Firm Productivity and Sales Destination:

Evidence from Within China

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Abstract

There is a rich literature studying firm productivity and its export destinations, using micro-level data from various countries. These studies generally find that more productive firms self-select into exporters. This paper compliments the literature, and examines the linkage between the productivity of firms operating in China and their sales destinations into other provinces within China. That is, each province in China is deemed as a "country" and firms' sales outside of their home province are viewed as "exports". Doing so conveniently avoids the hard-to-control heterogeneity across different destination markets in the export literature. Our econometric model explicitly controls the fact that many firms only sell in their home-province markets. We find that firms with higher productivity also sell in other provincial markets, and that more productive firms enter more provincial markets. The results are robust across a number of sensitivity analyses.

Keywords**:** Productivity, Domestic Market Extent, Firm Heterogeneity

JEL Classifications: D24, D21, F15

1. Introduction

A recent literature on firms' export activities, first examined by Bernard and Jensen (1995), has shown that only the more productive firms self-select into exporters, which was formally modeled by Melitz (2003) as the heterogeneous firm theory in international trade. Essentially, the heterogeneous firm theory argues that exporting products to other countries incurs transportation costs and other trade costs; and thus, exporting firms have to be more productive so that the higher productivity can help offset the extra costs associated with exports. This paper applies the heterogeneous firm theory to a set of firms operating in China, and examines the linkage between firms' productivity and their sales destinations into other provincial markets in China. Here, each province in China is deemed as a "country", and firms' sales into other provincial markets, other than their home province, are deemed as "exports".

Applying the heterogeneous firm theory to firms' sales into other provincial markets offers a nice alternative to the existing empirical studies, by that it conveniently avoids the heterogeneity issue arising from the sales markets. In the heterogeneous firm literature, firm heterogeneity is the central focus, with firm productivity differences being the main manifestation, and heterogeneity from the demand side is often left unstudied or assumed implicitly as homogeneous. However, different destination markets offer distinct sets of attributes and may require different thresholds on firm productivity to break in. The destination heterogeneity is even more pronounced when estimating the linkage between firm productivity and its multi-exporting destinations, due to the genuine differences among various markets. Firms' productivity threshold to export to certain types of foreign markets might also be affected by a host of other reasons such as language barriers and historical ties. For instance, Sui (2010) shows that although most Canadian firms find exporting to the United States (US) as their first natural overseas market, others choose to export to

non-US markets first, apparently due to a different set of reasons (such as those firms owned by immigrants from a particular country). These market differences arising from multiple-exporting markets are very hard to control for, and are often ignored in the literature.

This paper gets around the heterogeneity issue in the destination markets by looking at the productivity differences between a set of firms operating in China and their sales destinations into other relatively homogeneous provincial markets within China. Provincial markets in China are much less heterogeneous, despite segmented. Thus, firms' decision to sell in other markets can be better attributed to productivity differences other than the differences arising from different markets. The relatively homogeneous provincial markets become handy when we examine the linkage between firm productivity and the number of its exporting markets, because adding another homogeneous provincial market to a firm's sales destination won't greatly compound the relationship between productivity and new market entry.

Chinese firms' sales within China offer an ideal case study to study firm productivity and market entry. China is a large country, with a total of 31 provinces, municipalities, autonomous and special regions with provincial-level authority.[1] Provincial markets are segmented and protected by their home provincial governments, but they are homogenous in nature. All provincial markets in China share the same Confucius culture, speak the same national language despite many dialects, and are under the same set of central government regulations. The market segmentation, compounded by high transportation costs, requires out-of-province firms to be more productive so that they can break into other provincial markets. But at the same time, the

[1] China has 22 provinces (excluding Taiwan), 4 municipalities, 5 autonomous regions and 2 special administrative regions (Hong Kong and Macao). These are the provincial level (first level) of administrative division in China, but Hong Kong and Macao are excluded because sales to Hong Kong and to Macao are treated as exports by the Chinese customs. The 22 provinces, 4 municipalities and 5 autonomous regions enjoy similar, although not exactly the same, political status. For simplicity, we refer to the municipalities and the autonomous regions all as "provinces", making a total of 31 provincial markets in China.

relative homogeneous nature of the provincial markets offers a relatively clean relationship between firms' productivity and their export decision to multiple destinations.

This paper makes another novelty contribution by applying the zero-inflated negative binomial technique to explicitly control for the fact that many firms are 'non-exporting' firms. Using 2400 firms operating in China, we find that more productive firms are able to break into other provincial markets, and the more productive they are, the more other provincial markets they enter. These results are robust across different subsamples.

The remainder of the paper is structured as follows. Section 2 reviews the segmented nature of the Chinese provincial markets, and the related literature. Section 3 documents the data, Section 4 discusses the estimation strategy, Section 5 reports the estimated results, and Section 6 concludes.

2. The Segmented Chinese Provincial Markets and A Review of the Literature

2.1. The Segmented Chinese Provincial Markets

The Chinese provincial market segmentation is a reality, despite the many efforts made by the central Chinese government for an integrated market. There are many factors leading to market segmentation, with two standing out. First, although not allowed by the central Chinese government, local governments have every incentive to protect their local firms (Bai et al., 2004). These protective measures are unavoidable, and to a large degree, are the by-product of China's tax system or the fiscal decentralization system. There is no explicit sales tax for the majority of the goods sold in China (except for luxury goods), and firms pay value-added taxes to the government only at the production site. Due to the tax incentive, local governments take necessary means to boost their local firms' production and the consumption of the locally produced products in order to maintain the tax base (and employment). In many cases, in order

not to make these protective measures overt (so as not to contradict the national regulation), many local governments revert to some "underground" hidden measures to discriminate products from other provinces. These underground measures have in effect segmented the whole Chinese market into different provincial markets, and they are in essence equivalent to the non-tariff barriers across countries. For instance, for service industries, entry into each province is treated as a new application, and has to be approved by each provincial government with their own modified version of the national regulations.[2] Poncet (2003) finds that provincial border effects in China are as close or higher to those among European countries or those between the United States and Canada.

Second, transportation costs have become a big burden for firms (and for ordinary Chinese). On the one hand, China's national highway system has linked the country from the north to the south, and from the east to the west. On the other hand, the toll fee to use the national highway and the high fuel cost have become very cumbersome and costly. The high toll fee was clearly reflected by a major traffic congestion outside Beijing in 2010, as many contract truck drivers would like to use the local road (free of toll) rather than the highway to avoid the high toll costs, despite that it took longer and often they have to endure traffic jams.[3] [4]

Although segmented, provincial markets are much less heterogeneous than markets in different countries due to a host of reasons. First, there is only one official language in China

[2] For instance, in the overseas educational service industry, the agency must apply separately in each province to get its operating certificate in order to conduct business in that province. It is up to each provincial government to set up its requirements, and to decide how many agencies to approve and when.

[3] The widely reported road congestion outside Beijing in 2010 started on August 14th, 2010 due to a road construction. The congestion built up and last 9 days stretching over 100 kilometers (65 miles). Due to rising fuel costs and additional toll fees, many of the stranded truck drives chose to be grounded, rather than taking alternate highway routes. Road congestion and toll fee have become a major concern for many truck drives. The high toll cost has created under-usage of the national highway system, and the over-usage of the local roads, many of which are in desperate need for repair. This is counter-productive and has caused lots of anger. Recently, there have been many calls to abolish the toll system so that people can use them when needed.

[4] Due to the high toll costs, the recently build national highway system is severely underused. There have been so discussions about abolishing the toll stations, but so far, the discussions lead to nowhere.

(Chinese), despite the many dialects like Cantonese. Second, each provincial level municipality in China is subject to the uniform set of regulations set by the central government. Third, each province enjoys the same culture, and has the same coverage of the Chinese Central TV (CCTV) programs. In fact, the prime time CCTV news at 7pm Beijing time each evening is simultaneously broadcasted across China. And that also makes firms' advertisement on CCTV very effective in reaching out to consumers across China. Thus, studying the linkage between firm productivity and their sales destinations within China provides a nice alternative to the heterogeneous firm literature, to be discussed below.

2.2. The Related Literature

This study builds on a rich literature, lead by Bernard and Jensen (1995). Bernard and Jensen use firm survey data in the US and find significant differences between exporting firms and non-exporting firms in various aspects such as scale, investment, wages and productivity. The paper stimulated huge interests among researchers and a series of papers have gradually been published. These studies, using either cross-section or longitudinal data at the firm level, have demonstrated that firms that are active on international markets as exporters, importers, or multinational firms differ systematically from those that serve their national market only (the so called national firms) (for instance, Roberts and Tybout, 1997). The theoretical modeling of the heterogeneous firms by Melitz (2003) lends new insights into how the differences in firm characteristics lead to different paths of internationalization. A core finding here is that the significance and size of exporter productivity premium, though different across countries, is pronounced, as documented in surveys by Lopez (2005), Helpman (2006), Greenaway and Kneller (2007) and Wagner (2007). Empirical studies lend strong supports on self-selection bias,

with limited or weak support on “learning-by-exporting”, that is, firms’ productivity increases with exports. In order to better understand the sources of the cross-country productivity premium between exporters and non-exporters, International Study Group on Exports and Productivity (ISGEP) uses identically specified empirical models with identically defined variables to investigate the cross-country differences in a meta-analysis. Their findings first confirm that exporters are more productive than non-exporters even after observed and unobserved heterogeneity is controlled for, and further, they report that the exporter productivity premium tend to increase with the share of exports in total sales (ISGEP, 2008).

A direct extension to the above studies was to examine the relationship between the number of exporting destinations and firms’ productivity. Essentially, the extension asks whether firms export to several markets differ significantly from those that export to one single market, i.e., whether the productivity differences among exporters lead to different number of exporting markets. Damijan et al. (2004), using Slovakian firm-level data, find that firms' productivity level directly relates to the number of exporting markets: the more productive an exporting firm, the more markets they export to. Eaton et al. (2011) examine firm-level sales across 113 destinations as well as France itself, and find that nearly half of the market-entry variation across firms can be accounted for by firm-level productivity heterogeneity. That finding is echoed in Mu ûls and Pisu (2009), who use Belgian firm-level data. Later studies lead to similar conclusions that the most productive firms could export to multi foreign markets (Lawless, 2009; Greenaway et al., 2008; Sheard, 2011). This paper builds on the above literature, and extends that analysis into the context of Chinese firms' sales entry into Chinese provincial markets.

3. **Data Sources**

Data used here come from the World Bank Survey of 2400 firms operating in China in 2003. The survey was part of the World Bank's ongoing project, i.e., World Business Environment Survey. The randomly chosen 2400 firms located in 18 cities across 13 provinces. The 18 cities have a wide geographical representation: a third of the cities are in the west, a third in the middle and a third in the east coast.[5] The 2400 firms operate in 10 manufacturing and 4 service industries. For manufacturing industries, 353 firms in apparel and leather products industry, 185 firms in electronics industry, 276 firms in parts of electronics industry, 63 firms in appliances, 358 firms in auto and parts industry, 71 firms in food industry, 66 firms in chemicals and medicine industry, 36 firms in bi-technology and Chinese medicine industry, 158 firms in iron and metal industry, and 50 firms in transportation industry, making it a total of 1616 manufacturing firms— or 67.3% in total. For service industries, there are 203 firms in information technology industry, 157 firms in accounting and financial services industry, 154 firms in advertising and sales, and 270 in commercial services, with a total of 784 service firms, or 32.7% of all firms.

The survey collected firm information by two companion questionnaires. One was to be filled out by the senior manager, and the other by the accountant or personnel manager. The questionnaires ask firms' information, including firms' innovation, product quality certificate, business environment, relationship with suppliers and customers, the structure of its board of governors, and so forth, firms' finances, ownership structure, labor structure and wages, and access to loans from financial institutions, etc. The survey asks information for the above mainly for year 2002, but some of the questions asked earlier data back to 1999.

[5] The 6 coastal cities are: Benxi, Dalian, Hangzhou, Jiangmen, Shenzhen and Wenzhou. Cities in the middle of China: Changchun, Changsha, Harbin, Nanchang, Wuhan and Zhengzhou; and the 6 cities in the west are: Chongqing, Guiyang, Kunming, Lanzhou, Nanning and Xi'an.

As to cohorts, there are 475 firms born between 1949 and 1977, 566 between 1978 and 1992, and 1359 were born between 1993 and 2000. For the registered status and firms' ownership structure, the survey includes the whole spectrum of firms currently operating in China. There are: publicly traded or listed company—59, non publicly-traded shareholding companies—313, private, non-listed company—677, subsidiary (division) of a domestic enterprise—147, subsidiary (division) of a multinational firm—38, joint venture of a domestic enterprise (domestic investment scheme)—110, joint venture of a multinational firm (foreign investment scheme)—145, state owned company—636, Cooperative/collective—387, and other types—210.

4. Description of The Key Variables

This section briefly describes some of the key variables in the paper. The first is the number of other provincial markets that a firm sells its products to. In the questionnaire, firms are asked whether they have sales in provinces other than their home province, and if yes, firms are requested to write down the number of other provincial markets they entered. According to firms' response on out-of-province sales, we construct a variable called number of out-of-province markets, denoted as *MrtExt*, as the following:

$$MrkExt_i = \sum_{j=1}^{30} Sale_i(j) \qquad (1)$$

Where $Sale_i(j)$ is an indicator (0 if no, 1 if yes) of whether firm *i* has sales in province *j* and *j* is not firm *i*'s home province. In the Chinese context, the maximum of *MrtExt* is 30 as there are a total of 30 non-home provinces for each firm *i*. If a firm only has sales within its home province, then *MrkExt* is 0, otherwise, *MrkExt* is a positive integer, with 30 being the maximum.

Among the 2400 firms, 1069 firms have sales in their home provinces only, accounting for

44.5%. Among the remaining 1331 "exporting" firms, the majority of them sold their products in less than 3 markets: 155 firms sold only to one other provincial market, 138 in two other provinces, and 119 in three other provinces. This observation is consistent with the export literature in that the majority of exporting firms mainly export to one or two markets. But equally interesting, there are 144 firms which have sales in all other provinces in China, which effectively generates a U-shaped curve of the number of firms' out-of-province sales destination among all "exporting" firms.

Another key variable here is firms' productivity. Correctly measuring firms' productivity is an important step, and its accuracy is central to the main estimation results. However, firms' productivity is not directly observable, and firms' input choices are subject to endogeneity. The recent development has used either the Olley-Pakes method (Olley and Pakes, 1996) or the Levinshon-Petrin method (Levinshon and Petrin, 2003), rather than the traditional OLS to correct the endogeneity issue on input choices. We adopt the LP method as there are more data points on intermediates inputs, and used the following equation to estimate firms' productivity:

$$ln(y_t) = \beta_0 + \beta_l ln(l_t) + \beta_k ln(k_t) + \beta_m ln(m_t) + (\omega_t + \delta_t) \quad (2)$$

Where t =2000, 2001 and 2002, y is sales revenue, l is the number of workers, and k is capital stock, proxied by firms' book values for fixed assets, m is intermediate inputs, proxied by total material costs, ω_t is firm's total factor productivity (TFP) and δ_t is a random error, which is not correlated with the input choices. Thus, the coefficients on the logarithm of labor, capital and intermediate inputs are the respective elasticities of sales revenue with respect to them.

The estimated coefficients from the LP technique are presented in Table 1, together with OLS estimation results for comparison. The coefficients estimated on labor from both methods are close, but the coefficients are significantly different regarding capital and intermediate inputs, as indicated by the LP method. In order to alleviate TFP fluctuations, we use the three-year

average as the estimated firm productivity of years 2000 to 2002. Although using LP method takes care of the input endogeneity problem, it comes with a cost: it shrinks the number of firms from 2400 to 1615, due to the missing values on intermediate inputs. In the empirical analysis, we also use another measure of firm productivity, sales per person—ln(S/L) as an alternative measure to maintain the maximum number of firms in the regression for comparison. Not surprisingly, lnTFP is highly correlated with ln(S/L), with a correlation coefficient of 0.785.

In order to accurately capture the effects of firm productivity on their market expansion pattern, we include a few other firm-level factors which are known to affect firms' ability to enter other markets. The control variables are the following.

Export: percentage of exports in total sales. Firms might target all available markets for their products including domestic Chinese markets and markets in foreign countries. Given the fixed level of production, the more firms focus on overseas expansion, the less they would do so domestically, and thus less likely to expand to other regional Chinese markets.

lnSize: this is to capture firms' size, measured as the logarithm of employment. Size is one of the most important factors behind firm heterogeneity (Bernard and Jensen, 1995), and firms with large size enjoy the push-pull effects of market expansion. On the one hand, larger firms enjoy the economy of scale advantage, which enable them to price their products low, and thus enjoy some competitive advantage in expanding into other markets. On the other hand, large scale firms are motivated or even forced to expand aggressively to find markets for their products. Both of the two reasons will give large firms leverage over smaller ones in expanding into other provincial markets.

Subcontract: a 0/1 indicator with 1 for firms with subcontracts. Subcontracting has become a new way for firms to fragment their production stages in different markets. In the globalization

era, more and more firms rely on subcontract to geographically organize their production to take advantage of what every location has to offer to minimize the production cost. We expect to see that those firms using subcontract will be better able to enter other provincial markets due to the cost advantages.

Ad: firms' advertisement efforts to promote their products. In the information age, firms rely on different ways to promote their products, such as through internet, newspapers, posters, magazines, TV and radio. The questionnaire asked whether firms use the above means to advertise their products, not how much they spent on advertisement. We construct *Ad* as the number of channels firms used. For instance, if a firm uses both TV and radio to advertise its product, *Ad* is 2. If the firm does not use any of the channels, *Ad* is 0.

Bamem: a 0/1 indicator on whether a firm is a member of a business association, with 1 yes, and 0 no. Being a member of an industry organization often enables firms to get access to very valuable information on markets. In addition, industry association can often coordinate and facilitate as a third party between firms and different levels of governments on firms' behalf. We expect that being a member of an industry association helps firms enter other regional markets.

Age: years after birth. Age can be a double-edged sword regarding firms' market expansion. On the one hand, older firms can be more productive and more experienced, as only the more productive firms can survive; and older firms have accumulated experiences in business. Further, older firms have built up their intangible assets, which help earn consumers' trust, making it relatively easier to expand into new markets. On the other hand, older firms might be prone to be more conservative and are harder to get out of their comfort zone, which might hinder their efforts in looking for new markets. In the survey, many older firms are state-owned, or were founded as state-owned but were later sold to private owners. Unlike other young firms which

were founded under the new code of conduct for business (the modern enterprise system), those older state-owned firms often have surplus labor, and carry many social functions, both of which increase firms' costs. Thus, the effect of age on firms' market expansion is an empirical question.

Certification: a 0/1 binary variable. It takes on the value of 1 if a firm has passed the quality tests conducted either by a central Chinese government agency or an international agency, and 0 otherwise. Having a certificate is a strong signal of the product quality, that helps firms to win over new customers in other provinces who are not familiar with the products.

IndPark: a 0/1 binary variable. It takes on the value of 1 if a firm locates inside an industrial park, or a science park or an export processing zone, and 0 otherwise. In China, firms located in these special zones enjoy preferable treatments, such as tax policy and/or employment policy. At the same time, firms in the park or special zones can enjoy some exclusive advantages. For instance, firms might be able to purchase intermediate inputs right from other firms in the park. Further, it is often found in the literature that firms enjoy spillover effects from others located in the cluster (Wang and Chao, 2008). All these give firms special cost advantage over other firms.

Table 2 reports the summary statistics for all the variables with their mean, standard deviation, minimum and maximum. Clearly, the table indicates that there are widespread differences among firms, which highlights the fact that the sample is representative of the firms operating in China. Table 3 divides the firms into two groups, with firms only selling in their home province as one group (*MrkExt*=0), and others (*MrkExt*>0) as the other group. What the table reveals is that there are significant differences between the two groups. Firms with out-of-home province sales are more productive, have larger sales per person, have more workers, and are older. They also tend to locate in industrial parks, be a member of a business association and use more means to advertise their products.

Before we carry out some formal empirical analyses, we plot a kernel density of firms'

productivity in Figure 2 for firms with and without out-of-home province sales, and we plot firms' productivity and the values of *MrkExt*. Clearly, Figure 2 shows that "exporting" firms are on average more productive then "non-exporting" firms--their productivity is monotonously higher than non-exporters, and the more productive firms are, the more "exporting" destinations they enter (Figure 3). Although this information is not definitive, they reveal the linkage between firm productivity and their sales destinations.

5. The Estimation Strategy

We use the following specification to estimate the effects of firm productivity on the number of out-of-home province sales destinations:

$$MrkExt_i = \mu_c + \beta_1 ln(PRTY) + BX_i + \sum_{k=1}^{K} \sigma_k Ind_k + \sum_{c=1}^{C} \varphi_c City_c + \varepsilon_i, \qquad (3)$$

Where $MrkExt_i$ is the total number of out-of-home-province markets firm *i* sells its products to, $ln(PRTY)$ is firm *i*'s productivity (estimated using the LP method, and also by the logarithm of sales per person), X is a vector containing all other control variables, and *k* (*c*) indexes industry (city) where firm *i* belongs (locates), capturing industry (city) specific fixed effects, and ε is the error term.

The dependent variable, *MrkExt*, is a non-negative integer (0 to 30). It is a typical type of count data. Poisson and Negative Binormial (NB) are two common methods to estimate count data depending on their distribution. Poisson method assumes that the count data have a Poisson distribution, i.e., the mean of the count data equals to its variance. In the data, the mean of *MrkExt* is significantly larger than the standard deviation, and its variance (Table 2), which makes it problematic to use the Poission method. Instead, we choose to use the NB method with the maximum likelihood estimation technique.[6]

[6] In probability theory and statistics, the negative binomial distribution is a discrete probability distribution of the number of successes in a sequence of Bernoulli trials before a specified (non-random) number r of failure occurs.

But, because 44.5% of firms do not sell outside of their home provinces, it means that there is a large list of zeros in *MrkExt*, which will make the distribution of *MrkExt* flat on one end. In order to minimize their projected effects on the coefficients, we further choose the zero-inflated NB model to estimate the coefficients as in Cameron and Trivedi (2009). The "zero-inflated" model adds a binary process to the usual count process. The binary process assumes that "0" comes from the "0" binary process and "1" from the count process with a positive number (*MrkExt* > 0).[7] In other words, the estimation has two components: one is the *MrkExt* equation itself (the count type regression), and the other is the inflate model—we refer this as the zero-inflated NB model or ZINB model for short. Alternatively, due to the fact that the values of *MrkExt* are ordered, we can also use the ordered logit model or Ologit to proceed with the estimation. In estimating the results, we first use NB method to estimate the major coefficients, and then use NIZB and Ologit to analyze the robustness of the main results.

Before we turn to the estimation results, we would like to discuss one other issue of endogeneity. It might be possible that selling into other provincial markets increases firms' productivity, other than the other way around, although the literature has generally found weak or no support on "learning-by-exporting". In light of the vast evidence on self-selection, we don't expect this to be a major problem. Nonetheless, we choose to pursue this in a formal way. To correct this causality, one needs to introduce IVs (instrumental variables). However, good IVs are hard to find. In the context, it has to be a set of variables that are directly related to firms' productivity, but not related to firms' market expansion. Several pieces of information collected in the survey seem to meet that criterion and can be used as IVs. They are: whether the firms are

[7] The possible alternative would be Hurdle model. Hurdle model assumes that "0" observations and non-zero (positive) observations come from different processes, which means, in this specific case, that there are two different mechanisms which lead to firms with out-of-home province sales and without out-of-home province sales. Thus, Hurdle method requires we split the sample into subsamples. For more detailed discussions on both Hurdle and Zero-inflated NB method, please see Cameron and Trivedi (2009).

publically listed (*listed*), whether there is a board of directors (*Director*), the highest degree of the general manager (*Managedu*) and whether a firm has outstanding loan (*loanline*).[8]

6. The Estimation Results

6.1. The Baseline results

Table 4 reports the estimation results with only NB, that is, we do not explicitly control for the many zeros in the dependent variable. We use both lnTFP and ln(S/L) in the estimations, for comparison . Columns (1) to (3) use LP-estimated lnTFP, and columns (4) to (6) use ln(S/L). The reported coefficients are the marginal effects evaluated at the mean, and figures in parentheses are robust standard errors. That is, for continuous variables, the reported coefficients are the associated elasticities, and for concrete variables, the coefficients are the estimated marginal effects with the change of the variable from 0 to 1. In the table, we also report a test to see which model is a better choice, labeled as alpha. If alpha=0 is not rejected, then a Poission distribution should be assumed, and the rejection of alpha=0 indicates a NB distribution. As is clear, the NB distribution is preferred. We also gradually add other control variables, in order to see how the coefficients of the main variable change. For instance, in Columns (3) and (6), we add city and industry dummies as well. Since the estimated coefficients have little changes in magnitudes from Columns (1) to (3), and similarly from Columns (4) to (6), we focus on results in Columns (3) and (6) as they include the complete set of covariates. We now turn our attention to the main estimation results.

Productivity—The estimation results clearly indicate that firms' productivity significantly

[8] To a certain degree, since we use the mean of productivity from 1999 to 2002 for each firm, the causality will be minimized if there is any. Given that our IVs are all at the firm level, it might be feasible to make a connection between those variables for firms' sale expansion into other provincial markets, though some of these connections require a big stretch. We have also tried to use some aggregate measures at the city level as IVs, but the measures are not as good as expected.

leads to their market expansion into other provinces. Across the 6 columns, the coefficient on productivity is all positive and significant at the 1% level. The significance level is not affected by adding other controls. This result unambiguously suggests that more productive firms self-select into sales into other provincial markets, and the more productive a firm is, the more markets it sells its products to. This is consistent with the findings in the exporting literature that only the more productive firms can overcome the protection barriers and become exporters.

As to other control variables, the majority of them are significant at the 1% level, and their estimated signs have expected economic meanings. The coefficient on *Export* is significantly less than 0, suggesting that the more a firm exports its products overseas, the less it focuses on expanding its sales into other provincial markets. For firm size, it positively affects firms' expansion into other provincial markets, signalling a positive relationship between the number of markets a firm sells its products and its size. The coefficient on *Subcontract* is positive and significant, implying that subcontracting makes it easier for firms to enter other provincial markets. The positive and significant coefficient on *Ad* implies that the more channels a firm uses to promote its products, the more markets it can successfully enter. The coefficient on *Bamen* is significant at the 5%, which supports firms' efforts to become a member of a business association in order to get information to enter other provincial markets. The coefficient on *Age* is not significant—it might imply that the positive effects on market expansion associated with experiences cancels out with the negative effects of being conservatism. The coefficient on *Certificate* is positive, but its effects are reduced somewhat when industry and location fixed effects are added in—suggesting that it captures some of industry fixed effects. Having a quality certificate from trusted agencies proves to be a useful tool to promote firms' products in other provincial markets. The positive and significant coefficient on *IndPark* lends support on the

positive and clustering spillover effects on the insiders.

6.2. Some Technical Issues: The Many Zero Observations in the Dependent Variable

Since nearly half of the firms in the survey have sales only in their home provinces, which implies many zero values in the dependent variable, *MrkExt*. The many zeros might affect the estimation results due to the flatted distribution in one end of *MrkExt*. In order to purge out the noises associated with the flattened zeros, we now turn to the zero-inflated NB and the Ologit method respectively. The estimated results are reported in Table 5. The coefficients from the ZINB method are the associated marginal effects of the covariates, while it is not the case for Ologit. In both methods, the city and industry dummies are included. As we discussed earlier in Section 5, the ZINB estimation includes the NB model for the main regression equation and the Inflate function, where in the Inflation equation, the dependent variable is the zero event (where the dependent variable takes on value of 0). In that sense, the NB method and the Inflation method estimate two opposite events.

Results from the ZINB method are reported in columns (1) to (4) with two different productivity measures. With both productivity measures, under the *MrkExt* model, the coefficient on productivity is significantly positive—implying that more productive firms enter into more provincial markets. Results in Column (1) from the ZINB estimation are rather similar to those in Column (3) in Table 4 from NB, and similar conclusions are reached with respect to results in Column (4) in Table 5 and those in Column (6) in Table 4. This similarity implies that the many zeros were not generating large effects on the estimated coefficients even without being explicitly controlled for. Under the Inflate model, we report a negative coefficient associated with firm productivity. The negative coefficient suggests that the more productive firms are highly unlikely

to sell their products only in their home provincial markets, which echoes the results from the *MrkExt* model.

Columns (5) and (6) report the alternative Ologit regression results, also with both measures of productivity. Here, the coefficient on firm productivity is statistically significant at the 1% level. And the coefficients on the other controls yield to similar results as before, though with different magnitudes. The results from ZINB and Ologit reinforce each other, indicating that our results are quite robust.

6.3. How Serious is the Endogeneity Issue?

We now turn our attention to the endogeneity issue of productivity. Since there are no proper procedures associated with IVs in the usage of ZINB and Ologit, we refer to a two-step procedure. In the first step, we use OLS to regress productivity on IVs to get the predicted values of productivity. In the second step, we replace firms' productivity with the predicted values and then use both ZINB and Ologit to estimate the main coefficients of interests. Results from the second step are reported in Table 6, with similar layouts as in Table 5.

Compared with those in Table 5, although the signs on firms' productivity are unchanged, the magnitude is much larger here, which reinforces our major conclusion that the more productive firms expand into more markets. There are some minor changes on the magnitudes and in some cases the signs on the coefficients for some control variables, but by and large, the previous results generally hold.

6.4. Heterogeneity Among Firms with Out-of-home Province Sales

All of the previous discussions are based on the hererogeneity across firms for the whole sample. But as shown in Table 3 and Figure 2, firm characteristics are very different between firms with out-of-home province sales, and those without, and firms' productivity are

monotonically higher for the first group (with *MrkExt* > 0). To a large extent, the nature of the count data can partially capture the productivity differences and the number of markets a firm enters. We now focus on the subgroup of firms with at least some positive sales in their non-home provincial markets. Doing so offers a cleaner estimation on firms' productivity and the number of out-of-home province markets they enter. Table 7 contains the main estimation results, which reinforce the previous findings that more productive firms enter into more markets.

6.5. Manufacturing Firms Only

The last robustness test includes only the manufacturing firms. The heterogeneous firm theory is developed mainly for manufacturing firms. We would expect that there are some changes to the estimated coefficients, due to the different nature of sales expansion for service firms. We also use the predicted productivity in the main estimation to avoid any biases inherent in the possible endogeneity in productivity. The estimated results with ZINB and Ologit are reported in Table 8.

The results clearly show that all of the previous conclusions hold here. It indicates that manufacturing firms are the major driving forces in leading to the estimation results, as it should be expected.

7. Concluding Remarks

Research on firm heterogeneity has advanced quite well with the availability of micro-level data. Studies regarding firm productivity and its market expansion have found that firms' productivity has been proved to be an important aspect on firms' ability to expand overseas. Only the more productive firms are able to overcome the high trade barriers and export overseas. This

paper builds on the rational, but studies firms' market expansion for their products within a country with its much segmented regional markets. The novelty of the study is that by using firms' sales entry within other provincial markets in China, it conveniently avoids the hard-to-control for market heterogeneity, as different provincial markets are homogeneous rather than heterogeneous in nature, and thus studies here offer a nice alternative to the existing literature. We use the Chinese firm-level survey conducted by the World Bank for 2400 firms located in 18 cities, and study how firms' productivity affect their decision to enter other provincial markets. After controlling a host of other factors, we find that entering other provincial markets is a firm's self-selection behavior: the more productive firms enter more other provincial markets. Our results are robust across a number of tests.

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Figure 1: Plot of the Out-of-Home Province Markets

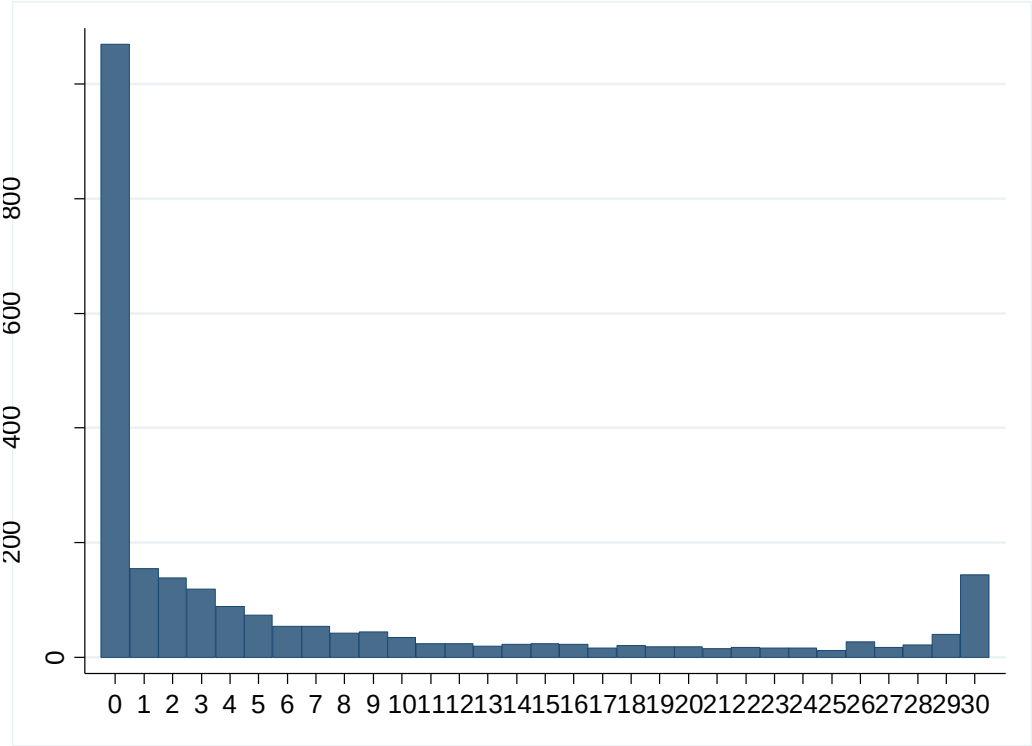

Table 1: Estimation of Total Factor Productivity

Dependent variable：ln(y)						
	LP（Levinsohn-Petrin）		Fixed Effect		OLS	
	coefficients	s.e.	coefficients	s.e.	coefficients	s.e.
ln l	0.209***	0.024	0.180***	0.033	0.225***	0.016
ln k	0.144***	0.055	0.071***	0.025	0.193***	0.011
ln m	0.429***	0.115	0.445***	0.031	0.591***	0.011
cons	—	—	4.136***	0.311	1.602***	0.053
R^2	—	—	—	—	0.85	—
Obs.	4744	—	4744	—	4744	—

Note: *** indicates 1% significance level. Standard errors (s.e.) from LP are bootstrapped; and those from fixed effects and from OLS are robust standard error.

Figure 2: Productivity Distribution of Firms

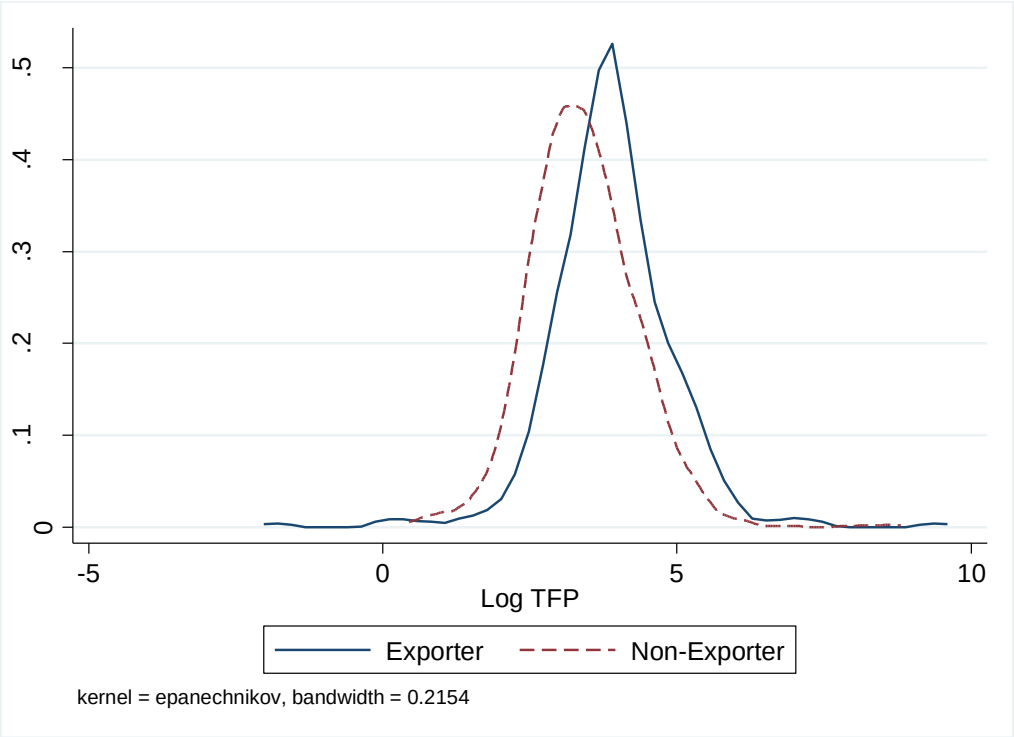

Table 2. Summary Statistics of the Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
MrkExt	2400	6.406	9.587	0.000	30.000
lnTFP	1615	3.524	0.963	-1.815	9.386
ln(S/P)	2271	4.259	1.451	-2.429	11.023
Export	2387	0.081	0.244	0.000	1.000
lnSize	2396	4.836	1.512	0.000	11.303
Subcontract	2253	0.199	0.400	0.000	1.000
Ad	2400	1.435	1.637	0.000	6.000
Bamem	2379	0.583	0.493	0.000	1.000
Age	2400	14.986	14.390	2.000	52.000
Certification	2400	0.484	0.500	0.000	1.000
Indpark	2353	0.257	0.437	0.000	1.000

Table 3. Mean Comparison between Firms with and without Sales in Out-of-home Provincial Markets

	Firms with Home-Province Sales Only		Firms With Sales in non-home Provinces		Are the means significantly different? F-Statistic
Variable	Mean	s.e	Mean	s.e	
lnTFP	3.338	0.043	3.633	0.029	32.36 (0.000)
ln(S/P)	3.989	0.060	4.536	0.043	54.80 (0.000)
Export	0.185	0.016	0.062	0.006	51.52 (0.000)
lnSize	4.683	0.057	5.337	0.046	78.69 (0.000)
Subcontract	0.172	0.016	0.278	0.014	23.78 (0.000)
Ad	0.881	0.059	1.777	0.053	126.35 (0.000)
Bamem	0.448	0.022	0.655	0.015	61.27 (0.000)
Age	13.913	0.555	16.353	0.472	11.22 (0.001)
Certification	0.374	0.021	0.708	0.015	169.93 (0.000)
Indpark	0.195	0.017	0.362	0.015	52.90 (0.000)

Table 4: Estimation Results from NB

	PRTY≡*TFP*			*PRTY*≡*S/P*		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
ln(*PRTY*)	0.884***	0.697***	0.631***	0.890***	0.677***	0.597***
	(0.285)	(0.259)	(0.218)	(0.123)	(0.132)	(0.130)
Export	-10.149***	-9.976***	-8.760***	-8.196***	-8.039***	-6.497***
	(0.951)	(0.897)	(0.844)	(0.927)	(1.002)	(0.968)
lnSize	1.342***	1.015***	1.005***	1.557***	1.211***	0.986***
	(0.149)	(0.179)	(0.157)	(0.118)	(0.139)	(0.129)
Subcontract	2.869***	1.834***	1.220***	2.546***	1.669***	1.365***
	(0.534)	(0.481)	(0.404)	(0.475)	(0.424)	(0.394)
Ad	1.402***	1.038***	0.932***	1.010***	0.757***	0.740***
	(0.134)	(0.125)	(0.120)	(0.111)	(0.116)	(0.113)
Bamem	—	1.362***	0.877**	—	0.930**	1.053***
		(0.411)	(0.356)		(0.372)	(0.345)
Age	—	0.010	0.007	—	0.018	0.008
		(0.017)	(0.014)		(0.015)	(0.013)
Certification	—	2.569***	0.825**	—	2.085***	0.580*
		(0.403)	(0.388)		(0.354)	(0.342)
IndPark	—	2.332***	1.031**	—	2.456***	0.990***
		(0.457)	(0.400)		(0.445)	(0.364)
Industry Fixed Effects	N	N	Y	N	N	Y
City Fixed Effects	N	N	Y	N	N	Y
Wald chi2	587.59	675.69	976.07	521.02	553.21	905.81
[P-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Test: alpha=0	9443.22	8419.33	6736.74	1.3e+04	1.2e+04	1.0e+04
[P-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1581	1554	1554	2141	2095	2095

Note: The coefficients are the associated marginal effects evaluated at the mean of the covariates. For discrete variables, the marginal effects are of the discrete change from 0 to 1. Figures in parentheses are robust standard errors, and figures in squared brackets are p-values. ***, ** and * indicate the significance levels of 1%, 5% and 10% respectively. Due to space limitations, we omit the regressions results on city and industry fixed effects.

Table 5: Estimation from ZINB and Ologit

	ZINB				Ologit	
	PRTY=*TFP*		*PRTY*=*S/P*		*PRTY*=*TFP*	*PRTY*=*S/P*
	(1)	(2)	(3)	(4)	(5)	(6)
variables	MrkExt Eq.	Inflate Eq.	MrkExt Eq.	Inflate Eq.		
lnPRTY	0.692***	-0.141	0.669***	-0.131**	0.194***	0.172***
	(0.262)	(0.117)	(0.140)	(0.059)	(0.074)	(0.041)
Export	-8.360***	2.249***	-7.964***	2.070***	-2.210***	-1.950***
	(0.944)	(0.364)	(0.869)	(0.323)	(0.261)	(0.232)
lnSize	1.142***	-0.113	1.182***	-0.185***	0.286***	0.305***
	(0.180)	(0.091)	(0.146)	(0.060)	(0.053)	(0.041)
Subcontract	1.647***	-0.346	1.747***	-0.332*	0.363***	0.353***
	(0.459)	(0.213)	(0.451)	(0.177)	(0.117)	(0.106)
Ad	1.147***	-0.299***	0.944***	-0.158***	0.339***	0.254***
	(0.138)	(0.081)	(0.117)	(0.050)	(0.038)	(0.031)
Bamem	1.153***	-0.102	1.457***	-0.302**	0.217*	0.324***
	(0.416)	(0.197)	(0.375)	(0.148)	(0.112)	(0.098)
Age	0.010	-0.016	0.008	-0.004	0.002	0.001
	(0.016)	(0.010)	(0.014)	(0.006)	(0.004)	(0.004)
Certification	0.776*	-0.533**	0.849**	-0.495***	0.234*	0.275***
	(0.460)	(0.219)	(0.407)	(0.164)	(0.121)	(0.104)
IndPark	1.232***	-0.777***	1.497***	-0.594***	0.386***	0.378***
	(0.434)	(0.213)	(0.423)	(0.179)	(0.113)	(0.102)
Industry Fixed Effects	Y	Y	Y	Y	Y	Y
City Fixed Effects	Y	Y	Y	Y	Y	Y
Wald chi2	587.59	675.69	976.07	521.02	553.21	905.81
[P-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Test: alpha=0	9443.22	8419.33	6736.74	1.3e+04	1.2e+04	1.0e+04
[P-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1581	1554	1554	2141	2095	2095

Note: The coefficients in Columns (1) and (2) are the associated marginal effects evaluated at the mean. For discrete variables, the marginal effects are the changes in MrkExt from 0 to 1. Coefficients in Columns (3) and (4) are the default coefficients in the Ologit model. Figures in parentheses are robust standard errors and figures in square brackets are the associated p-values. Coefficients on the industry and city fixed effects are omitted due to space limitations. ***, ** and * indicate significance levels of 1%, 5% and 10% respectively.

Table 6: Estimation Results with Correction of Productivity Endogeneity

	ZINB				Ologit	
	PRTY≡*TFP*		*PRTY*≡*S/P*		*PRTY*≡*TFP*	*PRTY*≡*S/P*
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	MrkExt Eq.	Inflate Eq.	MrkExt Eq.	Inflate Eq.		
$ln\widehat{PRTY}$	4.651***	-1.846**	2.102***	-0.963***	1.325***	0.701***
	(1.500)	(0.732)	(0.691)	(0.293)	(0.404)	(0.167)
Export	-9.684***	2.646***	-8.853***	2.242***	-2.460***	-2.063***
	(1.034)	(0.438)	(0.920)	(0.365)	(0.273)	(0.233)
lnSize	0.284	0.287	1.249***	-0.191***	0.019	0.306***
	(0.395)	(0.193)	(0.151)	(0.063)	(0.111)	(0.042)
Subcontract	1.681***	-0.271	1.789***	-0.272	0.345***	0.333***
	(0.470)	(0.216)	(0.471)	(0.181)	(0.119)	(0.108)
Ad	0.859***	-0.197**	0.791***	-0.066	0.256***	0.187***
	(0.183)	(0.099)	(0.150)	(0.062)	(0.049)	(0.037)
Bamem	1.134***	-0.130	1.329***	-0.236	0.243**	0.287***
	(0.433)	(0.198)	(0.396)	(0.151)	(0.114)	(0.099)
Age	0.069**	-0.041***	0.037*	-0.022**	0.021***	0.013**
	(0.028)	(0.015)	(0.021)	(0.009)	(0.008)	(0.005)
Certification	0.287	-0.287	0.568	-0.247	0.103	0.156
	(0.509)	(0.242)	(0.453)	(0.183)	(0.130)	(0.111)
IndPark	0.844*	-0.587**	1.321***	-0.376*	0.256**	0.247**
	(0.482)	(0.233)	(0.488)	(0.199)	(0.126)	(0.114)
Industry Fixed Effects	Y	Y	Y	Y	Y	Y
City Fixed Effects	Y	Y	Y	Y	Y	Y
Pseudo R2	—		—		0.107	0.102
Wald chi2	652.98		564.45		709.74	828.41
[P-value]	[0.000]		[0.000]		[0.000]	[0.000]
Observations	1505=518+987		2013=822+1191		1505	2013

Note：The IVs used in the first stage for productivity are *Listed*, *Director*, *Managedu*, *Skill and Loanline*, explained in Section 4. All the variables and the reporting format are the same as in Table 4.

Table 7: Results for the Subset of Firms with Out-of-Home Province Sales

	PRTY≡*TFP*			*PRTY*≡*S/P*		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
$ln\widehat{PRTY}$	4.766***	6.527***	4.014**	2.279***	2.267***	1.786*
	(0.705)	(1.049)	(1.999)	(0.384)	(0.501)	(0.948)
Export	-11.172***	-11.135***	-9.504***	-10.547***	-10.285***	-8.984***
	(1.364)	(1.288)	(1.312)	(1.321)	(1.248)	(1.270)
lnSize	0.870***	-0.069	0.622	1.767***	1.398***	1.531***
	(0.239)	(0.343)	(0.547)	(0.198)	(0.227)	(0.229)
Subcontract	2.545***	2.106***	2.022***	2.458***	2.134***	2.048***
	(0.646)	(0.630)	(0.613)	(0.654)	(0.641)	(0.613)
Ad	1.146***	0.899***	1.012***	1.285***	1.170***	1.096***
	(0.190)	(0.195)	(0.237)	(0.185)	(0.184)	(0.214)
Bamem	—	2.064***	2.024***	—	1.862***	1.885***
		(0.596)	(0.591)		(0.613)	(0.593)
Age	—	0.093***	0.046	—	0.042	0.025
		(0.028)	(0.039)		(0.026)	(0.031)
Certification	—	0.378	0.173	—	0.521	0.215
		(0.698)	(0.708)		(0.712)	(0.704)
IndPark	—	0.980	0.610	—	1.468**	0.627
		(0.628)	(0.650)		(0.639)	(0.652)
Industry Fixed Effects	N	N	Y	N	N	Y
City Fixed Effects	N	N	Y	N	N	Y
Wald chi2	502.55	580.38	754.96	481.84	521.30	752.97
[P-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Test: alpha=0	3799.35	3641.79	3243.54	3854.36	3748.98	3247.01
[P-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1016	1016	1016	1016	1016	1016

Note：the coefficients are the associated marginal effects evaluated at the mean of the covariates. For discrete variables, the marginal effects are of the discrete change from 0 to 1. Figures in parentheses are robust standard errors, and figures in squared brackets are p-values. ***, ** and * indicate the significance levels of 1%, 5% and 10% respectively. Due to space limitations, we omit the regressions results on city and industry fixed effects.

Table 8: Regression Results for Manufacturing Firms Only

	ZINB				OLogit	
	PRTY≡*TFP*		*PRTY*≡*S/P*		*PRTY*≡*TFP*	*PRTY*≡*S/P*
	(1)		(2)		(3)	(4)
	MrkExt Eq.	Inflate Eq.	MrkExt Eq.	Inflate Eq.	—	—
$ln\widehat{PRTY}$	4.312***	-1.886**	2.113***	-0.934**	1.297***	0.675***
	(1.640)	(0.883)	(0.734)	(0.423)	(0.428)	(0.197)
Export	-9.544***	2.743***	-8.821***	2.436***	-2.467***	-2.267***
	(1.088)	(0.493)	(0.921)	(0.403)	(0.281)	(0.253)
ln Size	0.257	0.317	1.1881***	-0.129	-0.005	0.295***
	(0.441)	(0.241)	(0.175)	(0.095)	(0.116)	(0.050)
Subcontract	1.874***	-0.270	1.705***	-0.298	0.371***	0.363***
	(0.495)	(0.235)	(0.470)	(0.226)	(0.125)	(0.122)
Ad	0.904***	-0.166	0.911***	-0.118	0.277***	0.262***
	(0.198)	(0.116)	(0.169)	(0.094)	(0.053)	(0.046)
Bamem	1.592***	-0.222	1.565***	-0.170	0.345***	0.309***
	(0.471)	(0.234)	(0.436)	(0.214)	(0.119)	(0.114)
Age	0.063**	-0.036**	0.042*	-0.024*	0.019**	0.013**
	(0.031)	(0.017)	(0.023)	(0.013)	(0.008)	(0.006)
Certification	0.297	-0.288	0.568	-0.358	0.092	0.179
	(0.562)	(0.285)	(0.510)	(0.260)	(0.139)	(0.130)
IndPark	0.965*	-0.638**	1.086**	-0.549**	0.250*	0.256**
	(0.526)	(0.283)	(0.499)	(0.261)	(0.133)	(0.129)
Industry Fixed Effects	Y	Y	Y	Y	Y	Y
City Fixed Effects	Y	Y	Y	Y	Y	Y
Pseudo R2	—		—		0.1006	0.1026
Wald chi2	589.19		595.68		631.48	705.40
[P-value]	[0.000]		[0.000]		[0.000]	[0.000]
Observations	1305=912+393		1441=985+456		1305	1441

Note：the same as for Table 5.