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Understanding the Bimodality of the Export Intensity Distribution in Thailand

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Understanding the Bimodality of the Export Intensity Distribution in Thailand*

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Abstract

The literature has established a pattern that exporters in developed countries sell most of their output in their domestic markets. However, recent evidence finds that firm-level export intensity, defined as the ratio of exports to revenue, in at least 47 countries is bimodally distributed. In this paper, we investigate the determinants of the bimodality of Thailand's export intensity distribution by using Thailand's manufacturing firm-level census data covering the period between 2007-2017. We do not find evidence that firm productivity can explain the variation in export intensity. We document that firms with export intensity at least 90 percent, so-called "pure exporters," can be explained by (i) the firm's characteristics, (ii) the demand-side factor, and (iii) the government's policy. Pure exporters are relatively young, have foreign ownership, produce narrow product variety, and export to high-income countries. The government's policy, such as investment promotion, can raise firms' export intensity and encourage firms to become pure exporters, thereby emphasizing another important channel through which the government can increase exports.

Keywords: Export Intensity, Firm-level heterogeneity, Bimodality
JEL classification numbers: F1.

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1 Introduction

A seminal work by Bernard et al. (2003) documents that exporters in the United States sell most of their output in their domestic markets; 66 percent of American firms sell less than 10 percent of their output abroad, and only 4.3 percent of them export more than 50 percent of their output. In other words, only a small fraction of American exporters' shares of revenue come from exports. This pattern also arises in many countries, such as France (Arkolakis, 2010; Eaton et al., 2011) and Colombia (Brooks, 2006). Recently, however, Defever and Riano (2017) document that among 72 countries in their dataset, the export intensity distributions in 47 countries are bimodally distributed.

This bimodality of export intensity distribution is puzzling because it cannot be explained by standard two-country trade models with CES preferences such as Melitz (2003) and Bernard et al. (2007). In these models, the export intensity is identical across firms since a firm's revenues from selling to two markets grow proportionally with the firm's productivity. A variation of export intensity can arise in multi-country models with heterogeneous fixed costs of exporting because in these models firms may select a different set of export markets. However, conditional on selling to the same set of export markets, the export intensity is identical across firms and is independent of firm productivity.

Thailand is one of many countries identified with bimodal export intensity. Using Thailand's firm-level census data, Figure 1 shows that, among manufacturing firms in Thailand, 47.4 percent of them export at least 50 percent of their total outputs, and 22.9 percent of them export at least 90% of their outputs. This heterogeneity in export intensity is interesting because it raises several questions. First, why does the degree of export intensity vary across exporters? Second, what are the fundamental differences between exporters with high export intensity and exporters with low export intensity? Understanding these questions would be useful for academic purposes in validating theoretical models and for policymakers in implementing export-promoting policy, especially in export-oriented developing countries.

Motivated by these questions, we investigate the economic rationale behind the heterogeneity in export intensities in developing countries by using Thailand as a case study. To be precise, we seek to find the fundamental differences between pure exporters, defined as firms that export at least 90 percent of their output, and general exporters, defined as firms that export less than 90 percent of their output. We use census data on manufacturing firms collected by the National Statistical Office (NSO) of Thailand. The survey was conducted in three waves: 2007, 2012, and 2017. The data comes in two formats: the repeated cross-sectional data, which covers around 300,000 observations, and the panel data, which contains a sub-sample of around 10,000 establishments that existed in all three waves of the industrial census. The panel data allows us to resolve the endogeneity problem that arises when we estimate firm-level productivity. We are among the first group of researchers who have access to the latest 2017 census data and the panel data.

We first document evidence for the bimodality of the export intensity distribution. We show that the bimodality of export intensity holds across various classifications such as the census year,

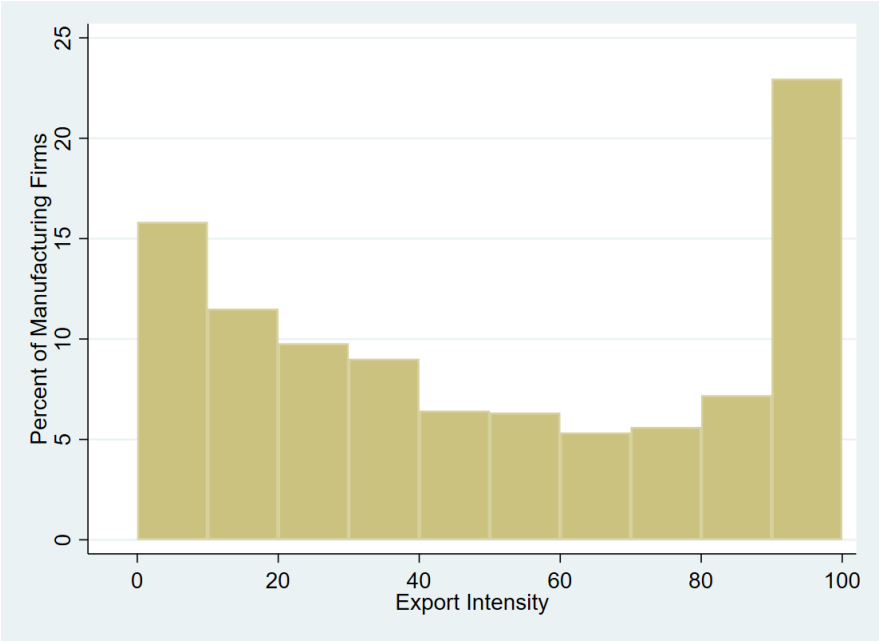

Figure 1: The probability density function of export intensity of manufacturing firms in Thailand in year 2007, 2012, and 2017.

region, industry (ISIC two-digit code), firm size, economical form and legal form of organization, and firm age. The evidence suggests that the existence of pure exporters is not driven by obvious factors. We do not find evidence that pure exporters are restricted to processing-trade firms that produce and export according to orders from abroad.

We use the repeated cross-sectional data to compare characteristics of pure exporters and general exporters. Pure exporters are, on average, larger than general exporters in terms of output and value added. We do not find a pure exporter premium on productivity (measured by output per worker and value added per worker). Pure exporters likely use more capital and labor than general exporters do, but the capital-labor ratio of pure exporters is smaller than that of general exporters. Generally, pure exporters export to developed countries while general exporters export to developing countries.

One possible source of the bimodality is the productivity distribution. To investigate this possibility, we use the panel data to estimate the productivity of Thai manufacturing firms using the productivity estimation method in Levinsohn and Petrin (2003) with the adjustment suggested by Wooldridge (2009). This estimation technique helps to eliminate the endogeneity problem between productivity and input usage choices. We find that the productivity distributions of pure exporters and general exporters are similar. In line with Melitz (2003), there is no evidence that the underlying productivity distribution is a driving factor of the bimodality of the export intensity distribution.

We use Logit models and linear probability models with fixed effects to identify factors that can explain the likelihood that an exporter self-selects to be a pure exporter. Again, we do not find

evidence that the underlying firm productivity drives the choice. Both models agree that having foreign ownership, receiving investment promotion from the Board of Investment (BOI), being a younger firm, having less product varieties, and exporting to a high-income country are factors that determine the probability of being a pure exporter. We repeat the same analyses using the repeated cross-sectional data which have more observations. The results are consistent with those from the panel data, and, as a result of larger sample size, the statistical power of the hypothesis tests increase and the confidence intervals of the estimates are narrower.

Finally, we provide policy recommendations to the government of an export-oriented country like Thailand. To promote export, the government can encourage more exporters (extensive margins), stimulate exports per firm (intensive margins), or incentivize firms to become pure exporters that focus only on foreign markets. These alternative channels require targeting different industries with different combinations of extensive margin, intensive margin, and proportion of pure exporters, so as to achieve the greatest results from investment promotion.

The main contribution of this paper is to investigate the underlying sources of heterogeneity in export intensity in a developing country by using the data from Thailand. Our paper is closest to Defever and Riano (2017), who use the World Bank Enterprise Surveys (WBES) to show that the bimodality pattern arises in other countries including Thailand, Ireland, and Uruguay. They argue that exporters choose export intensity based on realized firm-specific demand shocks in the domestic market and the world market. In small countries, wherein the magnitude of a demand shock in the world market is relatively large compared to the domestic demand shock, a mass of exporters select to serve only the world market. They present a theoretical model to show that the bimodality exists when the underlying distribution of demand shocks are lognormal, gamma, or Frechet with sufficiently large dispersion.

Alfaro et al. (2017) find this same pattern in firms in emerging economies in Asia, which have a higher export intensity than firms in other emerging economies and industrialized countries. They build and estimate a dynamic model of firm behavior in R&D and export decisions and find that the high export intensity of firms in emerging Asia is due to large foreign demand relative to domestic demand. Brooks (2006) studies export intensity in Colombia using Colombian plant-level data from 1981–1991. Low-intensity exporters are the best output producers; however, they are not able to produce at the quality level demanded by wealthy and large foreign markets. High-intensity exporters, on the other hand, are the highest quality producers and tend to sell most successfully abroad, but have a smaller size advantage and much lower domestic sales. Lu (2010) shows that the export intensity in China is bimodal and exporters are relatively less productive.

The main difference between our work and theirs is that we use detailed firm-level information to explore firms' characteristics and find that the bimodality comes from many dimensions other than the demand side. We show that the government's policy (investment promotion), firm's characteristics (firm age, foreign ownership, etc.), and the demand side (high-income export destinations) all play an important role. In contrast to Lu (2010), we do not find evidence that productivity is a driving factor.

The rest of the paper is organized as follows. Section 2 describes the data source and variable descriptions. Section 3 provides summary statistics of pure exporters and general exporters and compares the differences. Section 4 describes the productivity estimation procedure and compares the productivity distribution between groups. Section 5 investigates the determinants of export intensity and the likelihood of being pure exporters. Section 6 uses the repeated cross-sectional data to re-investigate the previous empirical exercises. Section 7 presents policy recommendations. Section 8 describes robustness checks. Section 9 concludes.

2 Data Source and Variable Descriptions

2.1 Data Source

We use Thailand's firm-level data from three rounds of the industrial census, namely: 2007, 2012, and 2017. We only use these three census surveys because prior to 2007, the National Statistical Office (NSO) only conducted the industrial census every 10 years.

The industrial census is suitable for our research question for several reasons. First, it contains our main variable of interest, namely export intensity, which is obtained from a question directly asking for the share of sales that a firm exported in the fiscal year. Second, this dataset offers a wide range of firm characteristics, including firms' main sector of operation, location, age, ownership status (whether the firm is domestic or foreign-own), the share of input materials accounted for by import, product variety produced, employment structure, investment incentives by the Board of Investment of Thailand (BOI), remuneration, and total sales. We will use these firm-specific attributes to compare exports with various degrees of export intensity.

One main advantage of our chosen data set is the data coverage that the census data provides. The data include the operational information of manufacturing establishments in Thailand covering around 300,000 firms, while other firm-level surveys, such as the World Bank Enterprise Surveys (WBES) or the Office of Industrial Economics' Annual Survey, usually cover only around 1,000 firms. In addition, the latest 2017 census survey questionnaire contains a special added section inquiring about international transactions of a firm (other than the usual export and import status). For example, one question asks whether a firm is an original equipment manufacturer (OEM) for a foreign company, which could be used to make an argument about processing trade.

The original data set comes in two forms: repeated cross-sectional data and panel data. The repeated cross-section data has 73,931 observations in 2007, 98,482 observations in 2012, and 118,639 observations in 2017. The number of observations in all three surveys is 291,052. Alongside the repeated cross-sectional data, we also obtain a sub-sample of 9,211 establishments in a panel format that existed in all three waves of the industrial census.

The panel data set is particularly useful for us in estimating the firm-level productivity, which allows us to correct the biases that usually arise in firm productivity estimated using traditional methods. The residual obtained from production function estimation via OLS is biased due to the correlation between productivity and input choices. We cleaned the data following standard pro-

cedures in the literature. The details of our data cleaning procedure are included in the appendix. The numbers of observations in the repeated crossectional data and the panel data become 246,390 and 25,495, respectively.

2.2 Variable Description

To study the determinants of export intensity, we fully utilize all available information from the questionnaire. The information can be grouped into two sets: (i) firm-specific general characteristics and (ii) firm-specific decisions made by individual firms.

The first set of variables includes firm-specific characteristics and their measurement, namely region, province, industry classification, size, the legal and economic forms of organization, age, foreign ownership, and investment promotion from the Board of Investment of Thailand (BOI). The variables region, province, industry classification, size, legal and economic form of organization are categorical variables. The 'Region' variable consists of five groups: Bangkok, Central region, Northern region, Northeastern region, and Southern region. The 'province' variable contains all 76 provinces in Thailand. The 'industry classification' follows the International Standard Industrial Classification of All Economic Activities (ISIC), the international reference classification of productive activities. We use the two-digit ISIC code and restrict our samples to the 23 groups of manufacturing industries. Firms are classified into small, medium, and large enterprises according to the total number of employees, with less than 50 people employed being small, more than 50 but less than 200 people being medium, and more than 200 people being large.

The legal form of organization contains nine groups: (i) individual proprietor, (ii) juristic partnership, (iii) company limited or public company limited, (iv) government of state-enterprises, (v) cooperatives, (vi) community enterprise, (vii) association, (viii) foundation, and (ix) others. The economic form of organization consists of three groups: (i) single unit, (ii) head office, and (iii) branch. The last two variables, foreign ownership and investment promotion from the BOI, are dummy variables. The foreign ownership dummy variable has a value of one if the firm receives foreign investment or involves foreign shareholding, zero otherwise. For the robustness of the empirical evidence, we also use the actual share of foreign ownership. The investment promotion dummy is a dummy variable that has a value of one if the firm receives investment promotion from the BOI, and zero otherwise.

Regarding the investment promotion, the BOI was found in 1966 under the aegis of the Prime Minister's Office. The mission of the BOI is to promote investment in Thailand through tax and non-tax incentives. The benefits include exemption of corporate income tax for up to 13 years, exemption of import duties on machinery and materials used in (i) production for export and (ii) research and development purposes, and permits to bring in skilled workers and experts to work in Thailand. In 2017, the BOI approved 1,456 projects: 480 projects were own sole by Thais, 502 projects were owned by foreigners only, and 474 projects were joint ventures between Thais and foreigners. The criteria are relatively achievable. For example, the value added of the project must be at least 20% of revenues, must use advanced technology, and must have a minimum capital

investment of 1 million baht (approximately $30,000).

The second set of variables pertain to firms' individual decisions such as export status, export intensity, input usages, output, use of imported materials, and capacity utilization. These variables are continuous variables except for export status and import status, which are dummy variables. For output and capital, we use sales of products produced in the survey year and fixed assets at the beginning of the survey year, respectively. The unit of account is in terms of Thai Baht ($\$1 \approx 32 - 35$ Baht). As for labor, we use the number of employees because Thai firms are reluctant to share wage compensation information (Kohpaiboon and Jongwanich, 2013). For intermediate inputs, we use the information on the purchase of raw materials and components.

Table 1 and 2 provide summary statistics of key variables used in this study for cross-sectional and panel versions, respectively. The continuous variables are reported in the log term.

3 Pure Exporters vs General Exporters

3.1 Definitions and stylized facts

3.1.1 Consistent patterns throughout classifications

Motivated by the data in Figure 1, we classify the firms into two groups based on their export intensity. We define the firms that have export intensity larger or equal to 90% as pure exporters (PE). The others are considered general exporters (GE). In the cross-sectional data, there are 3,393 pure exporters among 14,778 exporters (22.96%), and in the panel data, there are 1,030 pure exporters among 4,569 exporters (22.54%).

Using the repeated cross-sectional data and the panel data, we document evidence that export intensity is distributed bimodally. Export intensity is divided into 10 bins: 0-10, 10-20, 20-30, ... , 90-100. We find that the distribution of export intensity has two peaks (almost always at the top bin and the bottom bin). In Figures 2 - 11 in the Appendix, we illustrate that the bimodality pattern holds across various classifications: census year, region, location, firm size, firm age, industry (ISIC two-digit code), the economic form and the legal form of organization, the foreign ownership dummy, and the investment promotion dummy. The same pattern arises in the panel data as well.

3.1.2 Firm transition in and out of being pure exporters.

We use the transition matrix to study the origin of pure exporters whether they were born to be pure exporters or they were non-exporters or general exporters that later became pure exporters. If pure exporters were born to be, we would expect that the share of pure exporters among young exporters should be larger than the share of pure exporters among older firms. When we classify the exporters into groups by their age and calculate the share of pure exporters in each group, the share of pure exporters among all exporters that are younger than 10 years old is 0.28 and the shares in the other age groups are in a range of 0.24 to 0.33. The pattern of the shares does not exhibit a pattern that supports the hypothesis.

Furthermore, we use the panel data to investigate the transition matrix. On average, 55.1 percent of pure exporters were pure exporters in the previous census year, 24.8 percent were general exporters, and 20.1 percent were non-exporters. There are 44.9 percent of pure exporters that were not pure exporters in the previous period. Pure exporters in a current period have 46.5 percent chance of remaining pure exporter in the next census year, 22.5 percent chance to change to general exporters, and 31.1 percent chance of exiting the exporting market. Thus, the argument that pure exporters are born to be and change their status to general exporters or non-exporters is not solid.

3.1.3 Pure exporters are not restricted to processing-trade firms

One argument for the bimodality is that pure exporters are firms that are involved in processing trade. In other words, they import materials, assemble the output, and then export the final products. There are two main reasons why the data is not in favor of this argument.

First, if pure exporters were firms that are involved with processing trade only, then a large fraction of their materials would have been imported for production of export. However, most pure exporters import only a small fraction of their materials. In Figure 12, we compare the distribution of the shares of imported materials between export status. The share of imported materials of pure exporters is uniformly distributed except the top bin that contains 19.9% of pure exporters. Only 7.86% of the pure exporters import 100% of their materials and around 50.6% of the pure exporters import at most 50% of their inputs. This fact suggests that pure exporters' activities are not only concentrated in assembling imported material into final products.

In Figure 13, we classify firms into two groups based on whether or not the firm imported materials and compare the distribution of export intensity between the groups. The bimodality exists even in a group of firms that do not import materials. The distributions exhibit a similar pattern although the two-sample Kolmogorov-Smirnov test rejects the null hypothesis that they are drawn from the same distribution.

Second, if pure exporters were processing-trade firms, then they would produce for particular companies. To investigate this possibility, we exploit information from the question "Does the establishment assemble or produce for another establishment?" which was included only in the 2017 Industrial Census. This question directly asks whether a firm is an OEM which imports inputs and exports the final product to another firm. Based on the cross-sectional data of the year 2017, only 8.7% of general exporters and 12.7% of pure exporters were involved with activities related to OEMs. Therefore, 87.3% of pure exporters in the 2017 survey data are not related to processing trade.

Based on these two stylized facts, it is difficult to conclude that pure exporters are restricted to processing-trade firms only.

3.1.4 Pure exporters are not restricted to firms in free trade zones

Another possibility is that pure exporters are firms in free trade zones. Unfortunately, the data does not contain exact information whether the firms are located within the free trade zones. Thus, we proxy for whether a firm is located in a free trade zone by exploiting the information on whether the firm is located in an industrial district and whether the province where the firm is located has a free trade zone. The idea is that a firm that is not located in an industrial district or is not located in a province that has a free trade zone definitely is not located in a free trade zone. This proxy can be considered as the smallest upper bound of firms in free trade zones because a firm that is in an industrial district in a province that has a free trade zone is not necessarily located in a free trade zone. This is the most accurate proxy we can get from the data.

We create the FTZ dummy variable which is assigned the value of one if the firm satisfies two conditions: (i) being in an industrial district and (ii) locating in one of the 8 provinces that have at least one free trade zone area. The variables has a value of zero if a firm does not meet at least one of these conditions. These 8 provinces that have at least one free trade zone area are Bangkok, Chonburi, Chachoengsao, Lamphun, Pichit, Ayutthaya, Samutprakarn, and Songkhla.

According to the repeated cross-sectional data, 1.71% of the firms are located in an industrial district in a province that has a free trade zone, and 33.79% of these firms are exporters. When we compare the share of pure exporters to total exporters, we find that 21.84% of exporters in the industrial districts in the provinces that have at least one free trade zone are pure exporters while 20.80% of the other exporters are pure exporters. In addition, 11.68% of general exporters and 12.46% of pure exporters are located in the industrial districts in the province that have at least one free trade zones. Therefore, pure exporters are equally likely to be within or outside a free trade zone, and a majority of firms inside the free trade zone areas are general exporters.

3.2 Pure exporter premia

Exporter premia have been well established in the literature. Comparing between exporters and non-exporters, exporters are larger, more productive, and pay higher wages. In this section, we carry out the same exercise, asking whether such premia exists for pure exporters compared to general exporters.

To compare between pure exporters and general exporters, we use the repeated cross-sectional data and exclude firms that are non-exporters. We define the pure exporter dummy d^{PE} which takes the value of 1 if the firm is a pure exporter and 0 if it is a general exporter. Then we regress firms' characteristics with respect to the pure export dummy and industry-year fixed effects. The estimation takes the form of

$$y_{ist} = \beta^y d^{PE}_{ist} + \gamma_{st} + \varepsilon_{ist},$$

where y_{ist} is a characteristic of interest, β^y is the pure exporter premium on the characteristic y, γ_{st} is an industry-year fixed effect, and ε_{ist} is an error term.

3.2.1 Production

In the first set of characteristics, we investigate the pure export premia on output, value added, productivity measured by output per labor and value added per labor, export volumes, firm ages, and the number of products produced.

The results are reported in Table 3 and are summarized in Fact 1.

Fact 1. *Pure exporters are larger and younger than general exporters. There is no evidence of pure exporter premium on productivity.*

First, pure exporters are generally 30% larger than general exporters in terms of output and value added. Exports of pure exporters are 175% larger than exports of general exporters. The first two points suggest that pure exporters are not small firms that produce for exports only. Instead, they are large firms that also export a large volume of their output.

Second, pure exporters and general exporters seem to be equally productive. In this exercise, productivity is proxied by output per worker and value added per worker. The productivity proxies are normalized at the industry-year level. The estimated pure exporter premia are small and are not statistically significant from zero. This is contrast to the finding in Lu (2010) that high-export-intensity Chinese firms are less productive than Chinese firms that sell domestically.

Third, pure exporters are, on average, younger than general exporters. The average age of pure exporters is 16.0 years, while the average age of general exporters is 18.4 years. One interpretation is that firms start with aiming at foreign markets initially and later shift toward the domestic market. Another interpretation is that there could be a structural change that facilitated firms that were established after the change to become pure exporters. Lastly, pure exporters export slightly fewer number of products.

3.2.2 Pure exporters' input usages

In this section, the variables of interests are capital, labor, and materials. Since the dependent variables are log-transformed, we handle zeros in three ways: (i) excluding the zeros, (ii) employing the inverse hyperbolic sine transformation, and (iii) adding a small positive number to the zeros. These three ways give similar point estimates. We present only the regressions that exclude the zeros. The results are shown in Table 4 and are summarized in Fact 2.

Fact 2. *Pure exporters use more capital, labor, and materials than general exporters do.*

We find that pure exporters tend to use more inputs than general exporters do. This is consistent with the findings in Section 3.2.1 that pure exporters are larger than general exporters in terms of output and value added. First, on average, pure exporters employ 11.5% more capital and utilize their capital 2.5% more than general exporters do. The capital utilization rate of the average pure exporter is 81.3% and 25.2% of pure exporters fully utilize capacity. The capital utilization rate of the average general exporter is 78.9% and only 17.6% of general exporters use capital up to the capacity.

Second, pure exporters employ 29.1% more labor than general exporters do. This pure exporter premium is contributed by a 31.8% increase in labor in production and an 12.0% increase in labor not in production. In terms of skill decomposition among labor in production, pure exporters use 26.7% more skilled labor and 28.5% more unskilled labor than general exporters. The ratio of skilled labor to all labor in production, is not statistically significantly different between pure exporters and general exporters. Third, although pure exporters use more capital and labor than general exporters, the capital-labor ratio among pure exporters is generally 17.9% lower. This suggests that pure exporters may use a relatively more labor-intensive production technology. Lastly, pure exporters use 24.7% more input materials than general exporters. The average pure exporters imports 52.7% of its materials while the average general export imports 37.5% of its materials. Therefore, pure exporters also have a larger share of imported material than general exporters do.

3.2.3 Export destination

We exploit the 2007 census data to investigate whether pure exporters and general exporters share a similar pattern on export market.

Table 5 reports the numbers of pure exporters and total exporters in each export destination. We exclude destinations that are associated with fewer than 10 exporting firms, and we sort the destinations by the share of pure exporters out of the total number of exporters in that destination. The top-ten countries are Switzerland, Israel, Canada, Belgium, France, U.S.A., Italy, U.K., Spain, and Germany. The bottom-ten countries are Pakistan, India, Vietnam, Indonesia, Myanmar, Lao PDR, DPR of Korea, Bangladesh, Sri Lanka, and Nigeria.

The top-10 countries are high-income countries, and the bottom ten countries mostly are low-income or middle-income countries. Table 5 suggests that pure exporters are likely to concentrate in high-income countries.

Fact 3. *Pure exporters tend to export to high-income countries.*

Motivated by Fact 3, we will introduce a dummy variable for exporting to a high-income country in the estimation.

4 Firm-Level Productivity

One possible reason for the bimodality of the distribution of export intensity is that underlying productivity itself could be bimodally distributed. In this section, we use the confidential panel data to estimate firm-level productivity and show that the productivity distribution is not bimodal.

4.1 Productivity Estimation Methodology

To estimate firm productivity, we follow the literature by assuming sector-specific production functions of the form

$$\ln(va_{ist}) = a + \beta_s^k \ln(k_{ist}) + \beta_s^l \ln(l_{ist}) + \omega_{ist} + \epsilon_{ist}, \quad (1)$$

where $\ln(va_{ist})$ is the logarithm of the firm's value added, $\ln(k_{ist})$ is the logarithm of capital, $\ln(l_{ist})$ is the logarithm of labor, the subscript ist denotes the value of firm i in sector s in year t, ω_{ist} is the realized productivity which firm i knows before it makes production decision at time t, and ϵ_{ist} is the unexpected productivity which firm i did not know but is effective at time t. The input choice is made based on ω_{ist} but not ϵ_{ist}. Both ω_{ist} and ϵ_{ist} are assumed to be uncorrelated and unknown to econometricians.

It is commonly known that OLS estimators are biased and inconsistent due to the input-choice endogeneity problem; the firm's input decisions are influenced by productivity that is known to the firm but unknown to the econometrician. Thus, the regressors and the residuals are correlated. To surpass the endogeneity problem, we follow the production estimation methodology in Levinsohn and Petrin (2003; henceforth, LP). We assume that the demand functions of variable inputs are a function of productivity and fixed inputs. Assuming that these demand functions are invertible, we can recover productivity from information on variable inputs and fixed inputs. We use raw materials as a proxy for the unobservable productivity. Because of the identification problem in LP procedure, we use the adjustments based on Wooldridge (2009). In section 8, we discuss how our estimation results are robust to various alternative TFP estimation strategies. The industry-level production functions are estimated via the *prodest* Stata package developed by Mollisi and Rovigatti (2017). We cannot estimate the productivity of the firms in the office computing industry and the recycle industry due to data insufficiency; there are only 23 observations in the office computing industry and 26 observations in the recycle industry.

TFP is re-scaled around the industry-year TFP mean and divided by the industry-year TFP standard deviation.

4.2 Pure Exporters versus General Exporters

Can the productivity distribution explain the bimodal distribution of export intensity? To answer this question, we investigate the distribution of the estimated firm productivity.

The productivity distributions of general exporters and pure exporters are shown in Figure 14, and the summary statistics for demeaned productivity of general exporters, pure exporters, and non-exporters is provided in Table 6. Generally, exporters are relatively more productive than non-exporters. The averages of productivity of exporters and non-exporter are 0.93 and -0.20, respectively. The t-test rejects the null hypothesis that the averages are equal. In addition, the productivity distribution of non-exporters is more dispersed than that of exporters, as we can see that the standard deviations of productivity of non-exporters and exporters are 1.35 and 1.07, respectively.

The averages of productivity of general exporters and pure exporter are 0.92 and 0.97, respectively. The null hypothesis that the averages are equal cannot be rejected (ρ-value $= 0.16$.) The

standard deviations of productivity of both groups are almost equal.

Fact 4. *The productivity distributions of pure exporters and general exporters are similar.*

One possible reason for the bimodality of the distribution of export intensity is that underlying productivity itself is bimodally distributed. However, Figure 14 invalidates this reason because pure exporters are not significantly more productive and there is no unusual density of productivity that could generate a group of pure exporters. To show that our conclusion is robust to the definition of pure exporters, Table 7 provides the averages of productivity across different ranges of export intensity.

It is possible that pure exporters and general exporters have different production functions. We investigate this possibility by estimating separate production functions for pure exporters and general exporters. Again, we do not find a systematic difference between the two groups in terms of production function and firm productivity.

5 Empirical Results: Evidence from Panel Data

In this section, we use the panel data to study the determinants of export intensity. The advantage of using this set of data is that we can use more reliable productivity estimates in our regressions. Later, in Section 6 we use the repeated cross-sectional data, which has a large number of observations, to confirm the findings in this section.

5.1 Output and export of heterogeneous firms

We first test the standard findings in the literature whether a more productive firm is associated with larger output and export volume.

The dependent variables are output and value added. The regressors include firm productivity and a set of firm characteristics. The set of firm characteristics consists of the dummy for having foreign ownership, the dummy for receiving investment promotion from BOI, the dummy for using imported materials, and firm age. We include industry-year fixed effects to capture most sources of omitted variable bias, such as time-varying industry-specific tariffs or transportation costs. The results are shown in Table 8.

We confirm the standard finding in the literature that a more productive firm is relatively larger than a less productive firm in terms of output and value added. The estimates suggest that a one-percent increase in TFP is associated with a 2.1 percent increase in both output and value added, holding industry and year constant. When we include additional regressors, the estimates both decrease to around 1.9. A firm that has foreign ownership is likely to produce 43.4-percent more output and 44.1-percent more value added. Receiving investment promotion from BOI is associated with a 52.8-percent increase in output and a 47.2-percent increase in value added. These results are consistent with Danish firm-level data (Munch and Schaur, 2018). In addition, we estimate the same regressions in the subgroup that contains only exporters. The results are consistent

with the estimates from the full sample, but the coefficients for firm productivity, foreign ownership, and imported materials slightly decline while the coefficients for investment promotion and firm age slightly increase.

We then investigate the determinants of export status (extensive margins) and export volume (intensive margins). We use a Logit model to estimate the probability that a firm decides to export. The regressions from the Logit model do not include fixed effects due to an incidental parameters problem. We report both coefficients and their associated marginal effects in Table 9. In the same table, we provide the estimates from a linear probability model (LPM), which allows us to include industry-year fixed-effects. The results from the Probit model, which are not shown in the paper, are similar with those from the Logit model.

Our results are consistent with the findings in the literature. A highly-productive firm is more likely to be an exporter than a less-productive firm. A firm with a 100-percent larger productivity level is more likely to be an exporter by 13.4 percent based on the Logit model and 11.8 percent by the LPM. When we include more controls, we find that foreign ownership, investment promotion, imported materials, and firm age are associated with an increase in the likelihood of being an exporter. The results are consistent with the estimates from the LPM.

Subsequently, we study the determinant of export volume and show the estimates in Table 9. We find that increasing a firm's productivity by one-percent is associated with 1.45 percent increase in exports. The magnitude decreases to 1.28 percent when additional variables are included in the regression. Foreign ownership, investment promotion, imported materials, and firm age are associated with a larger export volume.

5.2 Export Intensity

In this section, we investigate the determinants of variation in export intensity among exporters. The dependent variables are export intensity and log(export intensity). We use log(export intensity) because it is related to log(output) and log(export volume) in the previous section. The models are estimated using OLS with industry-year fixed effects. The results are shown in Table 10.

Consistent with the similarity of productivity distributions between pure exporters and general exporters shown in Figure 14, we do not find evidence that firm productivity drives export intensity in any model specifications. Foreign ownership and investment promotion are positively correlated with export intensity, but firm age is negatively correlated with export intensity. The rationale for these correlations comes from the results in columns (3) and (4) in Table 8 and columns (5) and (6) in Table 9. A one-percent increase in firm productivity increases exporters' output and exports by approximately equal percentage points. Therefore, export intensity, which is the fraction of exports in output, does not significantly respond to a change in firm productivity. Foreign ownership increases exports by 69.5 percent whereas it increases output of exporting firms by 37.0 percent.

Similarly, investment promotion increases exports by 92.0 percent and increases output by 64.3 percent. These estimates are consistent with the coefficients of foreign ownership and investment

promotion, which are 0.326 and 0.277, respectively, in Table 10. A one-year increase in firm age, which raises output of exporters by 1.9 percent and raises exports by 1.1 percent, decreases export intensity by 0.8 percent. We also control for firm's other characteristics by including capital-labor ratio, fraction of skilled labor, and the number of products. The estimates do not show robust evidence in favor of these additional characteristics explaining differences in export intensity.

Motivated by Fact 3, we control for the income of the export destination by including the dummy for exporting to a high-income country. The classification is based on the World Bank's list of high-income countries. Because the information regarding export destination exists only in the 2007 census year, the estimation is done in the sub-sample of year 2007 and the industry-year fixed-effects are reduced to industry fixed effects. The results reveal that exporting to a high-income country corresponds to a 20.7 percent increase in export intensity.

5.3 The likelihood of being pure exporter

In this section, we investigate factors that sort exporters into pure exporters and general exporters. The dependent variable is the dummy for being pure exporter, which equals one if the firm is a pure exporter and zero otherwise. We estimate the model using linear probability models (LPM) with industry-year fixed-effects and Logit models. For the Logit models, we report both the coefficients and their corresponding marginal effects. The results are shown in Tables 11 and 12.

We confirm the finding from the previous section that the coefficient of firm productivity is not statistically significantly different from zero regardless of model specification. This finding is not unexpected after we have seen the productivity distribution in Figure 14 and the estimates in Table 10.

Fact 5. *Firm productivity cannot explain the choice of being a pure exporter or a general exporter.*

An important implication is that re-allocating inputs from general exporters to pure exporters does not necessarily increase the production efficiency or welfare of the economy. As suggested by Melitz (2003), one source of gains from trade is that trade liberalization leads to the production efficiency gains from re-allocating inputs from less productive firms to more productive firms. This source of gains from trade is supported by our empirical results because exporters are more productive than non-exporters. However, it is not necessarily true that promoting the production of pure exporters dominates promoting the production of general exporters in terms of welfare and efficiency consideration.

Next, we introduce firm characteristics as additional regressors. We find that having foreign ownership and receiving investment promotion increase the likelihood of being pure exporter while firm age decreases the likelihood. A firm that has foreign ownership is 7.9-percent more likely to be a pure exporter. A firm that receives investment promotion is 3.5-percent more likely to be a pure exporter. Firm age has a small but statistically significant negative effect. A one-year increase in firm age reduces the likelihood of being pure exporter by 0.3 percent. The marginal effects from the Logit model and the coefficients from the LPM are consistent.

To confirm that firm productivity cannot explain variation in export intensity, we repeat the estimation and add the square of firm productivity and the interactions of firm productivity with other variables. The results from both the Logit model and the LPM confirm that firm productivity cannot explain the likelihood of being pure exporter. We include additional firm characteristics and find a small positive effect for capital-labor ratio and a small negative effect for the number of products. The Logit model and the LPM suggest similar magnitudes; a one-percent increase in capital-labor ratio reduces the likelihood by one percent, and producing one additional type of products reduces the likelihood by 1.3 percent.

One may argue that pure exporters are a result of trade policy. Although export subsidies have been banned by the World Trade Organization (WTO), the government may promote exports by establishing free trade zones.[1] We capture the impact of locating in a free trade zone by including the dummy variable FTZ that was discussed in Section 3.1.4. The estimated marginal effect of the FTZ dummy variable is 0.008 in both the Logit and the LP models, but the estimate is not statistically significant. We are aware that the FTZ dummy is a noisy measure of the location. To reduce the noise, we also estimate the same models without exporters in Bangkok because only a small fraction of industrial districts in Bangkok are free trade zones. The conclusion remains unchanged.

We also investigate the demand side effect by including the dummy for exporting to a high-income country. Exporting to a high-income country increases the likelihood of being pure exporter by 23.5 percent (Logit model) and 19.4 percent (LPM).

Fact 6 concludes the finding.

Fact 6. *The likelihood of being pure exporter is positively associated with having foreign ownership, receiving investment promotion, and exporting to high-income country, and it is negatively associated with firm age, capital-labor ratio, and the number of products.*

One explanation that fits the estimation results is that pure exporters are firms that received benefits from the government's policy or received large demand from their export markets; pure exporters take advantage of locating in a relatively labor-abundant country by producing relatively labor-intensive products.

6 Empirical Results: Evidence from Repeated Cross-Sectional Data

In this section, we use the repeated cross-sectional data to re-investigate the empirical results in Section 5. One advantage of the repeated cross-sectional data is its larger sample size. The main disadvantage is that we cannot use the estimation technique to recover unbiased estimates of firm productivity. In this section, firm productivity is proxied by output per worker and value added per worker. We are less concerned about using unbiased measures of firm productivity because,

[1] The benefits of free trade zones include the exception of import tariffs, duty fees, and value added tax for selected imported product and merchandise. Free trade zones can be considered as location outside Thailand customs and tax authority.

according to Section 5, firm productivity is not a key determinant of export intensity or the likelihood of being a pure exporter.

The estimation results on output, value added, export status, export values, and export intensity are similar to the results obtained from the panel data that are shown in Table 8 - 10. Thus, we provide only the estimation results on the likelihood of being pure exporter, which is the main objective of the paper, in Tables 13 - 15.

The repeated cross-sectional data yields similar estimates to the estimates from the panel data. Firm productivity is not a key factor; its coefficient is not statistically different from zero in any model specifications. This result is robust to whether the proxy of productivity is output per labor or value added per labor.

Again, we find positive effects from foreign ownership and investment promotion and a negative effect from firm age. The effect of having foreign ownership is strongly robust. The point estimates of the marginal effects are in the range of 7.7-8.3 percent. They are close to the point estimates from the panel data, which is 7.5-10.4 percent. The point estimates of the marginal effects of investment promotion are in the range of 3.4-5.1 percent. This range is similar to the range of the point estimates of the marginal effects from the panel data, which is 2.2-3.7 percent. While the coefficients from the repeated cross-sectional data and the panel data are in the similar range, the standard errors from the repeated cross-sectional data are generally smaller than the standard errors from the panel data around 30-50 percent due to larger sample size. Thus, using a larger sample size from the repeated cross-sectional data increases the statistical power of the hypothesis test and allows us to reject the null hypothesis that the marginal effect of investment promotion is equal to zero.

A one-year increase in firm age reduces the likelihood of being a pure exporter by 0.2 to 0.3 percent. The effect of the capital-labor ratio is negative, but its statistical significance depends on model specification. Producing one additional type of products reduces the likelihood of being a pure exporter by 1.4-2.5 percent. We confirm that exporting to a high-income country increases the likelihood of being pure exporter by 20.8-21.1 percent (Logit model) and 17.6-17.7 percent (LPM). As in the previous section, we also estimate the effect of locating in a free trade zone. The results are similar to those from the panel data. We do not report them in the paper.

The results from the repeated cross-sectional data support the results from the panel data. The standard errors from the repeated cross-sectional data are, on average, lower than those of the panel data. Therefore, the confidence intervals from the repeated cross-sectional data are generally narrower.

7 Policy implications

Many developing countries use the export-led growth strategy as part of their long-term economic plan, and Thailand is no exception (Junetrakool et al, 2009). A natural question is how should the government stimulate exports? The government has at least three possible strategies: (i) en-

courages non-exporters to start exporting (extensive margins), (ii) encourages exporters to export larger volumes (intensive margins), and (iii) encourages firms to become pure exporters.

To provide policy suggestions to the government, we use the repeated cross-sectional data to evaluate the effectiveness of the investment promotion through the Board of Investment (BOI) by industry. The estimation results are reported in Table 16. First, if the government wishes to encourage non-exporters to become exporters, our analysis suggests that the government should grant investment promotion to firms in the wood, leather, food, furniture, or petroleum industries. Investment promotion policy is highly effective in the wood industry as it can increase the likelihood of being an exporter by 80.9 percent. The effects on the other four industries are around 59.4 to 64.0 percent.

Second, if the government wants to incentivize more exports by exporters, our analysis predicts that investment promotion should be directed to the medical optical, machinery leather, food, or electrical machinery industries. Investment promotion would increase exports of firms in the medical optical industry by 153.4 percent and exports of firms in the machinery industry by 132.4 percent. The effects in the other three industries are around 97.4 to 100.7 percent. The government may wish to increase export intensity instead of the export volumes. In this case, investment promotion would increase the export intensity of an exporter in the medical optical industry by 21.9 percentage points. The following industries are machinery (13.0), textile (11.8), rubber (9.3), and apparel (8.6).

Third, the government may wish to increase the number of pure exporters as most of their output would be exported. We find that investment promotion is very effective in the medical optical industry. When exporters in the medical optical industry receive investment promotion, they are 20.8 percent more likely to become a pure export. Other industries that have a large effect are furniture, apparel, textile, and apparel.

8 Robustness Checks

We describe additional analyses that we have conducted to verify the robustness of our results but are not shown explicitly in the paper.

8.1 Firm productivity estimation

We test whether our results depend on the choice of TFP estimation strategies. First, we allow for the possibility of model misspecification. To do so, we include previously-omitted firm characteristics as additional controls. These variables are location, the legal form of organization, and the economic form of organization, and size.

Kasahara and Rodrigue (2008) find that importing intermediate inputs improves productivity. They argue that each firm makes its export decision before choosing its variable inputs but after its productivity is realized. Following their idea, we introduce a dummy for imported intermediate inputs and a dummy for export status in the productivity estimation. We also estimate the sub-

sample of firms that have information on the share of imported intermediate inputs to use the actual share instead of the dummy. We do the same thing with export intensity. We try both imported inputs and export status as state variables and as part of control functions. The new TFP estimates are highly correlated with the TFP in the paper; their correlations are as large as 0.98.

Following De Loecker (2013), we also employ capital utilization and alternative measures of capital and labor. We use different measures of labor such as the number of labor used in production, the number of skilled labor, and the number of unskilled labor. To capture skill differences between workers, we try total labor compensation and total wage in case they include information on the skill levels. We consider payments to the total labor and the labor used in production. We find that the correlations between new TFP estimates and the TFP estimates used in the paper are in the range of 0.97-0.99. When we use payments to labor, the correlations slightly decline to 0.91.

It could be that pure exporters, general exporters, and non-exporters have different technologies. Therefore, we estimate the production function separately by sub-groups. To do so, we need to drop four sectors that do not have enough observations. We do not find significantly different production functions between non-exporters and exporters and between pure exporters and general exporters. We also use output per labor and value added per labor as simple measures of firm productivity in the panel data. We conclude that our results are robust to different measures of firm-level productivity.

8.2 Estimation

We test for the possibility of omitted variables, by including additional fixed effects for location, the legal form and the economic form of organization, and size. We also try interaction terms of variables of interest. We employ other estimation strategies. We consider a fractional outcome regression because export intensity is equivalent to a fraction between 0 and 1. When defining export intensity for non-exporters to be zero, we consider a Tobit model because we may interpret export intensity as a variable with a lower bound at 0 and an upper bound at 100. We also consider a zero-one-inflated beta model to deal with excess zeros. We try a Probit model that does not allow for the inclusion of industry fixed effects and time fixed effects. We estimate the Logit models with random effects. The magnitudes and significance of the estimates are similar under all specifications,

One concern is the endogeneity problem. It could be that export intensity or pure exporter status are simultaneously determined with the explanatory variables. Therefore, we use the panel data and employ lagged variables as instrumental variables. Our argument is that the lags of explanatory variables are correlated with the explanatory variables but the lags are not affected by the current export intensity or current pure exporter status. We find that the signs remain unchanged, but the coefficients of investment promotion and imported material occasionally are not statistically different from zero.

One argument is firm productivity should not be normalized by the industry-year standard deviation. We repeat the analysis by using the gross firm TFP, firm TFP demeaned by industry

average, TFP demeaned by industry-year average, TFP demeaned by industry average and re-scaled by industry average. The estimation results are consistent with the finding in the paper. We do not find evidence that firm productivity can explain the bimodality of export intensity.

Our results are also robust to various definitions of pure exporters. We alter the thresholds value to other export intensity levels (e.g., 80, 85, and 95) and different percentiles (e.g., 70th and 80th).

9 Conclusion

This paper studies the bimodality of export intensity distribution and its determinants. Using firm-level data on Thai manufacturing firms, we first show that the bimodality of the export intensity distribution arises regardless of categorization. To explain the two extreme export behavior of export intensity, in particular the existence of pure exporters, we first estimate firm productivity of Thai firms using Levinsohn and Petrin (2003) approach with Wooldridge (2009) adjustments. We do not find evidence that firm productivity is a factor driving the bimodality of the distribution. We find that pure exporters tend to be relatively young, have foreign ownership, receive investment promotion, and export to a high-income country.

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Appendix A: Data Cleaning Procedure

Data Cleaning Procedure

This section describes our data cleaning procedure. The repeated cross-sectional data has 291,052 observations from year 2007, 2012, and 2017. The data has been processed as follows:

- Firms are in the manufacturing industries (2-digit industry code: 15-37).
- Firms must have non-missing and unique identification numbers.
- Firms must have non-missing information for region, province, industry code, the economic form of organization, the legal form of organization, firm age, foreign ownership status, investment promotion status, export status, imported material status.
- Firms in the panel data must have consistent firm age.
- Firms must have positive value added, employment and fixed asset, which are used to estimate firm productivity.
- Firms must have output larger than 1.

After this cleaning procedure, the data set contains around 246,390 observations.

Appendix B: Figures and Tables

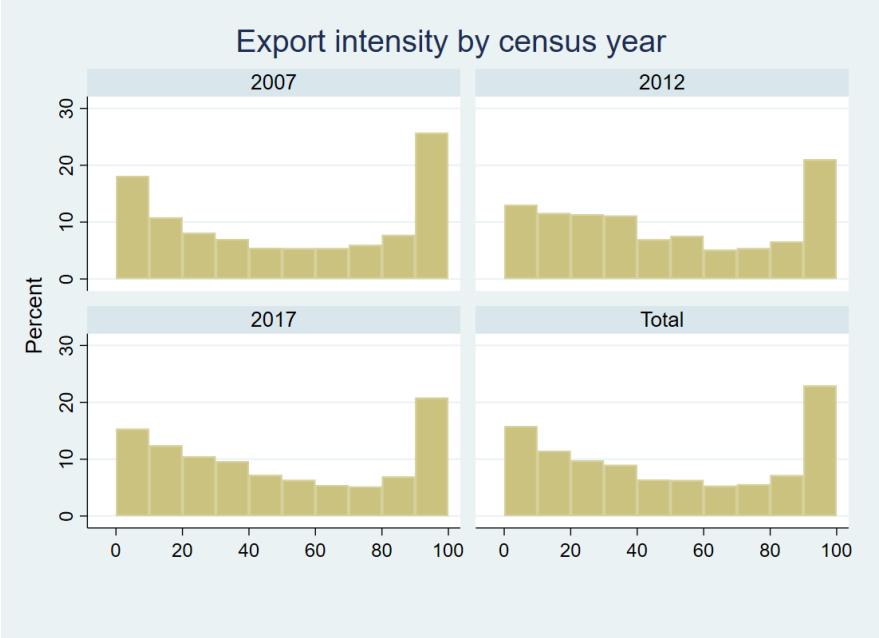

Figure 2: Export intensity by census year

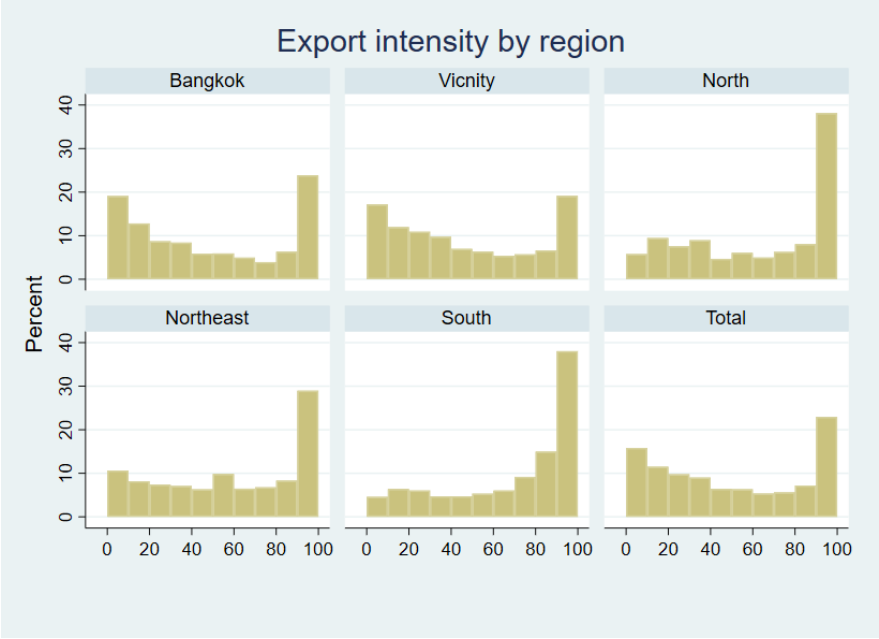

Figure 3: Export intensity by region

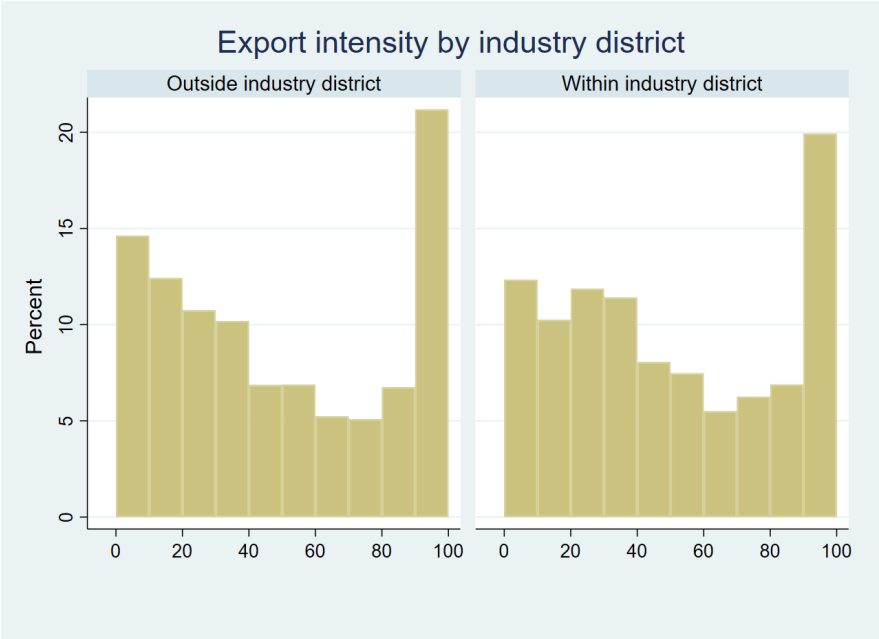

Figure 4: Export intensity by whether located in an industrial district

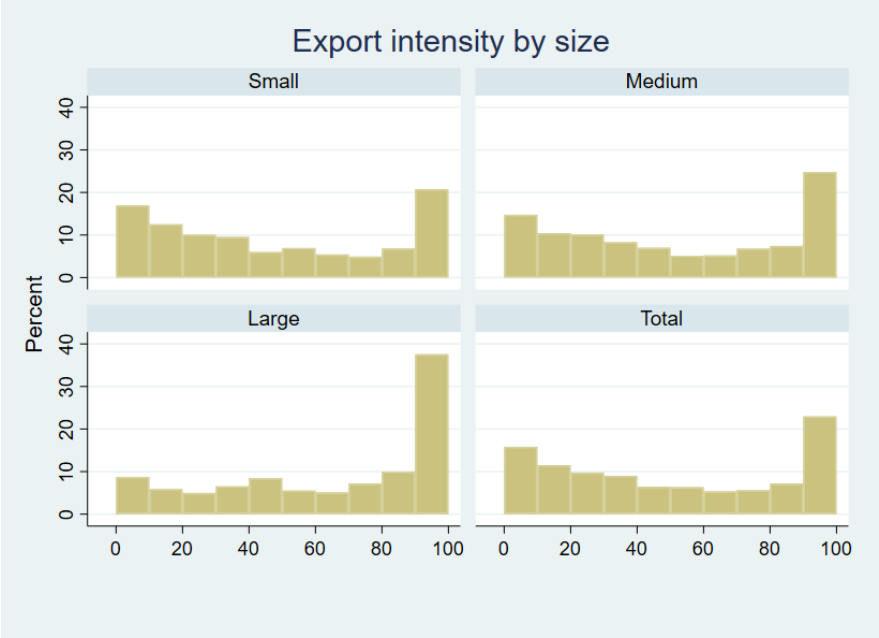

Figure 5: Export intensity by firm size

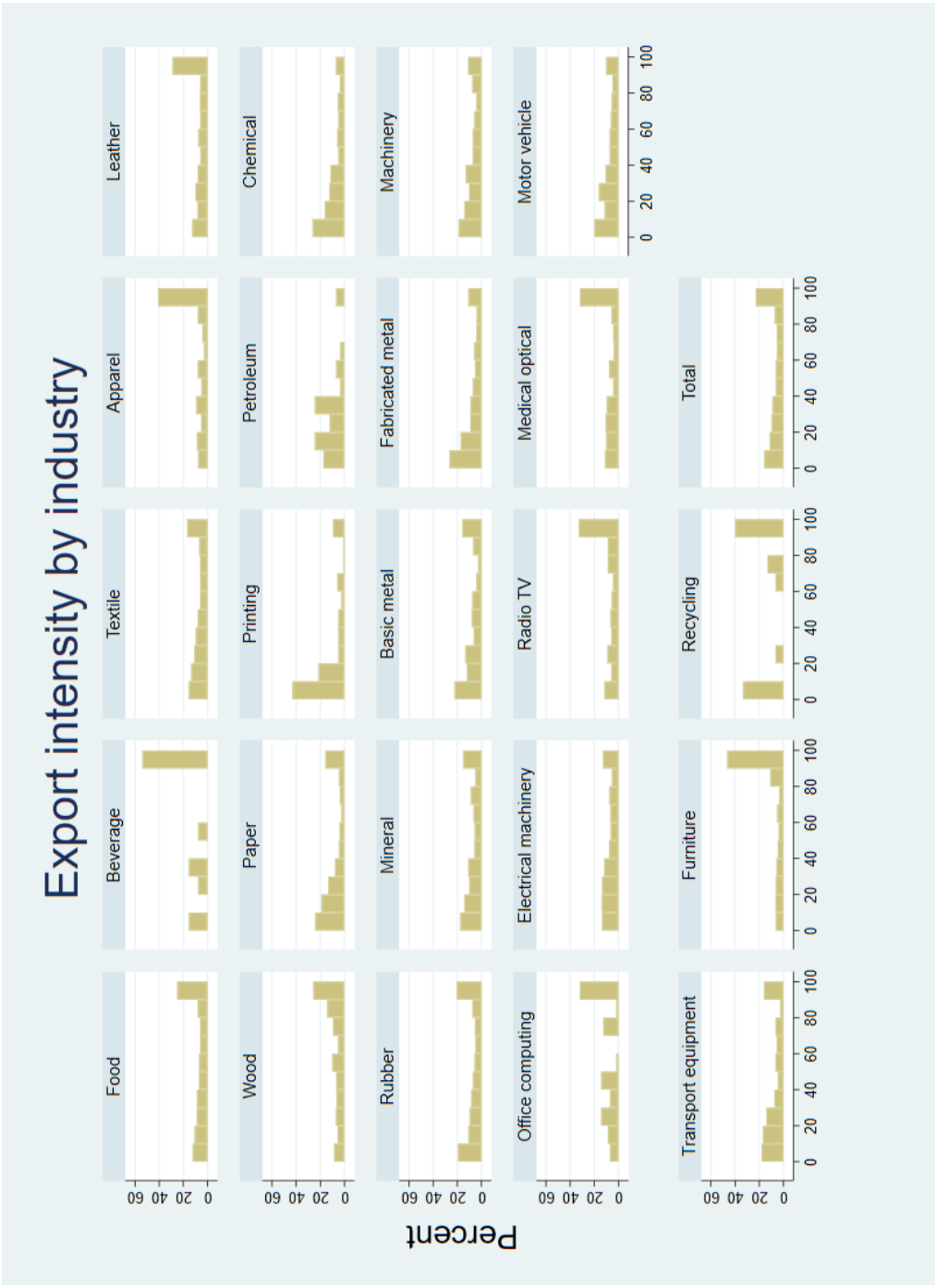

Figure 6: Export intensity by industry

Figure 7: Export intensity by firm age

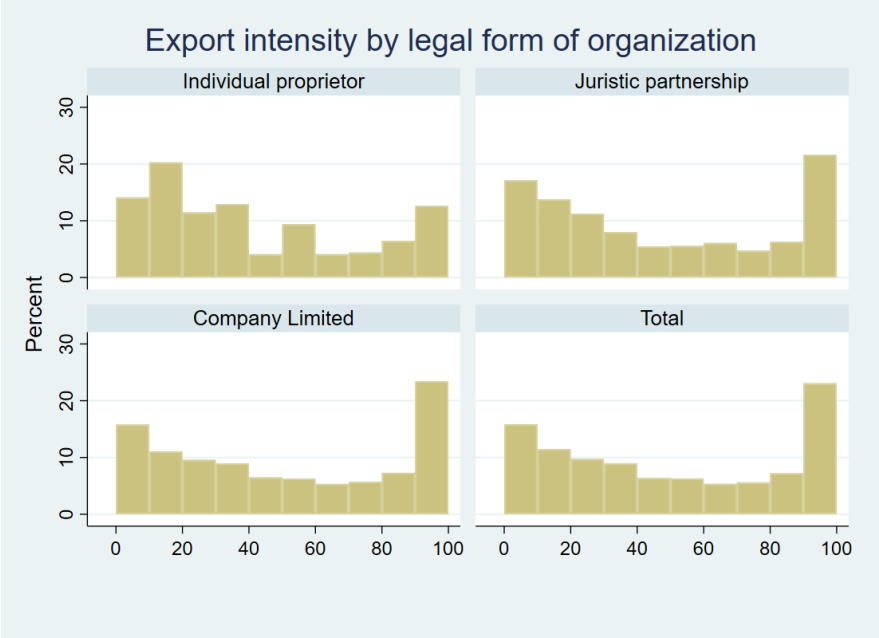

Figure 8: Export intensity by (main) form of legal organization

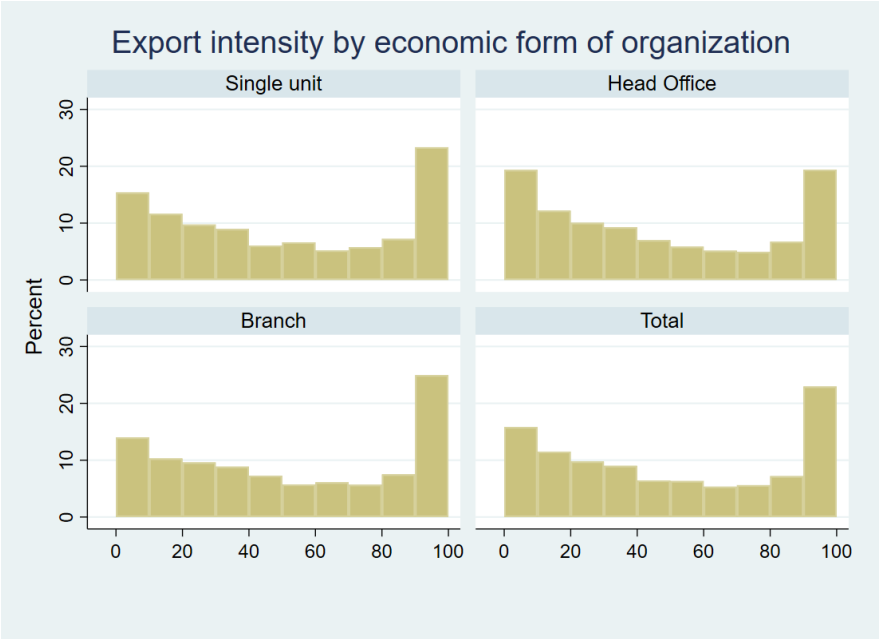

Figure 9: Export intensity by form of economic organization

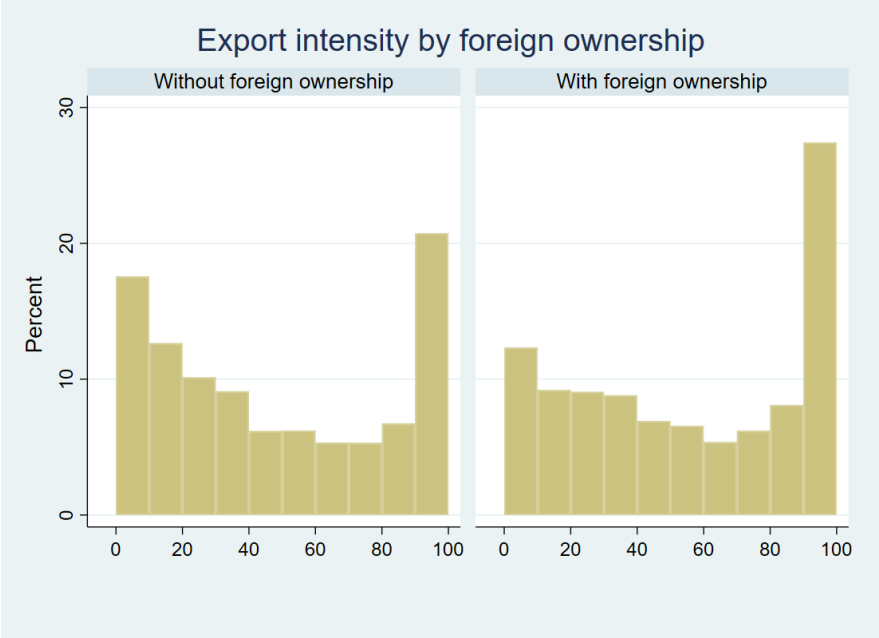

Figure 10: Export intensity by foreign investment or share holding

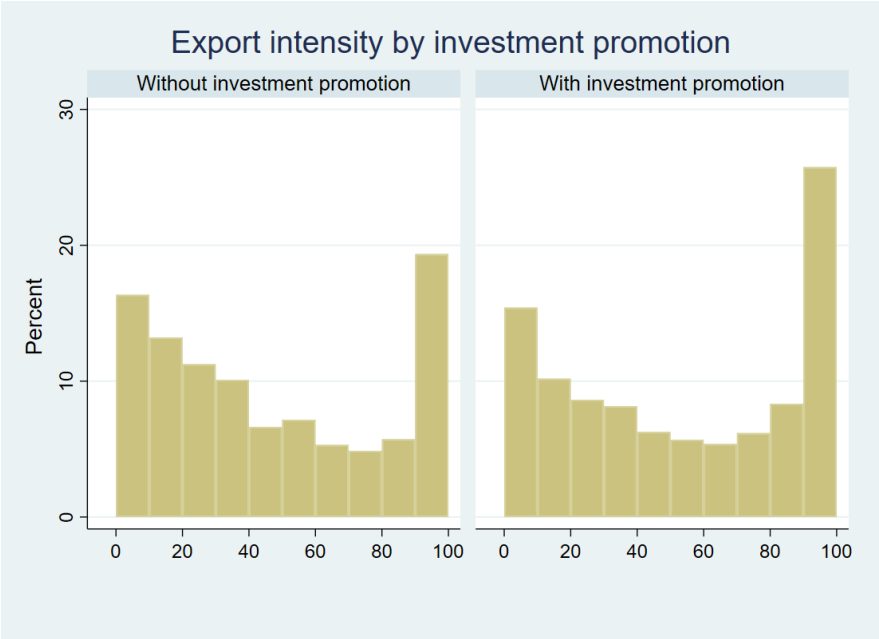

Figure 11: Export Intensity by investment promotion form the board of investment (boi)

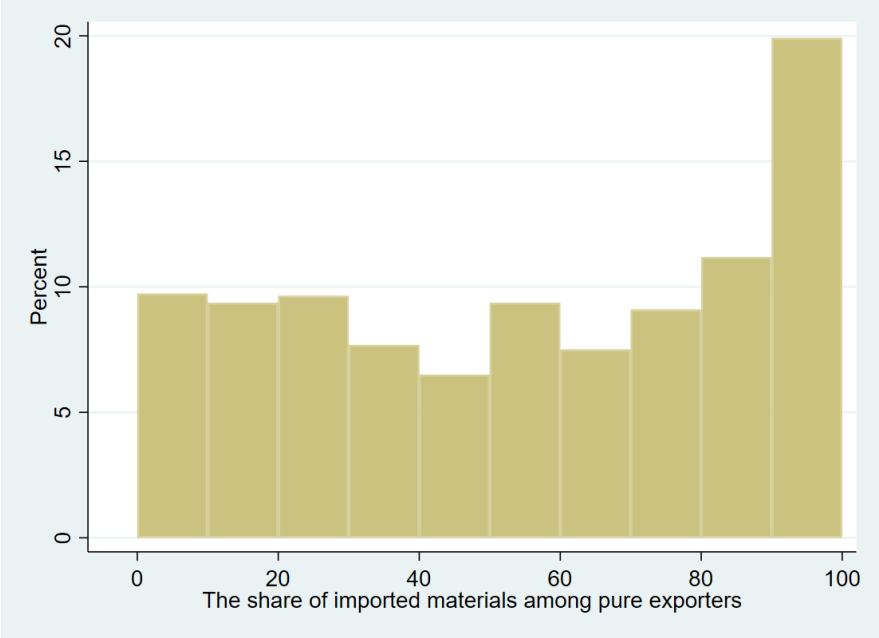

Figure 12: The share of imported materials among pure exporters

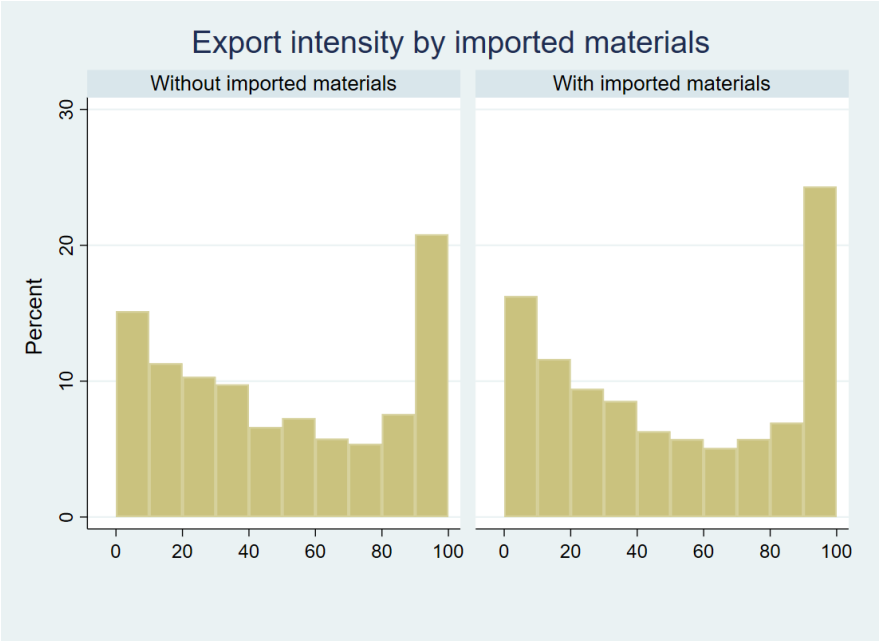

Figure 13: Export intensity by imported materials

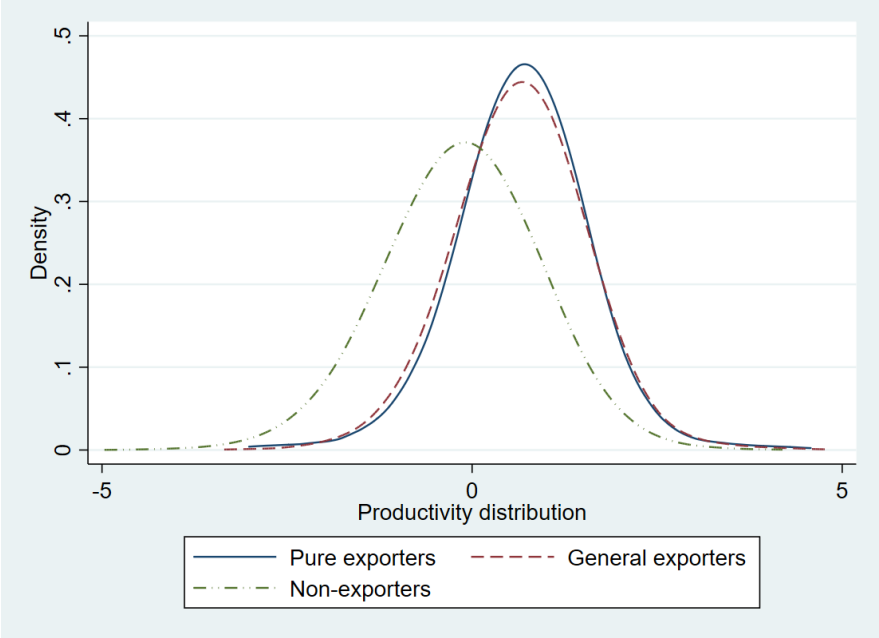

Figure 14: The distribution of the productivity of pure exporters and general exporters. The productivity is demeaned by industry and year.

Table 1: Statistical summary of the key variables from cross-section dataset

Categories		Obs	Percent	Total
Year	2007	70,034	28.42	246,390
	2012	79,859	32.41	
	2017	96,497	39.16	
Region	Bangkok	30,802	12.5	246,390
	Vicinity	88,430	35.89	
	North	46,587	18.91	
	Northeast	53,615	21.76	
	South	26,956	10.94	
Size	Small	236,534	96	246,390
	Medium	8,463	3.43	
	Large	1,393	0.57	
Form of Economic Organization	Single unit	228,431	92.71	246,389
	Head office	8,797	3.57	
	Branch	9,161	3.72	
Form of Legal Organization	Individual proprietor	144,808	64.9	223,134
	Juristic partnership	16,203	7.26	
	Company Limited	62,123	27.84	
Exporter (0/1 dummy)	Yes (1)	14,778	6	246,389
	No (0)	231,611	94	
Importer (0/1 dummy)	Yes (1)	15,932	6.47	246,389
	No (0)	230,457	93.53	
FDI (0/1 dummy)	Yes (1)	7,520	3.05	246,389
	No (0)	238,869	96.95	
BOI (0/1 dummy)	Yes (1)	9,948	4.04	246,389
	No (0)	236,441	95.96	

Variable	Obs	Mean	Std. Dev.	Min	Max
Age (years)	246,389	12.47114	10.29629	1	99
Export Intensity (%)	14,778	48.20531	35.1661	1	100
Import Intensity (%)	15,932	41.55517	30.27595	1	100
ln(Output)	246,390	14.17026	2.78429	1.098612	26.35448
ln(Value added)	246,390	14.08255	2.780434	0.6931472	26.34505
ln(Capital)	245,089	13.97489	2.634474	0	26.32169
ln(Intermediate inputs)	246,390	13.05596	3.230445	0	26.29542
ln(Cost of production)	246,390	10.83193	3.288334	0	24.54953
ln(Employment)					
All Sample	246,389	2.005951	1.596138	0	10.5141
Skilled	146,720	2.245792	1.454014	0	9.483644
Unskilled	63,247	2.396837	1.556078	0	10.21515
ln(total wage payment)					
Production	166,395	13.52755	1.943822	0	22.3653
Non-production	55,326	13.72863	1.733163	0	21.57065

Table 2: Statistical summary of the key variables from panel dataset

Categories		Obs	Percent	Total
Year	2007	8,984	35.24	25,495
	2012	8,271	32.44	
	2017	8,240	32.32	
Region	Bangkok	5,374	21.08	25,495
	Vicinity	12,781	20.13	
	North	2,978	11.68	
	Northeast	2,563	10.05	
	South	1,799	7.06	
Size	Small	14,864	59.50	24,981
	Medium	7,486	29.97	
	Large	2,631	10.53	
Form of Economic Organization	Single unit	21,250	83.35	25,495
	Head office	2,101	8.24	
	Branch	2,144	8.41	
Form of Legal Organization	Individual proprietor	6,901	28.51	24,204
	Juristic partnership	3,176	13.12	
	Company Limited	14,127	58.37	
Exporter (0/1 dummy)	Yes (1)	4,569	17.92	25,495
	No (0)	20,926	82.08	
Importer (0/1 dummy)	Yes (1)	4,606	18.07	25,495
	No (0)	20,889	81.93	
FDI (0/1 dummy)	Yes (1)	2,074	8.13	25,495
	No (0)	23,421	91.87	
BOI (0/1 dummy)	Yes (1)	2,939	11.53	25,495
	No (0)	22,556	88.47	

Variable	Obs	Mean	Std. Dev.	Min	Max
Age (years)	25,495	19.35603	11.40522	1	99
Export Intensity (%)	4,569	47.85515	35.0518	1	100
Import Intensity (%)	4,606	40.57718	30.03238	1	100
ln(Output)	25,495	16.60867	2.673939	7.495542	25.69931
ln(Value added)	25,483	15.86702	2.561459	7.32975	25.25716
ln(Capital)	25,363	15.90048	2.648003	0	25.59509
ln(Intermediate inputs)	25,495	15.64179	3.05141	0	25.51191
ln(Cost of production)	25,495	13.56548	3.188808	0	24.54953
ln(Employment)					
All Sample	25,495	3.457537	1.624911	0	9.548454
Skilled	18,350	3.155153	1.567209	0	9.483644
Unskilled	10,903	2.948322	1.655907	0	8.704834
ln(total wage payment)					
Production	23,734	14.78671	1.893009	0	21.40977
Non-production	12,586	14.2192	1.753595	0	21.57065

Table 3: Pure exporter premia

Variables	Coefficient	Standard error	R^2	# of observations
Firm size				
log (output)	0.302***	(0.038)	0.110	14,778
log (value added)	0.304***	(0.038)	0.109	14,778
log(export)	1.747***	(0.040)	0.157	14,778
Productivity				
log (output per worker)	0.004	(0.010)	0.164	14,778
log (value-added per worker)	0.016	(0.016)	0.131	14,778
Other characteristics				
firm age (years)	-2.010***	(0.204)	0.074	14,778
number of products	-0.075***	(0.016)	0.048	14,778

Note: The coefficients are from regressing the variables in column 1 on the dummy d_{PE}, the indicator for whether the exporter was a pure exporter in that year, including industry-year fixed effects. *,**, and *** indicate the significance level of 0.10, 0.05, and 0.01, respectively.

Table 4: Pure exporters' input usages

Variables	Coefficient	Standard error	R^2	# of observations
log (capital)	0.115**	(0.047)	0.086	14,718
◇ capital utilization rate	0.025***	(0.004)	0.019	14,778
log (labor)	0.291***	(0.029)	0.072	14,778
◇ log (labor in production)	0.318***	(0.030)	0.075	14,719
⋆ log (skilled labor)	0.267***	(0.033)	0.055	13,986
⋆ log (unskilled labor)	0.285***	(0.047)	0.067	8,356
⋆ fraction of skilled labor in labor in production	-0.008	(0.008)	0.036	14,719
◇ log (labor not in production)	0.120***	(0.032)	0.065	11,698
log (capital-labor ratio)	-0.179***	(0.038)	0.099	14,718
log (materials)	0.247***	(0.049)	0.097	14,778
◇ share of imported materials	0.163***	(0.008)	0.103	9,041

Note: The coefficients are from regressing the variables in column 1 on the dummy d_{PE} and industry-year fixed effects. *,**, and *** indicate the significance level of 0.10, 0.05, and 0.01, respectively.

Table 5: Export destinations by share of pure exporters

Ranking	Export destination	#Pure exporters	#Exporters	Share of PEs
1	Switzerland	23	37	0.62
2	Canada	22	44	0.50
3	Israel	7	14	0.50
4	Belgium	13	28	0.46
5	France	62	134	0.46
6	U.S.A.	504	1115	0.45
7	Italy	36	81	0.44
8	U.K.	75	172	0.44
9	Spain	16	37	0.43
10	Germany	73	174	0.42
11	Austria	8	21	0.38
12	Greece	5	15	0.33
13	Japan	411	1336	0.31
14	Denmark	6	22	0.27
15	U.A.E.	20	75	0.27
16	Russia	5	19	0.26
17	Hong Kong	26	107	0.24
18	Sweden	6	25	0.24
19	Taiwan	35	175	0.20
20	Mexico	3	15	0.20
21	South Korea	10	51	0.20
22	Norway	2	11	0.18
23	Turkey	2	11	0.18
24	Egypt	3	17	0.18
25	South Africa	3	18	0.17
26	Saudi Arabia	7	49	0.14
27	Netherlands	6	44	0.14
28	China	43	341	0.13
29	Australia	17	148	0.11
30	Malaysia	44	440	0.10
31	Philippines	7	83	0.08
32	Yemen	1	12	0.08
33	Iran	1	13	0.08
34	Singapore	15	273	0.05
35	New Zealand	1	21	0.05
36	Cambodia	4	97	0.04
37	Pakistan	1	27	0.04
38	India	3	83	0.04
39	Viet Nam	5	191	0.03
40	Indonesia	2	125	0.02
41	Myanmar	1	78	0.01
42	Lao PDR	0	75	0.00
43	DPR Korea	0	34	0.00
44	Bangladesh	0	28	0.00
45	Sri Lanka	0	20	0.00
46	Nigeria	0	14	0.00

Table 6: Productivity comparison by export status.

	Exporters			Non-exporters	All firms
	Pure exporters	General exporters	All exporters		
Mean	0.680	0.649	0.656	-0.143	0.000
Std. Dev.	0.818	0.804	0.807	0.979	0.999
10^{th} percentile	-0.225	-0.333	-0.320	-1.382	-1.277
25^{th} percentile	0.251	0.178	0.193	-0.765	-0.644
50^{th} percentile	0.705	0.667	0.678	-0.123	0.04
75^{th} percentile	1.099	1.131	1.125	0.506	0.671
90^{th} percentile	1.557	1.568	1.568	1.065	1.208
Firm-year observations	1,024	3,516	4,540	20,764	25,304

Note: Firm productivity is estimated from the panel data using Levinsohn and Petrin (2003) with the adjustments in Wooldridge (2009). It is demeaned by the industry-year average and re-scaled by the industry-year standard deviation.

Table 7: Productivity comparison by export intensity.

	Export intensity										All exporter
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	
Mean	0.64	0.59	0.56	0.70	0.66	0.71	0.71	0.71	0.68	0.69	0.66
Std. Dev.	0.79	0.77	0.81	0.88	0.83	0.77	0.86	0.80	0.79	0.81	0.81
10^{th} percentile	-0.33	-0.39	-0.38	-0.43	-0.26	-0.27	-0.42	-0.28	-0.26	-0.21	-0.32
25^{th} percentile	0.17	0.12	0.05	0.25	0.21	0.25	0.23	0.22	0.20	0.30	0.19
50^{th} percentile	0.64	0.62	0.54	0.75	0.65	0.67	0.81	0.75	0.72	0.71	0.68
75^{th} percentile	1.11	1.10	1.07	1.15	1.19	1.13	1.26	1.19	1.16	1.11	1.13
90^{th} percentile	1.54	1.52	1.48	1.78	1.69	1.53	1.55	1.56	1.57	1.57	1.57

Note: Firm productivity is estimated from the panel data using Levinsohn and Petrin (2003) with the adjustments in Wooldridge (2009). It is demeaned by the industry-year average and re-scaled by the industry-year standard deviation. Export intensity is the percent of the firm's production that is exported. The observations do not include non-exporters (with zero export intensity).

Table 8: log (output) and log (value added)

Dependent variable	log (output)				log (value added)			
	All sample		Exporters only		All sample		Exporters only	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
TFP	2.087***	1.866***	1.406***	1.301***	2.094***	1.891***	1.540***	1.440***
	(0.012)	(0.012)	(0.036)	(0.034)	(0.010)	(0.011)	(0.034)	(0.032)
Foreign ownership		0.434***		0.370***		0.441***		0.356***
		(0.037)		(0.042)		(0.032)		(0.037)
Investment promotion		0.528***		0.643***		0.472***		0.573***
		(0.038)		(0.046)		(0.033)		(0.040)
Imported materials		0.465***		0.316***		0.416***		0.315***
		(0.027)		(0.039)		(0.023)		(0.034)
Firm age		0.015***		0.019***		0.015***		0.019***
		(0.001)		(0.002)		(0.001)		(0.002)
Export status		0.700***				0.640***		
		(0.033)				(0.028)		
Observations	25,304	25,304	4,540	4,540	25,304	25,304	4,540	4,540
R-squared	0.709	0.753	0.510	0.563	0.762	0.803	0.594	0.645

Note: Odd-numbered columns regress the outcome variable on TFP and industry-year fixed effects; even-numbered columns add the controls listed and industry-year fixed effects. Columns (1), (2), (5), and (6) use the full sample; columns (3), (4), (7),_ and (8) are restricted to exporting firms only. *,**, and *** indicate the significance level of 0.10, 0.05, and 0.01, respectively.

Table 9: Export status and export volume

Dependent variable	Export status (extensive margin)						log (export) (intensive margin)	
	(1) Logit		(2) Logit		(3) OLS	(4) OLS	(5) OLS	(6) OLS
Variables	coef	marginal	coef	marginal				
TFP	1.011***	0.134***	0.543***	0.034***	0.118***	0.032***	1.415***	1.279***
	(0.070)	(0.013)	(0.062)	(0.005)	(0.002)	(0.002)	(0.046)	(0.044)
Foreign Ownership			1.349***	0.084***		0.155***		0.695***
			(0.152)	(0.012)		(0.011)		(0.060)
Investment Promotion			3.605***	0.225***		0.571***		0.920***
			(0.171)	(0.019)		(0.010)		(0.066)
Imported materials			2.283***	0.143***		0.289***		0.306***
			(0.116)	(0.008)		(0.008)		(0.059)
Firm Age			0.016***	0.001***		0.001***		0.011***
			(0.003)	(0.000)		(0.000)		(0.003)
Observations	25,304		25,304		25,304	25,304	4,540	4,540
R-squared					0.144	0.553	0.328	0.394

Note: The dependent variable in columns (1) - (4) is the dummy for export status that has a value of one if the firm is an exporter, and zero otherwise. Columns (1) and (2) show the results from Logit models, and Columns (3) and (4) show the results from linear probability models (LPM) with industry-year fixed-effects. For the Logit models, we report both the coefficients and their marginal effects. Columns (5) and (6) show OLS models with industry-year fixed-effects when the dependent variable is log (export). The Logit models do not include fixed effects. The OLS models include industry-year fixed effects. *,**, and *** indicate the significance level of 0.10, 0.05, and 0.01, respectively.

Table 10: Export intensity and log(export intensity)

Dependent variable	Export intensity				log (export intensity)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
TFP	0.815	-0.219	-0.134	-0.268	0.009	-0.022	-0.029	-0.023
	(0.655)	(0.650)	(0.709)	(1.151)	(0.023)	(0.023)	(0.025)	(0.040)
Foreign Ownership		9.624***	8.798***	7.914***		0.326***	0.290***	0.251***
		(1.116)	(1.199)	(1.879)		(0.040)	(0.042)	(0.068)
Investment Promotion		8.201***	9.382***	7.399***		0.277***	0.317***	0.207**
		(1.258)	(1.339)	(2.524)		(0.044)	(0.046)	(0.094)
Imported materials		1.574	1.330	0.355		-0.010	-0.003	-0.041
		(1.112)	(1.201)	(1.965)		(0.041)	(0.044)	(0.071)
Firm Age		-0.236***	-0.186***	-0.229***		-0.008***	-0.005***	-0.007**
		(0.047)	(0.050)	(0.084)		(0.002)	(0.002)	(0.003)
Capital-labor ratio			-0.912***	0.055			-0.020	-0.007
			(0.324)	(0.408)			(0.013)	(0.016)
Fraction of skilled-labor			1.668	-0.823			0.173***	0.066
			(1.678)	(2.577)			(0.061)	(0.095)
Number of products			-0.787	-1.783**			-0.034	-0.060*
			(0.607)	(0.831)			(0.022)	(0.031)
High-income country				20.713***				0.724***
				(1.810)				(0.073)
Observations	4,540	4,540	3,943	1,623	4,540	4,540	3,943	1,623
R-squared	0.122	0.160	0.165	0.248	0.095	0.126	0.131	0.209

Note: The dependent variable in columns (1) - (4) is export intensity, and the dependent variable in columns (5) - (8) is log(export intensity). All regressions include industry-year fixed effects, except models (4) and (8) that have year fixed effects.. *,**, and *** indicate the significance level of 0.10, 0.05, and 0.01, respectively.

Table 11: Logit models using panel data

Dependent variable	Dummy for being a pure exporter											
	(1)		(2)		(3)	(4)		(5)		(6)		
	Logit		Logit		Logit	Logit		Logit		Logit		
Variables	coef	marginal	coef	marginal	coef	coef	marginal	coef	marg.	coef.	marginal	
TFP	0.017	0.003	-0.029	-0.004	0.026	-0.016	-0.002	-0.007	-0.001	-0.088	-0.013	
	(0.131)	(0.019)	(0.153)	(0.021)	(0.209)	(0.146)	(0.021)	(0.156)	(0.022)	(0.170)	(0.025)	
Foreign Ownership			0.570***	0.080***	0.662***	0.530***	0.075***	0.533***	0.074***	0.538***	0.080***	
			(0.117)	(0.016)	(0.147)	(0.134)	(0.019)	(0.112)	(0.015)	(0.156)	(0.023)	
Investment Promotion			0.250**	0.035**	0.215	0.264**	0.037**	0.243*	0.034*	0.147	0.022	
			(0.100)	(0.014)	(0.134)	(0.104)	(0.015)	(0.127)	(0.018)	(0.199)	(0.029)	
Imported materials			0.271	0.038	0.374*	0.231	0.033	0.206	0.029	0.125	0.019	
			(0.242)	(0.034)	(0.207)	(0.237)	(0.034)	(0.230)	(0.033)	(0.216)	(0.032)	
Firm Age			-0.019***	-0.003***	-0.019***	-0.018***	-0.003***	-0.022***	-0.003***	-0.022***	-0.003***	
			(0.003)	(0.000)	(0.003)	(0.004)	(0.001)	(0.005)	(0.001)	(0.006)	(0.001)	
TFP^2					0.052							
					(0.040)							
Foreign Ownership					-0.132							
×TFP					(0.102)							
Investment Promotion					0.044							
×TFP					(0.104)							
Imported materials					-0.155							
×TFP					(0.128)							
Capital-labor ratio						-0.062**	-0.009**	-0.046	-0.006	0.001	0.000	
						(0.029)	(0.004)	(0.037)	(0.005)	(0.026)	(0.004)	
Fraction of skilled-labor						-0.157	-0.022	-0.199	-0.028	-0.253	-0.038	
						(0.181)	(0.026)	(0.206)	(0.029)	(0.282)	(0.043)	
Number of products						-0.091*	-0.013*	-0.098*	-0.014*	-0.145**	-0.022**	
						(0.049)	(0.007)	(0.054)	(0.007)	(0.068)	(0.010)	
FTZ								0.058	0.008			
								(0.254)	(0.035)			
High-income country										1.572***	0.235***	
										(0.243)	(0.032)	
Observations	4,540		4,540		4,540	3,943		3,288		1,623		

Note: All Logit models do not include fixed effects. we report both the coefficients and their marginal effects. *,**, and *** indicate the significance level of 0.10, 0.05, and 0.01, respectively.

Table 12: Linear Probability model using panel data

Dependent variable	Dummy for being a pure exporter					
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	OLS	OLS	OLS	OLS	OLS	OLS
TFP	0.0014	-0.007	-0.005	-0.003	-0.002	-0.017
	(0.008)	(0.008)	(0.015)	(0.009)	(0.010)	(0.015)
Foreign Ownership		0.089***	0.104***	0.082***	0.082***	0.081***
		(0.014)	(0.018)	(0.015)	(0.017)	(0.024)
Investment Promotion		0.036**	0.029	0.037**	0.033*	0.024
		(0.015)	(0.018)	(0.017)	(0.018)	(0.030)
Imported materials		0.042***	0.055***	0.036**	0.031**	0.029
		(0.013)	(0.016)	(0.014)	(0.015)	(0.024)
Firm Age		-0.003***	-0.003***	-0.002***	-0.003***	-0.003***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
TFP^2			0.010*			
			(0.005)			
Foreign Ownership			-0.019			
$\times$TFP			(0.017)			
Investment Promotion			0.008			
$\times$TFP			(0.016)			
Imported materials			-0.021			
$\times$TFP			(0.016)			
Capital-labor ratio				-0.010***	-0.007*	-0.000
				(0.004)	(0.004)	(0.005)
Fraction of skilled-labor				-0.021	-0.030	-0.039
				(0.021)	(0.023)	(0.033)
Number of products				-0.013*	-0.013*	-0.021**
				(0.007)	(0.008)	(0.010)
FTZ					0.008	
					(0.022)	
High-income country						0.194***
						(0.019)
Observations	4,540	4,540	4,540	3,943	3,288	1,623
R-squared	0.113	0.134	0.136	0.142	0.140	0.187

Note: All regressions include industry-year fixed effects, except model (6) that has year fixed effects. *,**, and *** indicate the significance level of 0.10, 0.05, and 0.01, respectively.

Table 13: Logit model using cross-sectional data. TFP is proxied by output per worker.

Dependent variable	Dummy for being a pure exporter							
	(1)		(2)		(3)		(4)	
	Logit		Logit		Logit		Logit	
Variables	coef	marginal	coef	marginal	coef	marginal	coef	marginal
TFP	-0.000	-0.000	-0.053	-0.008	0.020	0.003	-0.076	-0.012
(output per worker)	(0.096)	(0.015)	(0.129)	(0.019)	(0.158)	(0.025)	(0.251)	(0.039)
Foreign Ownership			0.508***	0.077***	0.509***	0.078***	0.528***	0.083***
			(0.094)	(0.024)	(0.090)	(0.024)	(0.102)	(0.015)
Investment Promotion			0.311***	0.047***	0.333***	0.051***	0.220**	0.035**
			(0.074)	(0.013)	(0.077)	(0.015)	(0.096)	(0.016)
Imported materials			0.283	0.043	0.291	0.044	0.203	0.032
			(0.272)	(0.048)	(0.271)	(0.047)	(0.200)	(0.032)
Firm Age			-0.018***	-0.003***	-0.017***	-0.003***	-0.018***	-0.003***
			(0.003)	(0.001)	(0.002)	(0.001)	(0.004)	(0.001)
Capital-labor ratio					-0.064	-0.010	-0.018	-0.003
					(0.044)	(0.009)	(0.034)	(0.005)
Fraction of skilled-labor					-0.070	-0.011	-0.107	-0.017
					(0.223)	(0.032)	(0.120)	(0.019)
Number of products					-0.099**	-0.015*	-0.156***	-0.025***
					(0.047)	(0.009)	(0.041)	(0.006)
High-income country							1.325***	0.208***
							(0.113)	(0.015)
Observations	14,778		14,778		14,659		6,080	

Note: All Logit models do not include fixed effects. We report both the coefficients and their marginal effects. *,**, and *** indicate the significance level of 0.10, 0.05, and 0.01, respectively.

Table 14: Logit model using cross-sectional data. TFP is proxied by value added per worker.

Dependent variable	Dummy for being a pure exporter							
	(1)		(2)		(3)		(4)	
	Logit		Logit		Logit		Logit	
Variables	coef	marginal	coef	marginal	coef	marginal	coef	marginal
TFP	0.029	0.005	-0.008	-0.001	0.043	0.007	0.063	0.010
(value added per worker)	(0.083)	(0.014)	(0.094)	(0.014)	(0.121)	(0.019)	(0.134)	(0.021)
Foreign Ownership			0.503***	0.077***	0.507***	0.077***	0.513***	0.081***
			(0.091)	(0.023)	(0.088)	(0.023)	(0.100)	(0.015)
Investment Promotion			0.310***	0.047***	0.330***	0.050***	0.214**	0.034**
			(0.073)	(0.013)	(0.076)	(0.014)	(0.099)	(0.016)
Imported materials			0.280	0.043	0.289	0.044	0.187	0.030
			(0.270)	(0.047)	(0.268)	(0.047)	(0.199)	(0.032)
Firm Age			-0.018***	-0.003***	-0.017***	-0.003***	-0.019***	-0.003***
			(0.003)	(0.001)	(0.003)	(0.001)	(0.004)	(0.001)
Capital-labor ratio					-0.067	-0.010	-0.026	-0.004
					(0.046)	(0.009)	(0.033)	(0.005)
Fraction of skilled-labor					-0.069	-0.010	-0.104	-0.016
					(0.223)	(0.033)	(0.123)	(0.019)
Number of products					-0.100**	-0.015*	-0.159***	-0.025***
					(0.048)	(0.009)	(0.041)	(0.007)
High-income country							1.335***	0.211***
							(0.110)	(0.015)
Observations	14,778		14,778		14,659		6,080	

Note: All Logit models do not include fixed effects. We report both the coefficients and their marginal effects. *,**, and *** indicate the significance level of 0.10, 0.05, and 0.01, respectively.

Table 15: Linear probability model using cross-sectional data

Dependent variable	Dummy for being a pure exporter							
	output per worker				value added per worker)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
TFP	0.002	-0.012*	0.001	-0.023	0.005	-0.004	0.005	0.004
	(0.006)	(0.006)	(0.007)	(0.015)	(0.004)	(0.005)	(0.005)	(0.009)
Foreign Ownership		0.081***	0.081***	0.082***		0.080***	0.080***	0.079***
		(0.008)	(0.008)	(0.013)		(0.008)	(0.008)	(0.013)
Investment Promotion		0.045***	0.048***	0.034**		0.044***	0.047***	0.032*
		(0.009)	(0.009)	(0.016)		(0.009)	(0.009)	(0.016)
Imported materials		0.048***	0.049***	0.043***		0.047***	0.049***	0.041***
		(0.007)	(0.007)	(0.012)		(0.007)	(0.007)	(0.012)
Firm Age		-0.003***	-0.002***	-0.003***		-0.003***	-0.002***	-0.003***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Capital-labor ratio			-0.011***	-0.004			-0.012***	-0.005*
			(0.002)	(0.003)			(0.002)	(0.003)
fraction of skilled-labor			-0.010	-0.012			-0.010	-0.012
			(0.009)	(0.015)			(0.009)	(0.015)
number of products			-0.014***	-0.022***			-0.014***	-0.022***
			(0.004)	(0.005)			(0.004)	(0.005)
High-income country				0.176***				0.177***
				(0.010)				(0.010)
Observations	14,778	14,778	14,659	6,080	14,778	14,778	14,659	6,080
R-squared	0.091	0.112	0.116	0.159	0.091	0.112	0.116	0.158

Note: All regressions include industry-year fixed effects, except models (4) and (8) that have year fixed effects. *,**, and *** indicate the significance level of 0.10, 0.05, and 0.01, respectively.

Table 16: The impacts of investment promotion by industry.

Export status (extensive margins)				
Ranking	Industry	Coef.	SE	95% Conf interval
1	Wood	0.809	(0.021)	0.769 - 0.850
2	Leather	0.640	(0.027)	0.586 - 0.694
3	Food	0.616	(0.012)	0.592 - 0.640
4	Furniture	0.615	(0.015)	0.585 - 0.645
5	Petroleum	0.594	(0.072)	0.454 - 0.735

log (export) (intensive margins)				
Ranking	Industry	Coef.	SE	95% Conf interval
1	Medical optical	1.534	(0.359)	0.827 - 2.242
2	Machinery	1.324	(0.151)	1.026 - 1.621
3	Leather	1.007	(0.205)	0.604 - 1.411
4	Food	0.985	(0.094)	0.800 - 1.170
5	Electrical machinery	0.974	(0.200)	0.580 - 1.367

Export intensity				
Ranking	Industry	Coef.	SE	95% Conf interval
1	Medical optical	21.9	(6.080)	9.947 - 33.929
2	Machinery	13.0	(2.552)	7.943 - 17.960
3	Textile	11.8	(2.917)	6.084 - 17.537
4	Rubber	9.3	(2.202)	4.971 - 13.608
5	Apparel	8.6	(2.631)	3.417 - 13.742

Prob (being pure exporter)				
Ranking	Industry	Coef.	SE	95% Conf interval
1	Medical optical	0.208	(0.081)	0.049 - 0.367
2	Furniture	0.109	(0.030)	0.051 - 0.168
3	Apparel	0.108	(0.037)	0.034 - 0.181
4	Textile	0.085	(0.034)	0.018 - 0.152
5	Rubber	0.075	(0.025)	0.025 - 0.125

Note: Due to data insufficiency, in the last three regressions we drop four industries, Beverage (16), Petroleum (23), Office computing (30), and Recycling (37). The rankings exclude the industries in which their confidence intervals contain zero.