some are exported directly and the remaining are exported indirectly), and a value of 3 if a firm has sales in the home country and direct exporting (i.e., some of the firm's sales are sold domestically and the remaining are exported directly). Hence, the order of self-selection is

¹¹Industry is defined quite broadly in the data. Specifically, there are twenty four industries: Textiles, Leather, Garments, Agroindustry, Food, Beverages, Metals and Machinery, Electronics, Chemicals and Pharmaceuticals, Construction, Wood and Furniture, Non-Metallic and Plastic Materials, Paper, IT Services, Other Manufacturing, Telecommunications, Other Services, Retail and Wholesale Trade, Hotels, and Restaurants, Transport, Real Estate and Rental Services, Mining and Quarrying, Auto and Auto Components, and Other Transport Equipment.

¹²Specifically, the PESPIC has a question asking a firm "whether access to financing is a problem for the operation and growth of your business?". The answer ranges from "No obstacle", to "Minor obstacle", to "Moderate obstacle", to "Major obstacle", and finally to "Very severe obstacle". Accordingly, we construct five dummy variables corresponding to these five possible answers.

$$\begin{cases} \textit{Exporting Behavior}_{fic} = 0 & \text{if } \Theta_{fic}^* \leq \gamma_1 \\ \textit{Exporting Behavior}_{fic} = 1 & \text{if } \gamma_1 < \Theta_{fic}^* \leq \gamma_2 \\ \textit{Exporting Behavior}_{fic} = 2 & \text{if } \gamma_2 < \Theta_{fic}^* \leq \gamma_3 \\ \textit{Exporting Behavior}_{fic} = 3 & \text{if } \gamma_3 < \Theta_{fic}^* \end{cases}, \quad (10)$$

where $\gamma_1 \equiv \Theta_1^{ix} + \mathbf{X}_{fic} + \delta_{ic}$, $\gamma_2 \equiv \Theta_1^x + \mathbf{X}_{fic} + \delta_{ic}$, and $\gamma_3 \equiv \Theta_N^x + \mathbf{X}_{fic} + \delta_{ic}$.

Equation (10) estimates not only the effect of firm productivity, but also the three cutoff points (i.e., γ_1 , γ_2 , and γ_3), from which we can test whether they are in the increasing order and statistically different.

To estimate equation (10), we assume that the error term, ε_{fic} , follows a normal distribution, and use the ordered probit model. Meanwhile, we compute the white-robust standard errors clustered at the country-level to deal with the potential heteroskedasticity. In the robustness checks, we experiment with some alternative estimation methods, i.e., ordered logit and ordinary-least-squares regressions.

4.3 Preliminary Results

Before we present the regression results, we, in Table 1, provide some preliminary comparison of the above four types of firms in terms of output, employment, capital, output per worker, capital per worker, and total factor productivity (TFP).¹³ In estimating TFP, we allow for the existence of unobservable productivity shocks. Specifically, following Levinsohn and Petrin (2003), we use intermediate inputs as a proxy for unobservable productivity shocks (denoted by *TFP LP*).¹⁴ For robustness check, we also use an alternative estimation method (denoted by *TFP FE*), that is, the panel fixed-effect estimation, which effectively controls for all time-invariant unobservable productivity shocks.¹⁵

Along each of these seven indicators, firms with both sales in the home country and direct exporting always have the highest mean value, followed by those with sales in the home country and exporting both directly and through intermediaries, then those with sales in the home country and exporting through intermediaries, and finally those with sales in the home country only. These preliminary results are consistent with our theoretical prediction in the Proposition.

¹³As information about intermediate inputs is not included in 12 of the 29 countries (i.e., Benin, Ecuador, Ethiopia, Kyrgyzstan, Mali, Moldova, Montenegro, Poland, Senegal, Serbia, Tajikistan, and Uzbekistan), the sample size for estimating TFP is reduced to 7,499 firms.

¹⁴An alternative method for dealing with the endogeneity problem is Olley and Pakes (1996)'s method, which uses investment as a proxy for unobservable productivity shocks. However, the data set does not include information about investment, which precludes the use of Olley and Pakes (1996)'s method in our case.

¹⁵For a detailed discussion on the differences among various methods for estimating TFP, please see Van Biesebroeck (2007, 2008).

4.4 Main Results

Regression results for equation (10) are reported in Table 2. For the measure of firm productivity, we respectively use *Logarithm of Output per Worker* in Column (1), TFP estimated using Levinsohn and Petrin (2003)’s method (*TFP LP*) in Column (2), and TFP estimated using panel fixed-effect method (*TFP LP*) in Column (3). And their correlations are shown in Table A.2.

It is found that in all these regressions the estimated coefficients of firm productivity are positive and statistically significant. These results indicate that along with the increase in productivity, a firm is more likely to switch from having sales in the home country only to having sales in the home country and exporting through intermediaries (i.e., those with productivity above γ_1), to having sales in the home country and exporting both directly and through intermediaries (i.e., those with productivity above γ_2), and finally to having sales in the home country and direct exporting (i.e., those with productivity above γ_3).

Moreover, across all these specifications, the estimated cutoff points of productivity (i.e., γ_1 , γ_2 and γ_3) display an increasing order, that is, $\gamma_1 < \gamma_2 < \gamma_3$, and the Chi2 tests show that this order is statistically significant.

Combined, these results further confirm the preliminary findings in Table 1 and are consistent with firms’ exporting behaviors derived in the Proposition.

4.5 Instrumental Variable Estimation Results

One may be concerned that our results (in Table 2) could be biased due to the endogeneity problem associated with firm productivity, that is, the omitted variables bias and the reverse causality (e.g., learning from exporting). An appropriate way to deal with this possible concern is to find an exogenous instrument for firm productivity, that is, the instrument does not affect a firm’s exporting behavior through channels other than its productivity. The instrument we propose is the degree of disruption of a firm’s production due to various possible reasons. Intuitively, the disruption decreases the firm’s productivity as it reduces the firm’s output. Meanwhile, the disruption of production may not directly affect a firm’s exporting decision, especially conditional on its productivity and country dummy.

Specifically, the PESPIC contains a question asking firm to estimate “what percent of your total sales value was lost last year due to power outages or surges from the public grid”. The reply to this answer is used to construct our instrumental variable, *Disruption of Production*, with a value ranging from 0 to 100% and a higher value meaning severer losses. The corresponding first-stage equation is

$$\Theta_{fic} = \beta \cdot \text{Disruption of Production}_{fic} + \mathbf{X}_{fic} + \delta_{ic} + v_{fic}. \quad (11)$$

The first-stage results of the instrumental variable estimation are presented in Table A.3. As expected, the disruption of production variable has a negative and statistically significant estimated coefficient with each of the three measures of firm productivity. With respect to our central issue, as shown in Table 3, firm productivity, after being instrumented, still has a positive and statistically significant estimated coefficient, albeit smaller in magnitude. And the three cutoff points (γ_1 , γ_2 and γ_3) exhibit an increasing and statistically significant order. These results are qualitatively similar to our early findings, implying that endogeneity may not be a big concern in our estimation.

Validity Check. The identification assumption of our above instrumental variable estimation is that the instrumental variable is orthogonal to the error term in the second stage, i.e., $E(\text{Disruption of Production}_{fic} \cdot \varepsilon_{fic}) = 0$. As a check on this identification assumption, we conduct a test following Acemoglu, Johnson, and Robinson (2002). Specifically, we re-write the orthogonal condition of our instrumental variable in the form of mean-independence, i.e.,

$$E[\varepsilon_{fic} | \text{Disruption of Production}_{fic}, \Theta_{fic}^*] = E[\varepsilon_{fic} | \Theta_{fic}^*]. \quad (12)$$

In other words, after the endogenous variable (Θ_{fic}^*) is controlled for, the instrumental variable ($\text{Disruption of Production}_{fic}$) should not have any partial impact on the outcome variable.

Regression results regarding this test are reported in Table 4. As shown in Column 1, when we regress the outcome variable on the instrumental variable (a la the estimation equation (10)), we recover a negative and statistically significant estimated coefficient, which is consistent with our earlier findings.¹⁶ When we include the regressor of interest (Θ_{fic}) in the estimation, however, the instrumental variable no longer has any statistical significance, which implies the satisfaction of condition (12) and validity of the instrumental variable estimation.

4.6 Robustness Checks

In this subsection, we conduct a number of robustness checks to confirm that our previous findings are not biased due to some estimation problems. To save space, we only report the results using *Logarithm of Output per Worker* for the measure of firm productivity, as the three measures of firm productivity are highly correlated (see Table A.2) and regressions using *Logarithm of Output per Worker* have more observations.¹⁷

¹⁶Angrist and Krueger (2001), Chernozhukov and Hansen (2008) and Angrist and Pischke (2009) point out that if the instrumental variable does not have any statistical significance in this reduced-form regression, it implies that the endogenous variable may also not have any statistically significant impact on the outcome variable.

¹⁷Results using the other two measures of firm productivity and the instrumental variable estimation are qualitatively the same and available upon request.

A sub-sample of domestic firms. As Lu, Lu, and Tao (2010) shows that foreign-owned firms behave differently from domestic firms in the relation between firm productivity and exporting behavior, we restrict our analysis to the sub-sample of domestic firms (based on the reply to the survey question on the ownership type). As shown in Column 1 of Table 5, our findings on the relation between firm productivity and methods of exporting in Table 2 remain robust to this sub-sample.

A sub-sample of manufacturing firms. In the benchmark analysis, we include all the industries, such as manufacturing and service industries. As trade in services has its own distinct features, this may raise a concern of whether our findings are due to trade in services rather than trade in goods. To address this concern, we restrict our analysis to a sub-sample of manufacturing firms. As shown in Column 2 of Table 5, our main findings remain robust to the sub-sample of manufacturing firms.

Alternative distribution of the error term. Thus far, we assume a normal distribution of the error term (ε_{fic}) in estimating equation (10). As a robustness check, we consider an alternative distribution function, that is, the logistic distribution, of the error term. Regression results are reported in Column 3 of Table 5. Clearly, our main results regarding the relation between firm productivity and exporting behavior remain robust to this alternative distribution assumption.

Alternative estimation method. Thus far, we use non-linear estimation methods (such as ordered probit and ordered logit models). As a robustness check, we use the standard linear estimation model; that is, the ordinary least squares method. Estimation results are reported in Column 4 of Table 5, which show similar results.

Two sub-samples of countries. The three cutoff points that we have estimated are country- and industry-adjusted cutoff points of Θ_1^{ix} , Θ_1^x and Θ_N^x , all of which are increasing in the home country's transport costs t . Hence, countries imposed with higher tariffs by other countries should have higher estimated cutoff points than those imposed with lower tariffs. To check this theoretical prediction, we divide our sample countries into two sets, members and non-members of WTO. Given that on average WTO member countries face lower tariffs than non-WTO member countries, it is expected that the estimated cutoff points for the sub-sample of WTO member countries should be lower than the corresponding numbers for the sub-sample of non-WTO member countries. As shown in Columns 5-6 of Table 5, we indeed find that this is the case in our estimation, which lends further support to our theoretical analysis.

5 Conclusion

There is an emerging literature investigating the roles of intermediaries in international trade (Feenstra and Hanson, 2004; Rauch and Watson, 2004; Blum, Claro, and Horstmann, 2009; Akerman, 2010; Antras and Costinot, 2011; Bernard, Jensen, Redding, and Schott,

2010; McCann, 2013; Ahn, Khandelwal, and Wei, 2011; Felbermayr and Jung, 2011). The few available studies focus mainly on how intermediaries work and how they differ from direct exporters. However, what seems to be the most basic question, i.e., what types of firms export through intermediaries rather than directly by themselves, has yet to be addressed.

To the best of our knowledge, this paper is among the first few providing direct evidence on the relation between firm productivity and methods of exporting. By incorporating intermediaries into the standard trade framework à la Melitz (2003) and Chaney (2009), we find that the most productive firms have sales in the home country and also exporting directly to foreign countries, followed by firms with sales in the home country and exporting both directly and through intermediaries, by firms with sales in the home country and exporting through intermediaries, and finally by firms with sales in the home country only. These theoretical predictions are borne out in a data set of 12,679 firms in 29 emerging economies during the period of 2002-2006.

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Appendix

Proof of Lemma

From $\pi_i^{ix}(\Theta_i^{ix}) = 0$, we can derive Θ_i^{ix} as

$$\Theta_i^{ix} = \frac{\gamma_i f_i T_i}{\beta_i (1 - \alpha) I_i}. \quad (13)$$

From $\pi_i^{dx}(\Theta_i^x) = \pi_i^{ix}(\Theta_i^x)$, we can derive Θ_i^x as

$$\Theta_i^x = \frac{(1 - \gamma_i) f_i T_i}{(1 - \beta_i)(1 - \alpha) I_i}. \quad (14)$$

Given the assumption of $\beta_i > \gamma_i$, we have

$$\Theta_i^x > \Theta_i^{ix}. \quad (15)$$

The optimal choice regarding whether and how to export to foreign market i is illustrated in Figure 1. For a firm with productivity $\Theta < \Theta_i^{ix}$, it cannot earn any profit from exporting. For a firm with productivity $\Theta_i^x > \Theta \geq \Theta_i^{ix}$, it earns profit from exporting through intermediaries, and this profit is higher than that from direct exporting. For a firm with productivity $\Theta \geq \Theta_i^x$, its profit from direct exporting is higher than that from exporting through intermediaries.

Proof of Proposition

Note that there are only two exhaustive and mutually exclusive scenarios. One is $\Theta_1^x > \Theta_N^{ix}$, which takes place when the costs of direct exporting are relatively high, and henceforth is referred to as *high-cost direct exporting*. The other is $\Theta_1^x \leq \Theta_N^{ix}$, referred to as *low-cost direct exporting*.

For the scenario of high-cost direct exporting (i.e., $\Theta_1^x > \Theta_N^{ix}$), we have $\Theta_0 < \Theta_1^{ix} \leq \Theta_N^{ix} < \Theta_1^x \leq \Theta_N^x$, where the first inequality comes from Assumption (A.1), and the remaining are from Condition (6). The optimal choice for firms regarding sales in the home and foreign countries is illustrated in Figure 2:

- Case (i), productivity $\Theta \geq \Theta_N^x$: the firm has sales in the home country because its productivity is above the cutoff point for production in the home country (i.e., $\Theta \geq \Theta_N^x > \Theta_0$). Meanwhile, it exports directly to all foreign countries, because its productivity is above the cutoff point for which direct exporting is more profitable than exporting through intermediaries for each of these foreign countries (i.e., $\Theta \geq \Theta_i^x \forall i \in \{1, \dots, N\}$).

- Case (ii), productivity $\Theta_1^x \leq \Theta < \Theta_N^x$: without loss of generality, assume that $\Theta_j^x \leq \Theta < \Theta_{j+1}^x$, where $j \in \{1, \dots, N-1\}$. The firm has sales in the home market because $\Theta \geq \Theta_j^x > \Theta_0$. It can export to all foreign countries through intermediaries because its productivity is above the cutoff point for exporting through intermediaries for each of the foreign countries (i.e., $\Theta \geq \Theta_j^x > \Theta_N^{ix} \geq \Theta_i^{ix} \forall i \in \{1, \dots, N\}$). For some foreign countries (i.e., $i \in \{1, \dots, j\}$), however, it is optimal for the firm to use direct exporting because its productivity is above the cutoff point at which the profit from direct exporting is higher than that from exporting through intermediaries (i.e., $\Theta_1^x \leq \dots \leq \Theta_j^x \leq \Theta < \Theta_{j+1}^x$). As a result, in equilibrium, the firm has sales in the home market, exports through intermediaries to foreign countries $\{j+1, \dots, N\}$, and exports directly to foreign countries $\{1, \dots, j\}$.
- Case (iii), productivity $\Theta_N^{ix} \leq \Theta < \Theta_1^x$: the firm has sales in the home country because $\Theta \geq \Theta_N^{ix} > \Theta_0$. It can export to all foreign countries through intermediaries because $\Theta \geq \Theta_N^{ix} \geq \Theta_i^{ix} \forall i \in \{1, \dots, N\}$. Meanwhile, because its productivity is below the cutoff point at which the profit from direct exporting is higher than that from exporting through intermediaries for each of the foreign countries (i.e., $\Theta < \Theta_1^x \leq \Theta_i^x \forall i \in \{1, \dots, N\}$), it is not optimal for the firm to export directly to any of these foreign countries. As a result, in equilibrium, the firm has sales in the home country and exports to all foreign countries through intermediaries.
- Case (iv), productivity $\Theta_1^{ix} \leq \Theta < \Theta_N^{ix}$: without loss of generality, we assume that $\Theta_j^{ix} \leq \Theta < \Theta_{j+1}^{ix}$, where $j \in \{1, \dots, N-1\}$. The firm has sales in the home country as $\Theta \geq \Theta_1^{ix} > \Theta_0$. It can export to some foreign countries (i.e., $i \in \{1, \dots, j\}$) through intermediaries as $\Theta_1^{ix} \leq \dots \leq \Theta_j^{ix} \leq \Theta < \Theta_{j+1}^{ix}$. Meanwhile, it is not optimal for the firm to export directly to any of these foreign countries because its productivity is below the cutoff point for direct exporting to be more profitable than exporting through intermediaries for each of these foreign countries (i.e., $\Theta < \Theta_{j+1}^{ix} \leq \Theta_N^{ix} < \Theta_1^x \leq \Theta_i^x \forall i \in \{1, \dots, N\}$). As a result, in equilibrium, the firm has sales in the home country, and exports through intermediaries to some foreign countries $\{1, \dots, j\}$.
- Case (v), productivity $\Theta_0 \leq \Theta < \Theta_1^{ix}$: the firm can only sell in the home country, because its productivity is above the cutoff point for production in the home country (i.e., $\Theta \geq \Theta_0$), but below the cutoff point for either direct exporting or exporting through intermediaries to any foreign country (i.e., $\Theta < \Theta_1^{ix} \leq \Theta_i^{ix} < \Theta_i^x \forall i \in \{1, \dots, N\}$).
- Case (vi), productivity $\Theta < \Theta_0$: the firm exits from the market because its productivity is even below the cutoff point for production in the home country (i.e., $\Theta < \Theta_0$).

For the scenario of low-cost direct exporting (i.e., $\Theta_1^x \leq \Theta_N^{ix}$), we have $\Theta_0 < \Theta_1^{ix} < \Theta_1^x \leq \Theta_N^{ix} < \Theta_N^x$. The optimal choice for firms regarding sales in the home and foreign countries is illustrated in Figure 3:

- Case (i), productivity $\Theta \geq \Theta_N^x$: the case is the same as case (i) under the scenario of high-cost direct exporting, in which the firm has sales in the home country and exports directly to all foreign countries.
- Case (ii), productivity $\Theta_N^{ix} \leq \Theta < \Theta_N^x$: the analysis for this case is the same as that for case (ii) under the scenario of high-cost direct exporting. In equilibrium, the firm has sales in the home market, exports through intermediaries to foreign countries $\{j + 1, \dots, N\}$, and exports directly to foreign countries $\{1, \dots, j\}$.
- Case (iii), productivity $\Theta_1^x \leq \Theta < \Theta_N^{ix}$: without loss of generality, we assume that $\Theta_j^x \leq \Theta < \Theta_{j+1}^x$, where $j \in \{1, \dots, N - 1\}$ and $\Theta_k^{ix} \leq \Theta < \Theta_{k+1}^{ix}$, where $k \in \{1, \dots, N - 1\}$. The firm has sales in the home country as $\Theta \geq \Theta_1^x > \Theta_1^{ix} > \Theta_0$. It can export through intermediaries to some foreign countries (i.e., $i \in \{1, \dots, k\}$) as $\Theta_1^{ix} \leq \dots \leq \Theta_k^{ix} \leq \Theta < \Theta_{k+1}^{ix}$. Meanwhile, it is optimal for the firm to export directly to some foreign countries (i.e., $i \in \{1, \dots, j\}$) because its productivity is above the cutoff point at which direct exporting is more profitable than exporting through intermediaries for these foreign countries (i.e., $\Theta_1^x \leq \dots \leq \Theta_j^x \leq \Theta < \Theta_{j+1}^x$). And it can be shown that $k \geq j$; otherwise, we have $\Theta \geq \Theta_j^x > \Theta_j^{ix} \geq \Theta_{k+1}^{ix}$, which contradicts the assumption $\Theta_k^{ix} \leq \Theta < \Theta_{k+1}^{ix}$.¹⁸ Thus, when $k = j$, the firm has sales in the home country and exports directly to foreign countries $\{1, \dots, j\}$; when $k > j$, the firm has sales in the home country, exports through intermediaries to foreign countries $\{j + 1, \dots, k\}$, and exports directly to foreign countries $\{1, \dots, j\}$.
- Case (iv), productivity $\Theta_1^{ix} \leq \Theta < \Theta_1^x$: the analysis for this case is the same as that for case (iv) under the scenario of high-cost direct exporting. In equilibrium, the firm has sales in the home country and exports through intermediaries to some foreign countries $\{1, \dots, j\}$.
- Case (v), productivity $\Theta_0 \leq \Theta < \Theta_1^{ix}$: the case is the same as case (v) under the scenario of high-cost direct exporting, in which the firm has sales only in the home market.
- Case (vi), productivity $\Theta < \Theta_0$: the case is the same as case (vi) under the scenario of high-cost direct exporting, in which the firm exits from the market.

¹⁸As shown in Lemma, whenever a firm can export directly to a foreign country, it can also use intermediaries to export to that same country. Following this intuition, the number of countries to which a firm can export through intermediaries should be at least equal to the number of countries to which the firm can export directly.

In a summary, in both scenarios, firms with productivity $\Theta \geq \Theta_N^x$ have direct exporting, those with productivity $\Theta_N^x > \Theta \geq \Theta_1^x$ have both direct exporting and exporting through intermediaries, those with productivity $\Theta_1^x > \Theta \geq \Theta_1^{ix}$ have exporting through intermediaries, and those with productivity $\Theta_1^{ix} > \Theta$ do not have any export.

Relaxation of Condition (6)

Note that in the main analysis (Section 3.2), we assume that the ranking of Θ_i^{ix} across N foreign countries is the same as that of Θ_i^x (i.e., Condition (6)). Now, we relax this condition, and show that all of our results still hold.

Let the ranking of Θ_i^{ix} and Θ_i^x across N foreign countries be

$$\begin{cases} \Theta_{1'}^{ix} \leq \Theta_{2'}^{ix} \leq \dots \leq \Theta_{N'}^{ix} \\ \Theta_1^x \leq \Theta_2^x \leq \dots \leq \Theta_N^x \end{cases}. \quad (6')$$

There are two exhaustive and mutually exclusive scenarios as in Section 3.2, high-cost direct exporting (i.e., $\Theta_1^x > \Theta_{N'}^{ix}$) and low-cost direct exporting (i.e., $\Theta_1^x \leq \Theta_{N'}^{ix}$). The analysis for the scenario of high-cost direct exporting is the same as that in Section 3.2, whereas the analysis for the scenario of low-cost direct exporting differs from that in Section 3.2 only for the case (iii).

Specifically, for the case (iii) of low-cost direct exporting (i.e., firms with productivity $\Theta_1^x \leq \Theta < \Theta_{N'}^{ix}$), without loss of generality, we assume that $\Theta_j^x \leq \Theta < \Theta_{j+1}^x$, where $j \in \{1, \dots, N-1\}$ and $\Theta_{k'}^{ix} \leq \Theta < \Theta_{k'+1}^{ix}$, where $k' \in \{1, \dots, N-1\}$. The firm has sales in the home country as $\Theta \geq \Theta_1^x > \Theta_0$. It can export through intermediaries to foreign countries $\{1', \dots, k'\}$ as $\Theta_{1'}^{ix} \leq \dots \leq \Theta_{k'}^{ix} \leq \Theta < \Theta_{k'+1}^{ix}$. Meanwhile, it is optimal for the firm to export directly to foreign countries $\{1, \dots, j\}$ because its productivity is above the cutoff point at which direct exporting is more profitable than exporting through intermediaries for these foreign countries (i.e., $\Theta_1^x \leq \dots \leq \Theta_j^x \leq \Theta < \Theta_{j+1}^x$). It can be shown that $k' \geq j$; otherwise, we have $\Theta \geq \Theta_j^x > \Theta_j^{ix} \geq \Theta_{k'+1}^{ix}$, which contradicts the assumption $\Theta_{k'}^{ix} \leq \Theta < \Theta_{k'+1}^{ix}$. Thus, when $k' = j$, the firm has sales in the home country and exports directly to foreign countries $\{1, \dots, j\}$; when $k' > j$, the firm has sales in the home country, exports through intermediaries to foreign countries $\{j+1, \dots, k'\}$, and exports directly to foreign countries $\{1, \dots, j\}$.

Hence, we have

Corollary 1: *The Proposition is robust to the relaxation of Condition (6).*

Relaxation of Assumption (A.2)

When Assumption (A.2) does not hold (i.e., the case of $\beta_i \leq \gamma_i$) for foreign country i , the optimal choice regarding whether and how to export to foreign country i is illustrated in Figure 4. Note that in this case, we have $\Theta_i^{ix} > \Theta_i^{dx} > \Theta_i^x$. For a firm with productivity $\Theta < \Theta_i^{dx}$ ($< \Theta_i^{ix}$), it cannot earn any profit from exporting. For a firm with productivity $\Theta \geq \Theta_i^{dx}$ ($> \Theta_i^x$), it earns profit from direct exporting, and this profit is higher than that from exporting through intermediaries. Hence, we have the following lemma:

Lemma 2: For foreign country i with $\beta_i \leq \gamma_i$, firms with productivity $\Theta \geq \Theta_i^{dx}$ use direct exporting, and firms with productivity $\Theta < \Theta_i^{dx}$ do not export.

Note that if Assumption (A.2) does not hold for all of the foreign countries (i.e., $\beta_i \leq \gamma_i \forall i$), we should not observe the use of exporting through intermediaries, which is not consistent with the empirical observation. Hence, we investigate the case that Assumption (A.2) holds for some but not all foreign countries.

Without loss of generality, we assume that Assumption (A.2) holds for foreign countries $i \in \{1, \dots, j\}$ (referred to as Group A) but not for foreign countries $i \in \{j+1, \dots, N\}$ (referred to as Group B).

For the foreign countries of Group A, let the ranking of Θ_i^{ix} and Θ_i^x across these foreign countries be

$$\begin{cases} \Theta_1^{ix} \leq \Theta_2^{ix} \leq \dots \leq \Theta_j^{ix} \\ \Theta_1^x \leq \Theta_2^x \leq \dots \leq \Theta_j^x \end{cases} \quad (9'')$$

The analysis regarding the exporting behavior of firms for this case is the same as that in Section 3.2. Specifically, firms with productivity $\Theta \geq \Theta_j^x$ have direct exporting, those with productivity $\Theta_j^x > \Theta \geq \Theta_1^x$ have both direct exporting and exporting through intermediaries, those with productivity $\Theta_1^x > \Theta \geq \Theta_1^{ix}$ have exporting through intermediaries, and those with productivity $\Theta_1^{ix} > \Theta$ do not have any export.

For the foreign countries of Group B, the optimal choice regarding whether and how to export to foreign country i is summarized in Lemma 2. Let the ranking of Θ_i^{dx} across these foreign countries be

$$\Theta_{j+1}^{dx} \leq \Theta_{j+2}^{dx} \leq \dots \leq \Theta_N^{dx}. \quad (16)$$

Thus, firms with productivity $\Theta \geq \Theta_{j+1}^{dx}$ have direct exporting, and those with productivity $\Theta < \Theta_{j+1}^{dx}$ do not have any exporting.

Taken together, we have two exhaustive and mutually exclusive scenarios: (i) $\Theta_{j+1}^{dx} >$

Θ_1^{ix} and (ii) $\Theta_{j+1}^{dx} \leq \Theta_1^{ix}$. For the scenario of $\Theta_{j+1}^{dx} > \Theta_1^{ix}$, the optimal choice for firms regarding sales in the home and foreign countries is qualitatively the same as that in the *Proposition*. Specifically, firms with productivity $\Theta \geq \Theta_j^x$ have sales in the home country and direct exporting; those with productivity $\Theta_j^x > \Theta \geq \min\{\Theta_{j+1}^{dx}, \Theta_1^x\}$ have sales in the home country and exporting both directly and through intermediaries; those with productivity $\min\{\Theta_{j+1}^{dx}, \Theta_1^x\} > \Theta \geq \Theta_1^{ix}$ have sales in the home country and exporting through intermediaries; those with productivity $\Theta_1^{ix} > \Theta \geq \Theta_0$ have sales in the home country only; and those with productivity $\Theta_0 > \Theta$ exit from the market.

For the scenario of $\Theta_{j+1}^{dx} \leq \Theta_1^{ix}$, the optimal choice for firms regarding sales in the home and foreign countries is as follows. Firms with productivity $\Theta \geq \Theta_j^x$ have sales in the home country and direct exporting; those with productivity $\Theta_j^x > \Theta \geq \Theta_1^{ix}$ have sales in the home country and exporting both directly and through intermediaries; those with productivity $\Theta_1^{ix} > \Theta \geq \Theta_{j+1}^{dx}$ have sales in the home country and direct exporting; those with productivity $\Theta_{j+1}^{dx} > \Theta \geq \Theta_0$ have sales in the home country only; and those with productivity $\Theta_0 > \Theta$ exit from the market. Clearly, in this scenario, having sales in the home country and exporting only through intermediaries is not an equilibrium choice. In other words, we should not observe any firms having sales in the home country and exporting only through intermediaries, which is not consistent with the empirical observation.

Let

$$\Theta_{j+1}^{dx} > \Theta_1^{ix} \tag{17}$$

Corollary 2: *As long as Assumption (A.2) holds for some foreign countries, the qualitative results in the Proposition hold under Condition (15).*

Recall that Θ_1^{ix} is the lowest cutoff point of productivity for exporting through intermediaries to be profitable among foreign countries of Group A, whereas Θ_{j+1}^{dx} is the lowest cutoff point of productivity for direct exporting to be profitable among foreign countries of Group B. If Condition (15) does not hold, it implies that direct exporting to Group B countries is rather easy. Meanwhile, note that for foreign countries of Group B, Assumption (A.2) does not hold, which implies that the costs of using intermediaries to export to these countries are relatively high. Combined, we have an apparent contradiction, that is, the costs of using intermediaries to export are high for those foreign countries where direct exporting is easy. Hence, we expect Condition (15) to hold for most cases.

Alternative Cost Structures of Using Intermediaries

In the analysis thus far, it is assumed that the cost structure of using intermediaries for exporting takes the form of a share of the exporting revenue ($\beta \in (0, 1)$) and a fixed fee (which can be written as a fraction of the fixed cost associated with the direct exporting, $\gamma \in (0, 1)$). Here we consider two alternative cost structures: (i) $\beta = 0$ and $\gamma < 0$; and (ii) $\beta > 1$ and $\gamma \in (0, 1)$.

The first case may arise when exporting firms are relatively more risk averse than intermediaries, and as a result intermediaries make fixed payments to those exporting firms in exchange for the entire exporting output. Under this cost structure, the profit from exporting to foreign country i through intermediaries becomes:

$$\pi_i^{ix} = \beta_i \frac{(1 - \alpha)I_i}{T_i} \Theta - \gamma_i f_i = -\gamma_i f_i > 0. \quad (18)$$

This implies that firms always make profits from exporting through intermediaries. As a result, we should observe all firms to have both sales in the home country and exporting, which contradicts with the empirical observation that majority of firms only serve the home country and only a small portion of firms have both sales in the home country and export (Bernard, Jensen, Redding, and Schott, 2007; Mayer and Ottaviano, 2007). In other words, this type of cost structure of using intermediaries for exporting is not widely used in reality.

The second case may arise when intermediaries have expertise in selling the output of exporting firms in the foreign countries at higher prices than the firms would have got from direct exporting. Under this cost structure, it can be shown that the profit from exporting to foreign country i through intermediaries is always higher than that from directly exporting, i.e.,

$$\pi_i^{ix} = \beta_i \frac{(1 - \alpha)I_i}{T_i} \Theta - \gamma_i f_i > \frac{(1 - \alpha)I_i}{T_i} \Theta - f_i = \pi_i^{dx} \quad (19)$$

as $\beta_i > 1$ and $\gamma_i < 1$. This implies that if any firm has any exporting, it should be done through intermediaries, which again contradicts with the empirical evidence reported in the literature (e.g., Akerman, 2010; Ahn, Khandelwal, and Wei, 2011). In other words, this type of cost structure is not widely used in reality, either.

Table 1, Descriptive Statistics

	Sales in the Home Country Only	Sales in the Home Country and Exporting through Intermediaries	Sales in the Home Country and Exporting both directly and through Intermediaries	Sales in the Home Country and Direct Exporting
Number of Observations	9,008	583	421	2,667
Log Output	8.698 [3.260]	9.953 [3.144]	10.688 [3.219]	11.389 [3.455]
Log Employment	3.240 [1.326]	3.942 [1.557]	4.692 [1.433]	4.756 [1.509]
Log Capital	8.122 [3.078]	9.122 [3.583]	10.222 [3.111]	10.738 [3.185]
Log Output per Worker	5.373 [2.809]	5.399 [2.374]	5.873 [2.872]	6.458 [2.998]
Log Capital per Worker	4.760 [2.588]	4.868 [2.800]	5.426 [2.614]	5.765 [2.544]
TFP LP	4.937 [1.627]	5.398 [1.641]	5.845 [1.696]	6.073 [1.683]
TFP FE	3.305 [1.239]	3.534 [1.222]	3.726 [1.356]	3.881 [1.268]

Table 2, Main Results

	1	2	3
Log Output per Worker	0.255*** [0.039]		
TFP LP		0.604*** [0.055]	
TFP FE			0.626*** [0.082]
<i>Controls</i>			
Firm Age (Log)	0.245*** [0.041]	0.139*** [0.038]	0.214*** [0.042]
Foreign Ownership	0.732*** [0.081]	0.502*** [0.081]	0.689*** [0.087]
State Ownership	0.181 [0.206]	-0.525* [0.313]	-0.313 [0.396]
Financial Constraints	[19.85]***	[11.89]**	[13.61]***
Industry-Country Dummy	Yes	Yes	Yes
<i>Cutoff Points</i>			
γ_1	3.488	5.339	4.213
γ_2	3.676	5.547	4.408
γ_3	3.819	5.721	4.570
Chi2-test of	[53.12]***	[52.40]***	[50.56]***
Chi2-test of	[32.73]***	[25.79]***	[23.96]***
Number of Observations	7,943	5,602	5,597
Pseudo R2	0.1751	0.2013	0.1683
<i>p</i> -value for Wald chi2	0.0000	0.0000	0.0000

Note: White-robust standard errors, clustered at the country-level, are reported in the bracket. *, ** and *** represent statistical significance at the 10%, 5% and 1%, respectively.

Table 3, IV Estimation Results

	1	2	3
Log Output per Worker	0.313*** [0.044]		
TFP LP		0.610*** [0.064]	
TFP FE			0.632*** [0.106]
<i>Controls</i>			
Firm Age (Log)	0.240*** [0.039]	0.138*** [0.038]	0.214*** [0.041]
Foreign Ownership	0.682*** [0.085]	0.497*** [0.090]	0.686*** [0.097]
State Ownership	0.188 [0.203]	-0.528* [0.308]	-0.314 [0.394]
Financial Constraints Industry-Country Dummy	[20.12]*** Yes	[11.57]*** Yes	[13.32]*** Yes
<i>Cutoff Points</i>			
γ_1	3.820	5.369	4.234
γ_2	4.008	5.577	4.429
γ_3	4.151	5,751	4.590
Chi2-test of	[52.86]***	[52.36]***	[50.53]***
Chi2-test of	[32.66]***	[25.79]***	[23.96]***
Number of Observations	7,943	5,602	5,597
<i>p</i> -value for Wald chi2	0.0000	0.0000	0.0000

Note: White-robust standard errors, clustered at the country-level, are reported in the bracket. *, ** and *** represent statistical significance at the 10%, 5% and 1%, respectively.

Table 4, IV Estimation, A Validity Check

	1	2
Log Output per Worker		0.237*** [0.40]
Disruption of Production	-0.458* [0.269]	-0.288 [0.282]
Controls	Yes	Yes
Industry-Country Dummy	Yes	Yes
Number of Observations	5,675	5,675
<i>p</i> -value for Wald chi2	0.0000	0.0000

Note: White-robust standard errors, clustered at the country-level, are reported in the bracket. *, ** and *** represent statistical significance at the 10%, 5% and 1%, respectively.

Table 5, Robustness Checks

	1	2	3	4	5	6
	Domestic Firms	Manufacturing Firms	Ordered Logit	OLS Estimation	WTO Members	Non-WTO Members
Log Output per Worker	0.267*** [0.045]	0.256*** [0.039]	0.450*** [0.067]	0.206*** [0.000]	0.254*** [0.040]	0.303*** [0.072]
<i>Controls</i>						
Firm Age (Log)	0.270*** [0.041]	0.251*** [0.041]	0.417*** [0.077]	0.182*** [0.000]	0.252*** [0.042]	0.041 [0.084]
Foreign Ownership	-	0.732*** [0.083]	1.216*** [0.141]	0.752*** [0.000]	0.740*** [0.0821]	0.436 [0.558]
State Ownership	0.181 [0.228]	0.126 [0.197]	0.269 [0.380]	0.048 [0.676]	0.140 [0.259]	0.534*** [0.049]
Financial Constraints Industry-Country Dummy	[11.81]** Yes	[17.16]*** Yes	[18.22]*** Yes	[3.95]** Yes	[18.49]*** Yes	[5.0e8]*** Yes
<i>Cutoff Points</i>						
γ_1	3.600	3.507	6.072	-	3.491	3.307
γ_2	3.796	3.692	6.396	-	3.679	3.506
γ_3	3.928	3.837	6.644	-	3.824	3.573
Chi2-test of	[46.17]***	[50.36]***	[52.47]***	-	[50.17]***	[6.45]**
Chi2-test of	[29.09]***	[32.11]***	[32.73]***	-	[31.90]***	[13.65]***
Number of Observations	7,189	7,687	7,943	7,943	7,480	463
Pseudo R2	0.1493	0.1718	0.1757	0.2687	0.1647	0.3389
p-value for Wald chi2	0.0000	0.0000	0.0000	-	0.0000	0.0000

Note: White-robust standard errors, clustered at the country-level, are reported in the bracket. *, ** and *** represent statistical significance at the 10%, 5% and 1%, respectively.

Table A.1, Description of the Dataset

Country	Survey Year	Number of Surveyed Firms
Bangladesh	2002	985
Benin	2004	190
Brazil	2003	1,636
Cambodia	2003	503
Ecuador	2003	445
El Salvador	2003	465
Ethiopia	2002	422
Guatemala	2003	455
Honduras	2003	450
India	2002	1,711
Indonesia	2003	711
Kyrgyzstan	2003	102
Lithuania	2004	239
Mali	2003	134
Moldova	2003	103
Montenegro	2003	100
Nicaragua	2003	452
Oman	2003	330
Philippines	2003	666
Poland	2003	108
Senegal	2003	241
Serbia	2003	408
South Africa	2003	600
Sri Lanka	2004	450
Syria	2003	552
Tajikistan	2003	107
Thailand	2004	1,385
Uzbekistan	2003	100
Zambia	2002	207

Table A.2, Correlations among Firm Productivity Measures

	Log Output per Worker	TFP LP	TFP FE
Log Output per Worker	1.0000		
TFP LP	0.9021	1.0000	
TFP FE	0.9099	0.9604	1.0000

Table A.3, First-stages of IV Estimations in Table 3

	1	2	3
	Log Output per Worker	TFP LP	TFP FE
Disruption of Production	-0.515*** [0.201]	-0.483*** [0.161]	-0.210* [0.120]
Controls	Yes	Yes	Yes
Industry-Country Dummy	Yes	Yes	Yes
Number of Observations	7,943	5,602	5,597

Note: White-robust standard errors, clustered at the country-level, are reported in the bracket. *, ** and *** represent statistical significance at the 10%, 5% and 1%, respectively.

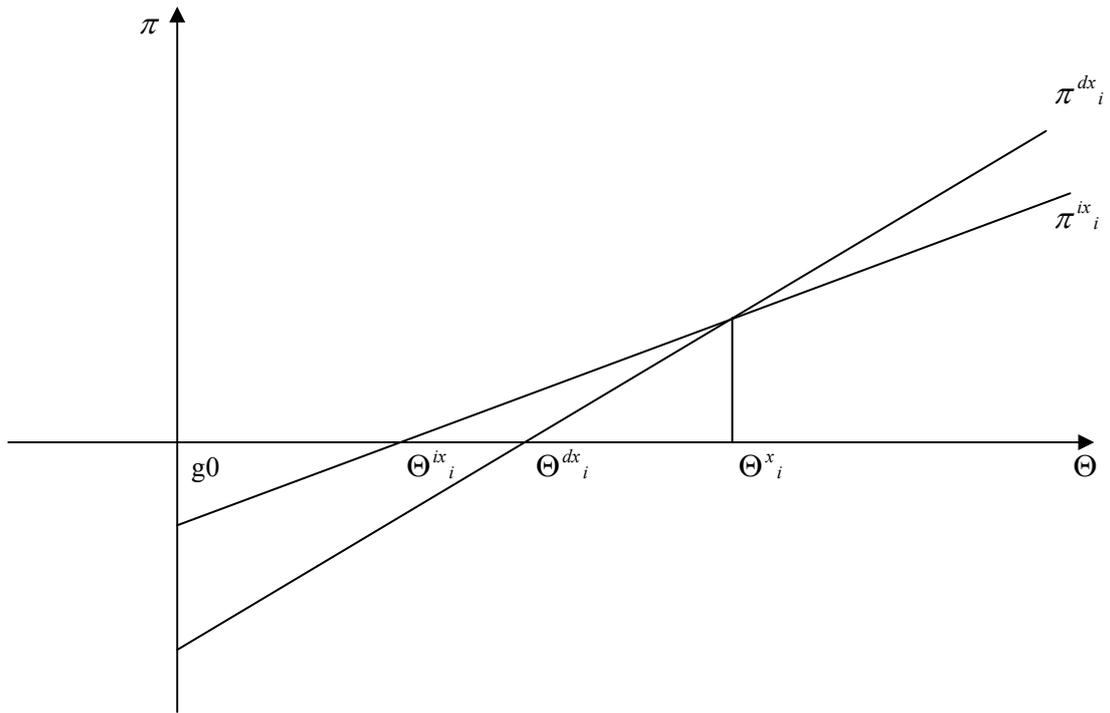


Figure 1, Optimal Choice of Whether and How to Export to Foreign Country i when $\beta_i > \gamma_i$

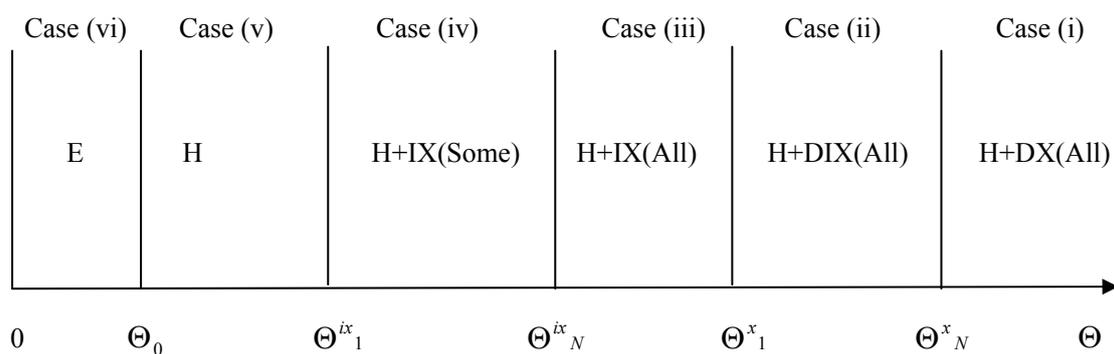


Figure 2, Equilibrium Choice for the Scenario of High-cost Direct Exporting

where

- E: Exit
- H: Home country
- IX: Exporting through intermediaries
- DIX: Exporting both directly and through intermediaries
- DX: Exporting directly
- Some: Exporting to some foreign countries
- All: Exporting to all foreign countries

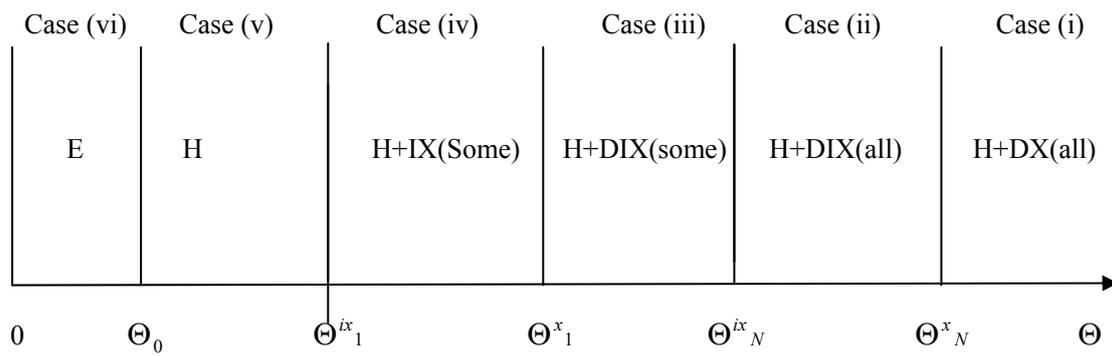


Figure 3, Equilibrium Choice for the Scenario of Low-cost Direct Exporting

where

- E: Exit
- H: Home country
- IX: Exporting through intermediaries
- DIX: Exporting both directly and through intermediaries
- DX: Exporting directly
- Some: Exporting to some foreign countries
- All: Exporting to all foreign countries

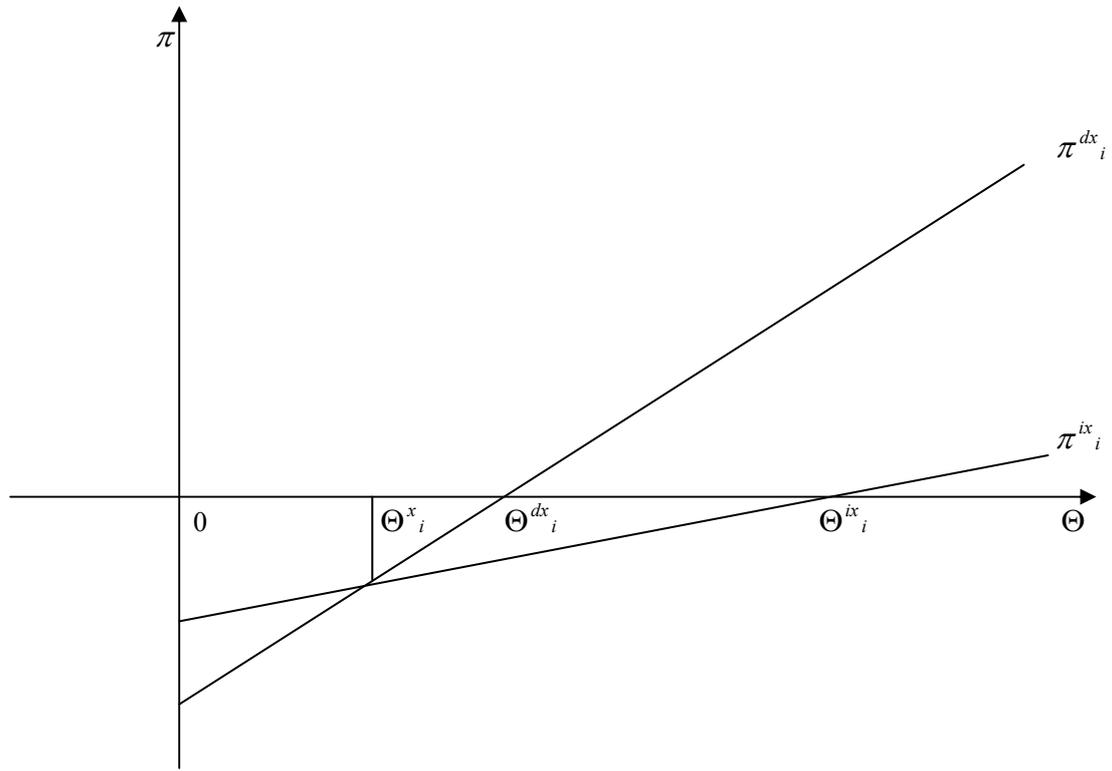


Figure 4, Optimal Choice of Whether and How to Export to Foreign Country i when $\beta_i \leq \gamma_i$