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Importing exporters and exporting importers: A study of the decision of Chinese firms to engage in international trade

Abstract

This paper examines the complex and interdependent relationship between importing and exporting for a panel of Chinese firms. We estimate the decision to import and export simultaneously within a dynamic random-effects bivariate probit framework addressing the endogenous initial conditions problem. Results show that decisions to export and import are simultaneously determined and that sunk entry costs play a significant role in a firm's decision to enter international markets. Costs are larger for exporting. We also find a substitution effect between the two decisions. The substitutability between exporting and importing is greater for financially constrained private firms.

Key words: Exporting, importing, sunk costs, firm heterogeneity, dynamic random-effects bivariate probit, initial conditions problem

JEL codes: F14, C33, D22

1 Introduction

In a world where globalization is under threat from a renewed interest in protectionist policies it is important to understand what drives the exporting and importing behaviour of firms and whether these activities are complementary or are substitutes. The existing literature has tended to concentrate on exporting and shows that exporters tend to outperform non-exporters in terms of productivity, capital-intensity, skilled labour intensity, size and financial health (Bernard and Jensen, 2004; Van Biesebroeck, 2005; Greenaway et al., 2007; Lawless, 2009). Central to this literature is the identification of factors that determine a firm's decision to export, with a number of studies identifying sunk-entry costs and various firm characteristics as important determinants of exporting behaviour (Das et al., 2007; Manez et al., 2008; Greenaway and Kneller, 2008; Impullitti et al., 2013).[1]

In contrast, relatively little attention has been given to explain the decision of firms to import. More general papers on importer behaviour include MacGarvie (2006), Kugler and Verhoogen (2009), Chen and Ma (2012), Augier et al. (2013), Cadot et al. (2014) and Halpern et al. (2015). The results of these and other papers show that importers tend to share many of the same characteristics as exporters in that they are larger (importers are generally larger than exporters), more productive and more capital- and skill-intensive than non-traders. In addition, there are a small number of papers that study importing and exporting simultaneously (a significant number of exporters also import intermediate inputs) which show that these so-called two-way traders are even larger, more productive and more capital- and skill-intensive than firms that only export or only import (Bernard et al., 2009; Manova and Zhang, 2009; Muuls and Pisu, 2009; Aristei et al., 2013; Castellani et al., 2010; Kasahara and Lapham, 2013).[2]

Central to this paper is the observation that access to intermediate inputs from abroad increases both the probability of exporting and the number of export destination countries (Bas, 2012; Bas and Strauss-Kahn, 2014; Fugazza and McLaren, 2014). The argument is that a firm will face lower sunk entry costs to exporting if it is already an importer especially if the imports

[1] When we write about sunk costs in the paper we are referring more broadly to a measure of state dependence (for example, learning-by-doing, accumulation of a customer base and any mechanisms that induce non-linearities in firm production costs).

[2] For example, Vogel and Wagner (2010) find that in 2005, 72% of German exporters were also importers, while Wang and Yu (2012) show that between 2002 and 2006 64% of exporters in China also imported. Finally, for France Bas and Strauss-Kahn (2014) reveal that between 1996 and 2005, 86% of exporters were also importers.

are sourced from the target export destination country. In this case, the firm is likely to be, for example, more familiar with that country's language and culture and may be able to exploit existing distribution channels and previously developed networks. Similarly, existing exporters should also find it easier to begin an importing relationship because of similar trade externalities/complementaries which lower the sunk entry costs of importing. The potentially complex and interdependent relationship between importing and exporting means that estimations that fail to take into account the influence of existing trade channels on the decision to participate in further international trade may bias (overstate) the size of sunk costs of entry for that particular channel.

Following Melitz (2003) and Bernard and Jensen (2004), a number of theoretical models and empirical studies have suggested that decisions to export and import are state dependent and that persistence in exporting and importing may be due to the large costs to individual firms of entering foreign markets (Campa, 2004; Kaiser and Kongsted, 2008; Kasahara and Lapham, 2013; Aeberhardta et al., 2014; Timoshenko, 2015). These costs can be categorized into upfront sunk costs (e.g., finding reliable buyers /suppliers and establishing distribution channels) and fixed costs (e.g., contracting costs, transportation costs and customer service costs). Sunk costs are assumed to be incurred before a firm enters a foreign market and hence cannot be recovered whether the firm remains or subsequently exits the market.[3]

In this paper we revisit the literature on the internationalization decision of firms employing a large dataset of manufacturing firms for China between 2002 and 2006 that contains rich information on a range of different firm characteristics and international trade activities. China is also central to current global trade patterns when it overtook the US as the world's largest trader (WTO).[4] China has attracted particular interest given its rapid growth of international trade. A number of recent papers examine the export behaviour of Chinese firms (Yang and Mallick, 2010; Lu, 2010; Yi and Wang, 2012). Although there are also a number of papers that consider the performance of Chinese importers (Manova and Zhang, 2009; Wang and Yu, 2012; Elliott et al., 2016) there is only limited research that has been done on the importing decision of firms. Although Fan et al. (2015) and Feng et al. (2016) link the two sides of international

[3]See for example Roberts and Tybout (1997), Alessandria and Choi (2007) and Das et al. (2007) for estimates of sunk costs of exporting, and Kasahara and Rodrigue (2008) and Kasahara and Lapham (2013) for estimates of the sunk costs of importing.

[4]China's international trade in merchandise reached 4,159 million USD and that of the US was 3,909 USD in 2013 (Statistics database, WTO).

trade in studies of manufacturing firms in China, their focus is on how imported inputs affect export performance.

More specifically, we make the following contribution. First, rather than focusing on only one side of a firm's internationalization strategy (exporting or importing), we estimate the probability of a firm engaging in both importing and exporting jointly, controlling for the effects of any previous trading relationship (exporting or importing). In doing so we are examining whether importing and exporting are complementary activities or whether they may be a substitution effect. We include a series of control variables previously suggested by the literature, including firm age, size, total factor productivity (TFP), wages, ownership and financial health. We also look carefully at the role played by financial constraints on the relationship between importing and exporting for private and state-owned enterprises (SOEs).

To the best of our knowledge, we are the first to study the joint decisions of exporting and importing for the case of Chinese manufacturing firms. The only other papers that study both firms' export and import decisions we are aware of consider countries other than China such as Aristei et al. (2013) on Eastern Europe and central Asian (ECA) countries, Kasahara and Lapham (2013) on Chile and Muuls and Pisu (2009) and Muuls (2015) on Belgium. Aristei et al. (2013) investigate the two-way relationship between exporting and importing using a bivariate probit model and a sample of 1,085 firms from 27 ECA countries. They find a positive relationship between importing and exporting, but, after controlling for firm characteristics, past exporting does not increase the current probability of importing, while past importing status has a positive effect on the current probability of exporting but such effect disappears when firms' productivity and innovation are controlled for. In a study of Chilean plants between 1990 and 1996 Kasahara and Lapham (2013) build a structural model of importing and exporting with heterogeneous firms and provide evidence that both exporting and importing require high start-up costs. They also find that plants that both export and import pay considerably lower sunk costs which they attribute to cost complementaries. Muuls and Pisu (2009) and Muuls (2015) both estimate the probability of exporting or importing separately using a dynamic random-effects probit model or a linear probability model respectively.

Our second contribution is to take into account two potentially important sources of bias in studies that use a dynamic random-effects (RE) probit model. The first, issue (1), is the

endogeneity concerns that arises from unobserved firm heterogeneity as a result of the standard RE probit model which assumes no correlation between unobserved heterogeneity and other explanatory variables. The second, issue (2), concerns the potential bias that could be induced by the initial conditions problem that arises when the start of the sample does not coincide with the start of the firms' exporting or importing process and that assuming that the initial observations are pre-determined or exogenous could lead to overestimation of the magnitude of the sunk costs of entry into exporting or importing. To address issue (1) we introduce a vector of the means of the observable variables (using a Mundlak specification) which enables us to allow for the correlation between unobserved firm heterogeneity and the observed characteristics. To address issue (2) we follow Wooldridge (2005) method and implement a modified version of this approach proposed by Rabe-Hesketh and Skrondal (2013).

A number of papers have considered the initial conditions problem (Roberts and Tybout, 1997; Das et al., 2007; Campa, 2004; Manez et al., 2008), although they have not taken into account import activity or have assumed no correlation between unobserved firm heterogeneity and other observable characteristics (issue (1)). Other papers acknowledge that exporting involves large sunk-entry costs for example searching information on target markets, meeting legal requirements and establishing distribution networks (Roberts and Tybout, 1997; Bernard and Jensen, 2004; Vogel and Wagner, 2010; Manova, 2013) and have included in their estimates lagged export status to capture the sunk costs associated with exporting. However, the majority of these studies fail to address the initial conditions problem (e.g., Bernard and Wagner, 2001; Arnold and Hussinger, 2005; Greenaway et al., 2007; Bellone et al., 2010; Yi and Wang, 2012).

To briefly summarise our main results, we find that for Chinese manufacturing firms it is not only whether a firm exports but also whether it imports that is important for explaining differences in firm performance, e.g., productivity and financial health. We also find that significant sunk entry costs need to be incurred for firms that wish to start exporting or importing, although we find, perhaps not surprisingly, that the sunk costs of importing are considerably smaller than those of exporting. Results from different specifications, under different assumptions related to unobserved heterogeneity and initial conditions show that if the correlation between unobserved heterogeneity and other firm characteristics and initial conditions, are not properly controlled for as in previous literature, sunk entry costs of exporting and importing are over estimated. In our preferred specification, a negative relationship between export and

import is observed (a substitution effect): previous importing experience is found to reduce the propensity to export and previous export experience is found to reduce the likelihood to import, although the impact is relatively small in comparison to the influence of other determinants.[5] Comparisons between private and state-owned firms of different degrees of financial health show that the substitutability between exporting and importing is greater for private firms rather than SOEs, especially the financially constrained private firms. This finding is consistent with the literature that financially constrained firms usually participate in one-way trade.

The remainder of this paper is organized as follows. Section 2 outlines our empirical strategy and discusses the related econometric issues and solutions. Section 3 describes the data and the variables. Empirical results are presented in Section 4 and finally Section 5 concludes.

2 Empirical Methodology

2.1 Dynamic bivariate probit model

Following the previous literature on firms' export behaviour (Roberts and Tybout, 1997; Bernard and Jensen, 2004; Greenaway et al., 2007; Yi and Wang, 2012), we use a dynamic binary discrete-choice model to examine the determinants of a firm's decision to engage in international trade:

$$Y_{it}^{j} = 1[y_{it}^{j} \geq 0] \quad j = 1, 2 \quad \text{and} \quad t = 2, ..., T \tag{1}$$

$$y_{it}^{1} = x_{it}^{'}\beta_{1}^{1} + \gamma_{1}^{1} y_{i(t-1)}^{1} + \upsilon_{it}^{1} \tag{2}$$

$$y_{it}^{2} = x_{it}^{'}\beta_{1}^{2} + \gamma_{1}^{2} y_{i(t-1)}^{2} + \upsilon_{it}^{2} \tag{3}$$

where $1[.]$ is the indicator function, Y_{it}^{j} are dummy variables with y_{it}^{1} (y_{it}^{2}) equal to one if firm i exports (imports) in year t and zero otherwise, x_{it} is a vector of explanatory variables affecting the propensity of the firm to export (import) and υ_{it} is the error term. x contains both firm and

[5]There is extensive literature on the substitution/complementarity between firms' growth strategies, such as the trade off between exporting and selling domestically, product diversification and international market diversification or innovation and internationalization (Salomon and Shaver, 2005; Golovko and Valentini, 2011; Kyläheiko et al., 2011; Hashai and Delios, 2012; Esteve-Perez and Rodriguez, 2013; Mayer et al., 2015). Evidence of a substitution effect between international and product diversification is shown by Kumar (2009), Mayer et al. (2015) and Bowen and Sleuwaegen (2017).

market characteristics including firm age, productivity, labour quality (proxied by the average wages of employees), size (measured by the number of employees), financial status (liquidity and leverage ratios), ownership structure, region, industry and year dummies. Region and industry dummies are included to control for time-invariant factors common to firms across regions and industries respectively and year dummies are included to account for business cycle effects and firm-invariant market factors such as changes in exchange rates or government policy. A lagged dependent variable, $y_{i(t-1)}$, is included to capture sunk entry costs. If γ_1 equals zero, there is no sunk costs of exporting (importing). If our estimations reveal a significant relationship between our lagged dependent variable and the dependent variable then we assume that sunk entry costs are important and that the magnitude of the coefficient on the lagged dependent variable can be considered as a measure of the size of these costs.

If a firm needs to incur potentially substantial sunk costs before starting to import or export the expectation is that this will reduce the probability of a firm deciding to start a new trade relationship (exporting or importing) while firm size, productivity, the average quality of the workforce and financial health are expected to positively impact the probability of firms starting to import or export. Foreign ownership is expected to positively influence a firm's decision to trade as the parent company will have an extensive knowledge of its home market and potentially many other markets if it has affiliates in other countries. The impact of firm age on international trade behaviour is rather mixed. On the one hand, long-established firms may be more likely to look for foreign markets for further growth and expansion. On the other hand, some younger firms may be born global which means that they engage with international markets almost immediately often using new technologies to access new markets. Since the domestic market is often dominated by a small number of experienced firms, these younger firms often look to foreign markets to grow the business almost from the start with globally focussed goods and services.

Equations (2) and (3) estimate firms' export or import behaviour separately, and given that the dependent variables are binary, the equations can be estimated by a probit modelling approach. Previous literature has shown that many firms participate in both export and import markets and these two-way traders perform differently from those that only export or only import. Studies also find evidence that better foreign inputs generate productivity gains (Augier et al., 2013; Kasahara and Lapham, 2013; Halpern et al., 2015; Elliott et al., 2016), and more

productive firms also have a higher probability of exporting as firms learn from participation in the export market and improve their productivity which may in turn generate a larger demand for cheaper or better foreign inputs (Van Biesebroeck, 2005; Aw et al., 2011). We thus include the previous import (export) status in the estimation of the export (import) decision. Also in order to take account of the interdependent relationship between exporting and importing, we estimate the export and import decisions simultaneously in a dynamic bivariate probit setting.[6] The dynamic bivariate probit model of exporting and importing decision is specified as follows:

$$\begin{cases} y_{it}^1 = x_{i(t-1)}^{'}\beta_1^1 + \gamma_1^1 y_{i(t-1)}^1 + \gamma_1^2 y_{i(t-1)}^2 + \upsilon_{it}^1 \\ y_{it}^2 = x_{i(t-1)}^{'}\beta_1^2 + \gamma_1^2 y_{i(t-1)}^2 + \gamma_1^1 y_{i(t-1)}^1 + \upsilon_{it}^2 \end{cases} \tag{4}$$

Since changes in firm characteristics, such as size and productivity, may induce firms to switch their trade status and participation in overseas markets may also in turn affects the other characteristics of the firm, the explanatory variables in equations in (4) are lagged by one year to mitigate possible simultaneity concerns. Although equations in (4) look like seemingly unrelated regression equations (SURE), they are in fact correlated via the error terms as the lagged dependent variable in one equation is among the explanatory variables in the other equation. The estimation of (4) raises two econometric concerns: (1) unobserved firm heterogeneity and (2) the initial conditions problem. We now discuss both issues in more detail. For the simplicity of the equations in the subsections, we now suppress x and the lagged import (export) status on the right-hand side of equations in (4) as X.

2.2 Unobserved firm heterogeneity

Although a set of observed firm characteristics that are assumed to influence a firm's decision to engage in international trade in equations in (4), there may be a number of characteristics that affect the decision to trade but are not influenced by previous trading experience (unobserved heterogenity). Examples include managerial ability or the existence of foreign networks as a result of employee or CEO connections. If the unobserved firm heterogeneity exhibits persistence over time, not controlling for this possibility could lead to an overestimation of

[6] See for example Alessie et al. (2004), Aw et al. (2007), Girma et al. (2008) and Esteve-Perez and Rodriguez (2013) for other studies that take a bivariate probit approach.

the importance of previous trading experience. For example, assume that a firm started to export and then continued to export because of a management strategy that was focussed on internationalization. The problem of such a conditional relationship between past and future trade participation caused by the improper control of the unobserved firm heterogeneity is the spurious state dependence problem as discussed by Heckman (1981a,b).

To address the problem we assume that the error term υ_{it} in Equation (4) consists of two components, the unobserved firm-specific time-invariant effects, k_i, and an exogenous random disturbance, μ_{it}, where:

$$\upsilon_{it} = k_i + \mu_{it} \tag{5}$$

where k_i is normally distributed and independent and μ_{it} is normally distributed and independent of the explanatory variables for each i and t. To control for unobserved firm heterogeneity, both fixed-effects (FE) and random-effects (RE) approaches can be used. The unobserved effect, k_i, is treated as a parameter to be estimated in a fixed-effects framework while the random-effects framework treats it as a random variable. In a linear setting, a fixed-effects estimator using a transformation such as differencing or demeaning is sufficient to control for such unobserved effects. However, in the case of dynamic binary choice model with T fixed and $N\rightarrow \infty$, treating k_i as a parameter can potentially lead to seriously biased estimations of β_1 and γ_1 because of the incidental parameters problem (Heckman, 1981b; Wooldridge, 2010).

As Wooldridge (2010, p.286) points out, with a large number of random draws, to treat the unobserved effects as random draws is appropriate from a neglected heterogeneity perspective. Hence, we use a RE Probit model which is an established approach for binary outcomes with panel data. However, the standard RE Probit assumes that the unobserved heterogeneity is uncorrelated with all the other explanatory variables. This is a strong assumption. In our case, part of the unobserved firm heterogeneity k_i that may affect a firm's decision to trade, for example managerial expertise, is likely to be correlated with firm productivity, which is an element of X. Following Mundlak (1978), we allow for possible correlation between k_i and X by estimating:

$$k_i = \bar{X}_i'\beta_2 + \epsilon_i \tag{6}$$

where X is a vector of means of all time-varying covariates in X and $\epsilon_i \sim$iid N(0, σ_ϵ^2), indepen-

dent of X and μ_{it} for all i and t. Substituting Equation (6) into Equation (4) gives:

$$y_{it} = \gamma_1 y_{i(t-1)} + X'_{i(t-1)}\beta_1 + \bar{X}'_i\beta_2 + \epsilon_i + \mu_{it} \tag{7}$$

2.3 The initial conditions problem

The estimation of (7) requires an assumption on the relationship between the initial participation in international trade, y_{i1}, and the error term ϵ_i. Estimations of a dynamic binary choice model using a standard RE probit assume that the initial conditions are pre-determined or exogenous, i.e., the initial observation values are independent of unobserved firm-specific effects. If the observation period for each firm starts from the beginning of the process generating y_{it}, the initial conditions can be assumed to be exogenous. However, as with the majority of studies that use panel data, the start of our sample does not coincide with the start of the international trade process (importing or exporting) and the assumption of exogenous initial conditions is inappropriate since the unobserved time-invariant firm heterogeneity that affects current trade participation, could also influence the trade behaviour in the initial period. Ignoring the endogeneity of the initial conditions will thus result in a biased estimation, leading to an overestimation of the state dependence, i.e., the effect of past trade experience on the current decision to participate in international trade which would lead to an upwardly biased estimation of the sunk costs of entry.

The solution proposed by Heckman (1981b) is to specify a reduced-form equation for the initial period:

$$y_{i1} = X'_{i0}\beta_0 + \zeta_i \tag{8}$$

where ζ_i is correlated with ϵ_i, but uncorrelated with μ_{i1} for $t \geq 2$. ζ_i can be written as $\zeta_i = \theta\epsilon_i + \eta_{i1}$, with ϵ_i and η_{i1} being independent. Equation (8) is then specified as:

$$y_{i1} = X'_{i0}\beta_0 + \theta\epsilon_i + \eta_{i1} \tag{9}$$

Together with Equation (7), a complete model for firms' exporting or importing behaviour can be estimated using maximum likelihood (Roberts and Tybout, 1997). However, the implementation of the Heckman estimator is computationally demanding (Stewart, 2007; Arulam-

palam and Stewart, 2009).[7] A simpler, and more practical, approach is proposed by Wooldridge (2005).

Wooldridge (2005) suggests a conditional maximum likelihood (CML) estimator that considers the distribution of the unobserved firm heterogeneity which is conditioned on the initial values and exogenous variables. The model for ϵ_i given y_{i1} and X_i is:

$$\epsilon_i = \alpha_1 y_{i1} + X_i'\beta + a_i \tag{10}$$

where $X_i' = X_{i1}', \ldots, X_{iT}'$ and $a_i \sim N(0, \sigma_a^2)$. A constrained model of the Wooldridge estimator (used by, for example, Akay, 2012) is more popularly used and is given by:

$$\epsilon_i = \alpha_1 y_{i1} + \bar{X}_i'\beta_2 + a_i \tag{11}$$

which uses $\bar{X}_i'$, within-means of the time-varying explanatory variables, instead of X_i'.

Substituting Equation (11) into Equation (7) gives:

$$y_{it} = \gamma_1 y_{i(t-1)} + X_{i(t-1)}'\beta_1 + \alpha_1 y_{i1} + \bar{X}_i'\beta_2 + a_i + \mu_{it} \tag{12}$$

where $\bar{X}_i$ is derived from the Mundlak specification discussed in the previous subsection. The Wooldridge (2005) method leads to a simple and tractable likelihood function that has the same structure as a standard RE Probit model and the parameters can be estimated by expanding the list of explanatory variables to include y_{i1} and $\bar{x}_i$. Due to its simplicity and the advantage of employing any standard RE Probit software, the Wooldridge estimator has been used in a number of empirical applications (Contoyannis et al., 2004; Stewart, 2007; Michaud and Tatsiramos, 2011; Conti and Pudney, 2011; Drakos and Konstantinou, 2013).[8]

More recently, however, Rabe-Hesketh and Skrondal (2013) have shown that the con-

[7] We initially attempted to employ a standard Heckman estimator but unfortunately the regressions did not converge due in part to the large size of our dataset.

[8] Estimation by such method requires a balanced panel as Wooldridge (2005, p44) states "*The log-likelihood in equation (10) assumes that we observe data on all cross-section units in all time periods.*" Also as explained in Wooldridge (2005, p44), this solution allows selection and attribution to depend on the initial conditions: "*When attrition is an issue, obtaining the density conditional on (y_{i0}, z_i) has some advantages over the more traditional approach, where the density would be conditional only on z_i. In particular, the current approach allows attrition to depend on the initial conditions, y_{i0}, in an arbitrary way.*"

strained version of the Wooldridge estimator can lead to a severe bias for short panels because the conditional distribution of the unobserved effect depends more directly on explanatory variables in the initial period than on those in the other periods. To avoid this problem, they propose adding the initial values of explanatory variables separately from their means in subsequent periods to the constrained model:

$$\epsilon_i = \alpha_1 y_{i1} + \bar{X}_i' \beta_2 + X_{i1}' \beta_3 + a_i \tag{13}$$

and Equation (12) then becomes:

$$y_{it} = \gamma_1 y_{i(t-1)} + X_{i(t-1)}' \beta_1 + \bar{X}_i' \beta_2 + \alpha_1 y_{i1} + X_{i1}' \beta_3 + a_i + \mu_{it} \tag{14}$$

where $\bar{X}_i' = \frac{1}{T-1} \sum_{t=2}^{T} X_{it}$ as the first period observation of X has been included in the equation. Given our short period sample (see next section), we follow Rabe-Hesketh and Skrondal (2013) and estimate a modified version of the Wooldridge procedure.

Expanding (14) to two equations to model firms' export and import decisions and substituting X with x and considering the other side of the international trade status gives us :

$$\begin{cases} y_{it}^1 = \gamma_1^1 y_{i(t-1)}^1 + x_{i(t-1)}^{'} \beta_1^1 + \gamma_2^1 y_{i(t-1)}^2 + \bar{x}_i' \beta_2^1 + \bar{y}_i^2 \gamma_3^1 + \alpha_1^1 y_{i1}^1 + \alpha_2^1 y_{i1}^2 + x_{i1}' \beta_3^1 + a_i^1 + \mu_{it}^1 \\ y_{it}^2 = \gamma_1^2 y_{i(t-1)}^1 + x_{i(t-1)}^{'} \beta_1^2 + \gamma_2^2 y_{i(t-1)}^2 + \bar{x}_i' \beta_2^2 + \bar{y}_i^1 \gamma_3^2 + \alpha_1^2 y_{i1}^1 + \alpha_2^2 y_{i1}^2 + x_{i1}' \beta_3^2 + a_i^2 + \mu_{it}^2 \end{cases} \tag{15}$$

where μ_{1t}^1 and μ_{1t}^2 are the error terms of each equation with $\rho = Corr(\mu_{1t}^1, \mu_{2t}^2)$. If ρ is insignificant then no endogeneity bias is present and the two equations can be estimated separately as binomial probit and the log likelihood for the bivariate probit model is equal to the sum of the log likelihoods of the two univariate probit models. If ρ is significantly different from zero, and the log-likelihood of the bivariate estimate is significantly less than the joint binomial probit log-likelihoods, then y^1 and y^2 are interdependent processes. In our study, it is highly likely that μ_{1t}^1 and μ_{1t}^2 are correlated, a joint estimation is more efficient than two separate probit models. We thus estimate the equations jointly using dynamic bivariate RE probit regressions.[9]

[9]We use Stata program -cmp- by Roodman (2011) for the estimation. -biprobit- fits maximum-likelihood two-equation probit models, but it does not control for unobserved heterogeneity which is common in panel data studies. We would like to thank an anonymous referee for this suggestion.

3 Data and Descriptives

3.1 The Data

Our data are drawn from two sources. The first is the Annual Survey of Industrial Enterprises provided by the National Bureau of Statistics of China (NBS) and the second is the transaction-level trade data provided by the Department of Customs Trade Statistics, the General Administration of Customs of China. We use data from both sources for the period 2002 to 2006.

The NBS data cover all state-owned industrial enterprises and non-state-owned industrial enterprises with annual sales of 5 million Chinese Yuan (RMB) or more.[10] According to the NBS industry classification, industrial enterprises refer to enterprises that operate in the mining and quarrying sector, manufacturing sector or in the production and supply of power, gas and water. The NBS survey is the primary source for the construction of numerous aggregate statistics used in the China Statistical Yearbooks. The NBS data include the firm's identification (tax code) and basic information such as year founded, location, ownership type, employment, China industrial classification (CIC) code as well as over 50 financial variables from the accounting statements, including capital, assets, liabilities, industrial value-added, sales, income, profits, investment, depreciation, wage bill and R&D expenses.

The ownership structure of a firm is defined according to the share of capital. We group firms into five categories: state-owned enterprises (*SOE*), collectively-owned enterprises (*COL*) and private firms (*PRI*); Hong Kong, Macao and Taiwan-owned firms (*HMT*) and foreign-owned firms (*FOR*). Due to significant differences in infrastructure, economic development and education levels between the eastern and western regions of China, we categorise each firm into one of three regions, *EAST*, *CENTRAL* and *WEST*, based on their principal address.

The customs trade dataset records all import and export transactions with non-zero values that enter or exit through China's customs system. Each observation represents a shipment and contains detailed information on the time of the transaction (month and year), type of trade

[10]The official RMB-US dollar exchange rate between 2002 and 2004 was 8.277, 8.194 in 2005 and 7.973 in 2006 (World Development Indicators, World Bank). Hence, the threshold for inclusion in the dataset is equivalent to between USD600,000 and USD627,000 over the sample period.

(import/ export), exporting/ importing firm identifier, ownership type, product traded (8-digit Harmonized System code and name), value, quantity, unit, destination country (of the exported commodities) / country of origin (of the imported products), type of trade (ordinary trade, processing trade or other types) and finally mode of transport.

In order to explore the relationships between firm characteristics and trading activity, we match the NBS data and the trade data following the matching procedures outlined in Brandt et al. (2012). We first link firms from each year of the survey data using firm registration IDs and names. To avoid complications related to firm births and deaths, we only select firms that operated continuously for the whole sample period.[11] Since the NBS and trade data use different coding systems for the firm identifier it is not possible to merge datasets by firm IDs alone. Hence, the matching is done by using firm names and the location of registration. We concentrate only on manufacturing firms (CIC13-43). We also exclude firms with incomplete records or negative values for key variables such as firm age, assets, real capital stock, number of employees, output, value-added and total wages. We also drop observations if any of the following are found: total assets smaller than fixed assets; total assets smaller than current assets; total liabilities smaller than current liabilities; current depreciation smaller than accumulated depreciation. Following Yu (2015) and Feng et al. (2016) we drop the intermediary firms (pure trading firms) as they do not produce goods directly but simply facilitate trade for domestic firms (imports or exports).[12] We also exclude processing trade firms as they are, by definition, both importers and exporters.[13] In addition, following Brandt et al. (2012) and Upward et al. (2010), we drop all firms with less than 8 employees as they fall under a different legal regime.

Our final balanced sample consists of 42,666 firms which corresponds to 213,330 firm-year observations for the period 2002 to 2006. Nominal variables are deflated by 4-digit CIC industry deflators from Brandt et al. (2012).[14]

[11] Bernard and Jensen (2004), Girma et al. (2004) and Arnold and Hussinger (2005) use a similar rule for the construction of their datasets.

[12] Ahn et al. (2011) discuss the role of the Chinese intermediaries in facilitating international trade. We identify the intermediary firms based on Chinese characters that have the English-equivalent meaning of "importing", "exporting", and/or "trading company" in the firm name.

[13] See Wang and Yu (2012), Yu (2015) and Manova and Yu (2016) for more discussion on the behaviour and performance of China's processing firms.

[14] One concern with using a balanced panel of firms that are in each year of the sample (continuous firms) is that of sample selection related to attrition. However as discussed in the previous section, Wooldridge method requires a balanced panel and when attrition is an issue, this method allows attrition to depend on the initial condition in an arbitrary way. Thus, to estimate a firms' decision to export and import and correctly control for initial conditions it is appropriate to use a balanced panel in a dynamic non-linear model with unobserved heterogeneity.

Detailed definitions of our variables are provided in Table A1 of the appendix. We calculate firm-level total factor productivity (TFP) following De Loecker (2007), which builds on Olley and Pakes (1996) by including import and export status as additional state variables in the production function. In addition, because the ownership structure of a firm may also influence input decisions, ownership dummies are included in the production function. Furthermore, since firms in different industries have different factor inputs and input prices, we estimate the production function for each 2-digit industry separately rather than doing this for the entire manufacturing sector. See Elliott et al. (2016) for details of how this methodology has been applied to similar Chinese data and a description of TFP estimation based on De Loecker (2007).[15]

3.2 Descriptives

Our analysis begins with a brief look at some simple summary statistics. In Table 1 we group only-exporters, only-importers, two-way traders and non-traders. Consistent with previous studies, the majority of Chinese manufacturing firms (73.68%) do not export (non-traders plus only importers). Of the 26.32% of firms that export, over half also import. Consistent with the stylized facts documented in the existing literature, compared to non-traders, Chinese two-way traders appear to be larger, more productive, more capital-intensive, have higher liquidity and pay higher wages. Such premia show that importing behaviour also has a potentially important impact on firm performance. It is interesting to note that only-importers tend to have higher values than only-exporters for all of our controls except leverage.

[Table 1 about here]

As part of our descriptive evidence, we now examine the role of trade as a determinant of difference performance indicators. Hence, we estimate the following:

$$P_{it} = \alpha_o + \alpha_1 EXPonly_{it} + \alpha_2 IMPonly_{it} + \alpha_3 EXPIMP_{it} + \lambda Z_{it} + \varepsilon_{it} \qquad (16)$$

[15] De Loecker (2007) argues that exporting firms face a different market structure and factor prices and by introducing exports in the estimation procedure, the decision to invest and to exit now depends on export status. Van Biesebroeck (2005) also includes export status in the production function. For similar reasons, in their TFP calculations, Kasahara and Rodrigue (2008) and Bas and Strauss-Kahn (2014) include import status and the number of imported inputs respectively. Amiti and Konings (2007) and Yu (2015) also include both export and import status in their TFP calculations.

where P_{it} represents firm performance, i.e., employment, wage, capital intensity, and TFP respectively. The variables *EXPonly*, *IMPonly* and *EXPIMP* are dummy variables representing firms that export only, import only and both export and import, respectively. Firms that do not export or import are the omitted category. Z is a vector of control variables, namely firm age, employment, wages, and ownership. Region, industry and year dummies are included in all specifications.[16]

Table 2 presents the results from a fixed effects estimation. The coefficients on our trade status variables are positive at 0.01 significance level. Firms that participate in international markets are found to be larger, more productive, more capital- and skill-intensive than firms that serve domestic markets only. In general, firms that both import and export (Row 3) have the highest performance premium, followed by only-importers. Interestingly, only-exporters are better performers than only-importers for employment but have a worse performance for the other three indicators.[17]

To check whether these different groups are statistically different from each other we report Wald test results for each performance indicator in the lower half of Table 2. Of primary interest is whether firms that both export and import perform differently to those that export only or import only. The hypotheses that $\alpha_3 = \alpha_1$ is rejected at the 0.01 significance level for all performance indicators. Similar results are found for importer only firms, although we cannot reject the null hypothesis for TFP. The Wald test results also suggest that the only-importers and only-exporters coefficients are only significantly different for our measure of employment. Our results suggest that papers that estimate export premia could be overestimating the size of the effect if they do not take into account importing activity.

[Table 2 about here]

[16]When the dependent variable is employment (wage), the same variable is omitted from the control variables. A Hausman test on the choice between fixed effects and random effect favours the former.

[17]The results are consistent with Muuls and Pisu (2009) and Silva et al. (2013) who also find better performance for only-importers over only-exporters in terms of productivity, sales, wages and capital intensity. Castellani et al. (2010), Vogel and Wagner (2010) and Haller (2012) divide firms into four groups according to their trade orientation and find the highest premia for firms that both import and export although they find that only-exporters outperform only-importers.

4 Empirical Results

Our main empirical results are presented in Table 3. We estimate three different specifications for the import and export decision. Specification (1) is the standard RE bivariate probit model with no consideration given to the correlation between unobserved firm heterogeneity and other explanatory variables and initial conditions problem. This model is used as our benchmark estimation. To control for the possible correlation between unobserved effects and other observable firm characteristics Specification (2) includes the vector of means of time varying observable factors. Finally, Specification (3) builds on Specification (2) and applies the Rabe-Hesketh and Skrondal (2013) approach to correct for the bias inherent in the Wooldridge method and is our preferred specification. More specifically, averages of time-varying independent variables for the whole sample period are included in Specification (2) and averages for subsequent periods from the second period and initial values of the dependent and explanatory variables are included in Specification (3).[18] Due to non-linearity of the probit model and to help with the interpretation of the results, we report the average marginal effects (AMEs).[19] The coefficient estimates are provided in Table A2 of the Appendix.

Consider first the decision to export. Results from our three different specifications all show that lagged export status (a measure of the sunk entry costs of exporting) is positive and significant at the 0.01 level.[20] Compared to firms that had not previously exported, Specification (1) shows that firms that exported in the previous year are 32.8% more likely to export in the current period. The likelihood of entry into exports markets falls to 27.4% once we take into account unobserved heterogeneity in Specification (2). Adding the initial period independent variables to correct for the bias inherent in the Woodridge method in Specification (3) gives us a propensity of 22.4% which is about two thirds of the value of our benchmark estimate in Specification (1). This suggests that previous studies may have over estimated the size of the sunk entry costs for exporters by not controlling for the endogeneity of unobserved firm

[18]For reasons of space we do not present the Wooldridge (2005) results without the Rabe-Hesketh and Skrondal (2013) modification but the results are available upon request.

[19]The average marginal effects of continuous variables are computed by $AME = \frac{1}{n}\sum_{i=1}^{n}\phi(X_i^{'}\beta)\beta$ and dummy variables by $AME = \frac{1}{n}\sum_{i=1}^{n}[\Phi(X_i^{'}\beta|X_j = 1) - \Phi(X_i^{'}\beta|X_j = 0)]$, where $\Phi(.)$ is the standard normal cumulative distribution function and $\phi(.)$ is the standard normal density function.

[20]We are not able to estimate the actual value of the sunk costs as Das et al. (2007) or Kasahara and Lapham (2013) due to the lack of information on input prices.

heterogeneity and initial conditions problem.

Turning to the effect of import experience on the export decision, we find that lagged import status has a positive and significant impact on the export decision of firms in Specification (1) suggesting that firms that imported in the previous period are 3.7% more likely to export in the current period. However, once we control for the endogenous unobserved heterogeneity in Specification (2), as well as initial conditions in Specification (3), the results show that past import experience has a negative effect on firms' export participation. A negative effect of lagged import experience on the decision to export is somewhat surprising and seems to contradict the results from the leaning-from-importing literature that finds that importing firms improve their productivity as they have access to a greater number and better quality of inputs or absorb the embedded advanced technology from the use of foreign intermediate goods and higher productivity in turn should allow them to break into export markets (Amiti and Konings, 2007; Kasahara and Rodrigue, 2008; Vogel and Wagner, 2010; Elliott et al., 2016). However, in a study of the two-way relationship between exporting and importing, Aristei et al. (2013) show no significant effect of past import status on current export activity after controlling for productivity and innovation using ECA firm-level data. In a related study Fugazza and McLaren (2014) find that being an importer has a negative impact on the survival of firms' exports for Peruvian exporting firms.[21]

There are several possible explanations why firms that import in the previous year may be less likely to export in current period. The first is that assuming importing incurs sunk entry costs (as we discuss shortly), this may make exporting less likely in the subsequent period as firms may not have sufficient funds to invest in exporting immediately. The second explanation

[21] Although we discussed the need for a balanced panel in the methodology section, it is worth noting how ignoring new entrants and exiting firms may bias the estimates either upwards or downwards. If it takes four years for a new firm to start exporting or importing, then given our sample length, the dependent variable would still be zero although it would change the means of the X variables (firm characteristics). If the means of the X variables for the new firms are above those of continuous firms then the "true" coefficients would be larger (the initial conditions is generating a downward bias). If the firms start international trade in less than four years then the dependent variable would be a combination of zeros and ones. To understand the direction of bias then requires knowledge of the mean of each X variable for traders against not traders. In the case of exiting firms they cease to trade so the dependent variable would become zero. As long as the means of the independent variables are similar to surviving firms there should be no bias (although it may affect the standard errors). However, it is not possible to undertake such an investigation as we are not sure whether a firm is newly established or just new to the survey and we do not have information of the exiting firms. Given that only 2.83% of the firms in our sample are newborn in the first year of our sample and only 14% or 9% of these new firms (equivalent to 0.42% or 0.28% of the sample) started to export or import during the period, we expect the proportion of the new entrants that start international trade to be relatively small and hence any bias is likely to be minimal.

is that firms that imported in the previous year would face a degree of uncertainty and in order to keep good control of the risks they may delay their decision to export until they have gained more international experience.[22] Theoretically, Rauch and Watson (2003) demonstrate that with search costs and uncertainty, buyers from developed countries will choose to start with a small trial orders with suppliers from less developed countries in order to gain information about the ability of the supplier. The third explanation is that the learning-from-importing effect takes time and depends on their absorptive capability especially for Chinese manufacturing firms that during the period were considered to be far from the technological frontier (Augier et al., 2013).

In terms of our other control variables, we find in the standard RE bivariate probit model (Specification (1)) that firm age has a negative effect on the export decision suggesting that on average younger firms are more likely to export. However, this effect disappears once we control for unobserved heterogeneity and initial conditions in Specifications (2) and (3). Firm size (proxied by employment) and wages, are found to have positive and significant impacts on the decision to export in Specification (1), showing that larger and higher wage paying firms are more likely to become exporters. However, both become insignificant in Specifications (2) and (3). TFP has a negative effect on the probability of exporting in Specification (1), but the magnitude is rather small. Also for Specification (1) the leverage ratio is found to affect exporting behaviour positively, indicating that Chinese manufacturing firms with external finance are more likely to break into exports markets. Such effect also becomes insignificant in Specifications (2) and (3). Finally, ownership is found to play a significant role in the decision to export across all specifications: foreign-, HMT-owned and private firms are about 3-5% more likely to enter the export market than SOEs. This finding is in line with the existing literature and is explained by foreign- and HMT-owned firms being able to make use of their foreign networks to enter the exports market and private firms usually are more willing to experiment in foreign markets when searching for profitable opportunities compared to SOEs and collective firms.

If we consider Specifications (2) and (3) in more detail we find that the averages of the time-varying independent variables (apart from firm age and liquidity ratio in export decision) are found to be significant, indicating that there is a correlation between unobserved firm het-

[22] In the study of the Dutch household decisions to invest stocks and mutual funds, Alessie et al. (2004) find negative cross-effects of lagged ownership of one asset type on the decision of investing the other. Their explanation for this is that people have an incentive to remain focused on one asset type to avoid adjustment costs.

erogeneity and the other independent variables. In addition, the initial observation of export (import) status as well as other independent variable for the initial period in Specification (3) are shown to be significant for export (import) decisions. The implication of our results is that it is important to address the endogeneity of the unobserved firm heterogeneity as well as initial conditions when studying the firms' export and import behaviour.

Still referring to Table 3, we now look at the determinants of the decision of Chinese manufacturing firms to import. First and foremost, our results show that lagged import status is a positive and highly significant determinant of current import status across all specifications. In the standard RE bivariate probit in Specification (1) we find that firms that had a positive level of imports in the previous period are 18% more likely to import in the current period. The impact of past import participation drops slightly to 17.2% in Specification (2) and is further reduced to 13.5% in our preferred Specification (3). These results show, as with exporting, that importing also incurs sunk entry costs and that the size of sunk costs are overestimated if the correlation between unobserved heterogeneity and other explanatory variables and initial conditions are not taken into account. Compared to that of exporting, the size of importing sunk entry costs tends to be considerably smaller (13.5% for the decision to import vs. 22.4% for that of exporters in Specification (3)).[23]

From Specification (1) we find that larger and more productive firms, firms with more skilled labour, and foreign or privately owned firms are more likely to import while firms with higher liquidity or leverage ratios have a lower propensity to import. This is consistent with Muuls and Pisu (2009) who also find larger and more productive firms and those with previous export experience have a higher propensity to import for a sample of firms in Belgium, although their finding is based on the import decision only. When we control for unobserved firm heterogeneity and initial conditions, in Specification (3), we find that lagged export status has a negative and significant impact on firms' entry into the import market, although the magnitude is rather small. The signs are similar to the effect of past import experience on exporting. Aristei et al. (2013) also find that past export experience has a negative but insignificant effect on the probability of exporting for ECA firms. The negative effect of previous export activity can also be explained by the uncertainty, information asymmetries and search costs faced by

[23]Manova and Zhang (2009) find many more small firms among importers rather than exporters when looking at Chinese trade data for the period 2003-2005.

the traders. For example, Iacovone (2010) show that new Mexican exporters break into export markets with a single variety and a very small volume and a vast percentage of export varieties do not survive for more than a year in the foreign market and hence, firms thus frequently adjust their scope of production and exports. Such uncertainty and adjustment costs discourage exporters from making the decision to start importing in the subsequent period.

The results in Specification (3) show that firm age, size and foreign ownership are significant determinants of Chinese firms' importing behaviour, but average wages, TFP and financial status are no longer significant compared to the results from Specification (1). As with the exporting decision, the coefficients on the time-averages of firm characteristics and variables in the initial period are highly significant (except initial values of age and TFP), indicating that it is important to control for correlations between the unobserved firm heterogeneity and other explanatory variables as well as the initial status of explanatory variables in the estimation of firms' decision to import.

Finally we look at the correlation (ρ) between the residuals of the two participation equations. Across different specifications, the correlation is positive and statistically significant at the 0.01 level, indicating that export and import activities are interdependent and that some unobserved factors affects both decisions positively. This also supports our choice to estimate the decision to export and import simultaneously rather than separately as Muuls and Pisu (2009) or Muuls (2015).

[Table 3 about here]

To investigate the channels by which imports effect future exports and vice versa we examine the role of financial constraints for the sub-samples of private firms and SOEs. The reason for comparing private and SOEs is that the connections between SOEs and central or local government may give them preferential access to financial markets or policies related to investment or taxes which private firms usually do not have. The samples are further split into groups of below average liquidity (low liquidity) and above average liquidity (high liquidity) and the decisions to export and import for each category are estimated simultaneously using our preferred econometric specification. The results are presented Table 4.[24] Consistent with

[24]We also compare groups of the first and four quartiles of liquidity as well as same classifications using leverage ratios and the results are broadly consistent. Due to limits on space the results are not reported but are available

our main findings in Specification (3) of Table 3, large sunk costs are found for both private firms and SOEs to export (import) as shown by the positive and significant effect of the lagged export (import) status. There are a number of other interesting findings. First, previous import experience reduces the propensity to export for private firms regardless of their financial status and SOEs with low liquidity while previous export activity decreases the likelihood of entry into importing only for low liquidity private firms. Second, sunk costs of exporting (importing) are found to be larger for private firms than SOEs (see the magnitudes of lagged export (import) status on the decision to export (import)) and they are also larger for low liquidity firms. Third, though previous import activity reduces the propensity to export for private firms regardless of their liquidity level, the export decision of more liquid firms is less affected by previous participation in importing activity.

[Table 4 about here]

So far we have studied firms' decisions to export and import using joint bivariate probit models. Finally, as a robustness check we do the estimation by linear probability models despite the drawback that predicted probabilities can lie outside the [0, 1] range as mentioned earlier. Fixed effects and a general method of moments (GMM) approach are applied following Bernard and Jensen (2004) and Muuls (2015) and results are reported in Table 5.

Columns (1) and (2) are the results from the FE estimations. Consistent with the existing literature on export behaviour, firms with previous export experience and are older, larger and more productive are found to be more likely to export. As expected, the import experience coefficient is positive and significant (similar to result found in Specification (1) in Table 3). However, when we consider the decision to import we find that lagged import status has a negative and significant effect on current period import behaviour. However, given that the export and import decisions are estimated separately here and that the FE estimator does not address possible endogeneity between the explanatory variables the result may be unreliable. Similarly, previous export experience is found to be a positive determinant of starting to import.

Since lagged dependent variables are included in the regression, it is necessary to address the endogeneity concerns that result from serial correlation in the error term. Hence, we take a system GMM approach. The results are presented in Columns (3) and (4) of Table 5. The

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hypothesis of no second-order autocorrelation in the residuals of the differenced equations is rejected for both the export and import decision. Unfortunately due to our short period sample, we are not able to test the third-order autocorrelation. In this case we use the fourth lags of the independent variables as instruments in the differenced equations. The hypothesis of over identification of the instruments is not rejected for either the export or import decision, ensuring the validity of the instruments. Results for the export decision are consistent with our bivariate RE probits in Table 3 which is to say that firms that exported in the previous period are more likely to export and those that imported previously are less likely to export. In terms of the import decision, firms that have previous import experience and are younger, with more skilled labour and higher TFP have a higher probability of importing. Export experience is not found to be a significant factor explaining importing behaviour which is consistent with the result found in Table 5. Again, we conclude that both exporting and importing incur large sunk entry costs. However, the size of such costs are considerably higher in our GMM estimates compared to the bivariate probit results in Specification (3) of Table 3 (73.1% vs 22.4% for exports and 57.6% vs 13.5% for imports).

[Table 5 about here]

5 Conclusions

In this paper we investigate the trading decisions of Chinese manufacturing firms. Our empirical strategy is to estimate a dynamic RE bivariate probit model to examine the decision to export and import simultaneously under different assumptions regarding unobserved heterogeneity and initial conditions. An important feature of this paper is that we take into account previous import activity when examining the determinants of a firm's decision to export and previous export experience in a firm's decision to import. We also control for the unobserved firm heterogeneity and the correlation between such unobserved effects and other explanatory variables as well as for initial conditions using a modified version of the Wooldridge (2005) approach suggested by Rabe-Hesketh and Skrondal (2013). Using a large dataset of Chinese manufacturing firms with rich information on firm characteristics and import and export data for the period 2002 to 2006, we investigate whether there are exporting and importing sunk

costs of entry. We find that the entry sunk costs for exporting are about twice the size of those estimated for importing. We also find that previous import experience has a significant and negative impact on the propensity to export and that previous export performance has a significant and negative impact on the propensity to import. Ignoring this experience biases the size of sunk entry costs. More importantly, our results suggest that firms experiment with either importing or exporting and that one does not necessarily lead to the other at least initially. This suggests a substitution effect between importing and exporting activity. Comparisons between private firms and SOEs of different degrees of financial health show that previous import (export) activity has a more negative impact on the current export (import) decision for more financially constrained firms. Our results also show the importance of controlling for the correlation between unobserved effects and other firm characteristics and initial conditions in the analysis of firms' international trade behaviour.

Our results have a number of policy implications. Since both exporting and importing incurs significant sunk entry costs, policies that are aimed at reducing these costs and to assist firms in overcoming barriers to entry into international markets could be encouraged. For example, international trade promotion agencies can be useful at providing information about potential markets, arranging trade visits and trade fairs. Our finding of a substitution effect between exporting and importing and financial constraints could act to prevent the emergence of importer-exporters. Hence, strengthening global value chains and financial institutions may further encourage firms' engagement in international trade. Likewise, our results have implications for tariff reductions and tentatively suggest that cutting tariffs on imports may have a damaging effect on exports if firms export less in the short term as they concentrate on developing new import relationships.

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Table 1: Summary statistics of key variables

	All firms	Non-traders	Only-exporters	Only-importers	Two-way traders
	(1)	(2)	(3)	(4)	(5)
age	2.261	2.267	2.204	2.244	2.292
	(0.701)	(0.744)	(0.624)	(0.556)	(0.563)
employment	5.100	4.901	5.362	5.557	5.731
	(1.107)	(1.035)	(0.991)	(1.295)	(1.178)
capital intensity	5.005	4.906	4.792	5.802	5.470
	(1.034)	(1.035)	(0.954)	(1.162)	(1.077)
wage	2.422	2.326	2.417	2.852	2.791
	(0.588)	(0.555)	(0.497)	(0.641)	(0.613)
TFP	6.538	6.381	6.540	7.179	7.146
	(1.080)	(1.027)	(0.938)	(1.207)	(1.133)
liquidity	0.103	0.094	0.097	0.158	0.142
	(0.270)	(0.274)	(0.262)	(0.262)	(0.253)
leverage	0.546	0.557	0.559	0.476	0.501
	(0.236)	(0.239)	(0.224)	(0.228)	(0.221)
Observations	213,330	148,174	27,468	8,998	28,690
(share of total)	(100.00%)	(69.46%)	(12.88%)	(4.22%)	(13.45%)

Notes: Reported are the means of variables with standard deviations in parentheses. All variables are expressed in natural logarithms except liquidity and leverage. The last two rows are the number of observations and the share of the total sample of each category. Table A1 in Appendix A provides detailed definition of the variables.

Table 2: Trade and the performance of Chinese manufacturing firms (2002-2006)

	employment	wage	K/L	TFP
	(1)	(2)	(3)	(4)
EXPonly	0.092***	0.018***	0.064***	0.015**
	(0.004)	(0.005)	(0.004)	(0.008)
IMPonly	0.057***	0.021***	0.071***	0.034***
	(0.006)	(0.007)	(0.006)	(0.010)
EXPIMP	0.150***	0.036***	0.099***	0.050***
	(0.005)	(0.006)	(0.005)	(0.009)
Observations	213,330	213,330	213,330	213,330
R-squared	0.070	0.097	0.371	0.147
Wald tests (p-value)				
$\alpha_1 = \alpha_2$	0.0000	0.6937	0.2508	0.0952
$\alpha_3 = \alpha_1$	0.0000	0.0003	0.0000	0.0000
$\alpha_3 = \alpha_2$	0.0000	0.0304	0.0000	0.1131

Notes: Standard errors in parentheses. All regressions include firm age, employment (except (1)), wage (except (2)), ownership, region, industry and year dummies. Wald tests (p-values reported) in the final three rows test whether the coefficients on *EXPonly*, *IMPonly* and *EXPIMP* are statistically different from each other. ***, ** and * denote significance at 0.01, 0.5 and 0.1 respectively.

Table 3: Decisions to export and import of Chinese manufacturing firms (AMEs)

	(1)		(2)		(3)	
Variables	export	import	export	import	export	import
$EXP_{i(t-1)}$	0.328***	0.082***	0.274***	-0.020***	0.224***	-0.010***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.003)
$IMP_{i(t-1)}$	0.037***	0.180***	-0.055***	0.172***	-0.042***	0.135***
	(0.002)	(0.001)	(0.005)	(0.002)	(0.003)	(0.002)
$age_{i(t-1)}$	-0.009***	-0.000	-0.007	0.022***	-0.006	0.021***
	(0.001)	(0.001)	(0.005)	(0.006)	(0.005)	(0.006)
$emp_{i(t-1)}$	0.010***	0.014***	-0.003	0.0004	0.003	0.005***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
$wage_{i(t-1)}$	0.007***	0.030***	-0.001	0.001	-0.0002	0.002
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
$TFP_{i(t-1)}$	-0.001**	0.012***	-0.001	0.001	0.0004	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Liq_{i(t-1)}$	-0.003	-0.018***	0.004	0.005	0.003	0.005
	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
$Lev_{i(t-1)}$	0.008***	-0.029***	-0.008	0.007	-0.006	0.008
	(0.003)	(0.003)	(0.006)	(0.007)	(0.006)	(0.006)
$FOR_{i(t-1)}$	0.045***	0.092***	0.034***	0.081***	0.030***	0.067***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
$HMT_{i(t-1)}$	0.035***	0.070***	0.029***	0.062***	0.026***	0.051***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
$COL_{i(t-1)}$	0.002	-0.005	0.0002	0.000	-0.00003	-0.001
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
$PRI_{i(t-1)}$	0.033***	0.026***	0.028***	0.027***	0.028***	0.020***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Time averages						
$\overline{IMP_i}$			0.142***		0.130***	
			(0.007)		(0.005)	
$\overline{EXP_i}$				0.129***		0.134***
				(0.005)		(0.005)
$\overline{age_i}$			-0.001	-0.023***	0.003	-0.032***
			(0.005)	(0.006)	(0.007)	(0.009)
$\overline{emp_i}$			0.015***	0.012***	0.023***	0.015***
			(0.002)	(0.002)	(0.002)	(0.002)
$\overline{wage_i}$			0.005**	0.046***	0.007***	0.034***
			(0.002)	(0.002)	(0.002)	(0.002)
$\overline{TFP_i}$			-0.005***	0.015***	-0.003**	0.011***
			(0.001)	(0.002)	(0.001)	(0.001)
$\overline{Liq_i}$			-0.004	-0.035***	-0.005	-0.014**
			(0.006)	(0.006)	(0.005)	(0.006)
$\overline{Lev_i}$			0.028***	-0.048***	0.026***	-0.020***
			(0.007)	(0.008)	(0.006)	(0.007)
Initial conditions						
EXP_{i1}					0.063***	-0.030***
					(0.002)	(0.002)
IMP_{i1}					-0.020***	0.065***
					(0.002)	(0.002)
age_{i1}					-0.003	0.008
					(0.005)	(0.006)
emp_{i1}					-0.015***	-0.010***
					(0.001)	(0.002)
$wage_{i1}$					-0.001	0.006***
					(0.001)	(0.001)
TFP_{i1}					-0.004***	0.000
					(0.001)	(0.001)
Liq_{i1}					0.001	-0.012***
					(0.004)	(0.004)
Lev_{i1}					-0.004	-0.021***
					(0.004)	(0.005)
ρ	0.411***		0.059***		0.085***	
	(0.010)		(0.015)		(0.020)	
Observations	170,664		170,664		170,664	
Log pseudoL	-64,477		-62,796		-60,661	

Notes: Marginal effects reported with robust standard errors in parentheses. All regressions include region, industry and year dummies. ***, ** and * denote significance at 0.01, 0.5 and 0.1 respectively.

Table 4: Decisions to export and import: private firms vs SOEs (AMEs)

	(1) PRI-low liquidity		(2) PRI-high liquidity		(3) SOE-low liquidity		(4) SOE-high liquidity	
Variables	export	import	export	import	export	import	export	import
$EXP_{i(t-1)}$	0.234***	-0.013***	0.128***	0.004	0.120***	-0.021	0.044***	0.023
	(0.004)	(0.005)	(0.005)	(0.007)	(0.014)	(0.014)	(0.011)	(0.016)
$IMP_{i(t-1)}$	-0.061***	0.092***	-0.028***	0.039***	-0.047***	0.078***	0.003	0.024**
	(0.007)	(0.003)	(0.007)	(0.003)	(0.013)	(0.007)	(0.018)	(0.010)
$age_{i(t-1)}$	-0.001	0.013	-0.0003	0.017*	0.008	0.017	0.028	0.026
	(0.009)	(0.008)	(0.009)	(0.010)	(0.028)	(0.036)	(0.023)	(0.027)
$emp_{i(t-1)}$	0.003	0.011***	0.005	0.004	0.008	-0.003	0.004	-0.003
	(0.004)	(0.003)	(0.003)	(0.004)	(0.009)	(0.009)	(0.007)	(0.010)
$wage_{i(t-1)}$	-0.0003	0.003	-0.001	0.003	0.002	-0.005	-0.003	0.0001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.007)	(0.005)	(0.007)
$TFP_{i(t-1)}$	0.003	0.002	-0.003	-0.002	0.003	0.003	0.005	0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.005)	(0.004)	(0.004)	(0.006)
$Liq_{i(t-1)}$	0.013	0.003	0.0004	0.013	-0.038	0.021	-0.012	0.030
	(0.008)	(0.008)	(0.008)	(0.010)	(0.026)	(0.028)	(0.024)	(0.024)
$Lev_{i(t-1)}$	-0.017	0.012	-0.005	0.009	-0.042	-0.053*	-0.012	0.004
	(0.011)	(0.011)	(0.009)	(0.012)	(0.033)	(0.030)	(0.028)	(0.028)
ρ	0.103***		0.234***		0.080		0.785***	
	(0.036)		(0.038)		(0.121)		(0.207)	
Observations	43,468		43,570		4,446		4,462	
Log pseudoL	-13,124		-11,001		-878.495		-729.165	

Notes: Marginal effects reported with robust standard errors in parentheses. All regressions include region, industry and year dummies. Time averages and initial conditions are included but not reported here due to space limit. ***, ** and * denote significance at 0.01, 0.5 and 0.1 respectively.

Table 5: Decisions to export and import of Chinese manufacturing firms: linear models

	FE		GMM	
	(1)	(2)	(3)	(4)
Variables	export	import	export	import
$EXP_{i(t-1)}$	0.141***	0.074***	0.731***	0.007
	(0.005)	(0.005)	(0.040)	(0.055)
$IMP_{i(t-1)}$	0.026***	-0.071***	-0.107*	0.576***
	(0.004)	(0.006)	(0.058)	(0.080)
$age_{i(t-1)}$	0.024***	0.015***	-0.026	-0.039**
	(0.005)	(0.005)	(0.016)	(0.019)
$emp_{i(t-1)}$	0.021***	0.018***	-0.039	0.075**
	(0.002)	(0.002)	(0.024)	(0.032)
$wage_{i(t-1)}$	0.002	0.005***	-0.022	0.027
	(0.001)	(0.002)	(0.017)	(0.019)
$TFP_{i(t-1)}$	0.002*	0.004***	0.083***	0.082***
	(0.001)	(0.001)	(0.019)	(0.022)
$Liq_{i(t-1)}$	0.004	0.007	-0.023	0.019
	(0.004)	(0.004)	(0.019)	(0.021)
$Lev_{i(t-1)}$	0.007	0.010*	-0.022	-0.035
	(0.005)	(0.005)	(0.024)	(0.027)
Observations	170,664	170,664	127,998	127,998
R-squared	0.034	0.010		
Year dummies	Yes	Yes	Yes	Yes
AR(2) p-value			0.00003	0.015
Hansen(p-value)			0.118	0.859

Notes: Coefficients reported with robust standard errors in parentheses. AR(2) is the test for second-order autocorrelation in the residuals of the first-differenced equation and Hansen is the test for overidentification of the instruments. ***, ** and * denote significance at 0.01, 0.5 and 0.1 respectively.

Appendix

Table A1: Definition of variables

Variable	Definition
EXP	a binary variable which equals 1 if a firm reports positive exports and 0 otherwise
EXPonly	a binary variable which equals 1 if a firm reports positive exports and zero imports, 0 otherwise
IMP	a binary variable which equals 1 if a firm reports positive imports and 0 otherwise
EXPonly	a binary variable which equals 1 if a firm reports positive imports and zero exports, 0 otherwise
EXPIMP	a binary variable which equals 1 if a firm reports both positive exports and imports, 0 otherwise
age	log of a firm's age
emp	log of number of employees
wage	log of wage bill divided by the number of employees of a firm
K/L	capital intensity, log of total assets devided by the number of employees of a firm
TFP	total factor productivity of a firm obtained by the method of De Loecker (2007)
Liq	ratio of current assets minus current liabilities over total assets of a firm
Lev	ratio of total liabilities over total assets of a firm
SOE	a dummy which equals 1 if a firm is state-owned and 0 otherwise
COL	a dummy which equals 1 if a firm is collectively-owned and 0 otherwise
PRI	a dummy which equals 1 if a firm is private-owned and 0 otherwise
FOR	a dummy which equals 1 if a firm with over 25% of its capital from foreign investors and 0 otherwise
HTM	a dummy which equals 1 if a firm with over 25% of its capital from Hong Kong, Taiwan or Macao investors and 0 otherwise
EAST	a region dummy which equals 1 if a firm is located in the East of China and 0 otherwise
CENTRAL	a region dummy which equals 1 if a firm is located in Central area of China and 0 otherwise
WEST	a region dummy which equals 1 if a firm is located in the West of China and 0 otherwise

Table A2: Decisions to export and import of Chinese manufacturing firms (coefficients)

	(1)		(2)		(3)	
Variables	export	import	export	import	export	import
$EXP_{i(t-1)}$	2.797***	0.851***	2.868***	-0.209***	2.479***	-0.102***
	(0.014)	(0.013)	(0.016)	(0.037)	(0.021)	(0.034)
$IMP_{i(t-1)}$	0.317***	1.874***	-0.574***	1.778***	-0.466***	1.445***
	(0.014)	(0.016)	(0.049)	(0.018)	(0.034)	(0.019)
$age_{i(t-1)}$	-0.073***	-0.004	-0.078	0.232***	-0.064	0.220***
	(0.007)	(0.010)	(0.051)	(0.058)	(0.053)	(0.059)
$emp_{i(t-1)}$	0.088***	0.148***	-0.033	0.004	0.030	0.055***
	(0.005)	(0.007)	(0.020)	(0.022)	(0.021)	(0.021)
$wage_{i(t-1)}$	0.059***	0.309***	-0.012	0.008	-0.003	0.016
	(0.009)	(0.012)	(0.017)	(0.019)	(0.018)	(0.018)
$TFP_{i(t-1)}$	-0.011**	0.124***	-0.007	0.006	0.004	0.014
	(0.005)	(0.007)	(0.012)	(0.013)	(0.012)	(0.012)
$Liq_{i(t-1)}$	-0.030	-0.187***	0.046	0.050	0.037	0.048
	(0.022)	(0.030)	(0.049)	(0.056)	(0.051)	(0.055)
$Lev_{i(t-1)}$	0.069***	-0.304***	-0.084	0.069	-0.070	0.083
	(0.024)	(0.033)	(0.061)	(0.068)	(0.063)	(0.067)
$FOR_{i(t-1)}$	0.384***	0.953***	0.352***	0.833***	0.328***	0.712***
	(0.026)	(0.036)	(0.033)	(0.035)	(0.037)	(0.039)
$HMT_{i(t-1)}$	0.303***	0.726***	0.306***	0.638***	0.284***	0.547***
	(0.025)	(0.035)	(0.031)	(0.035)	(0.036)	(0.038)
$COL_{i(t-1)}$	0.013	-0.056	0.002	0.002	-0.0003	-0.015
	(0.025)	(0.043)	(0.032)	(0.040)	(0.037)	(0.043)
$PRI_{i(t-1)}$	0.285***	0.271***	0.294***	0.274***	0.306***	0.215***
	(0.023)	(0.035)	(0.029)	(0.034)	(0.033)	(0.036)
Time averages						
$\overline{IMP_i}$			1.489***		1.445***	
			(0.070)		(0.055)	
$\overline{EXP_i}$				1.331***		1.435***
				(0.056)		(0.050)
$\overline{age_i}$			-0.006	-0.242***	0.030	-0.339***
			(0.054)	(0.061)	(0.082)	(0.097)
$\overline{emp_i}$			0.155***	0.121***	0.257***	0.165***
			(0.021)	(0.023)	(0.021)	(0.023)
$\overline{wage_i}$			0.049**	0.475***	0.074***	0.362***
			(0.022)	(0.025)	(0.023)	(0.026)
$\overline{TFP_i}$			-0.048***	0.153***	-0.031**	0.122***
			(0.014)	(0.016)	(0.014)	(0.015)
$\overline{Liq_i}$			-0.038	-0.359***	-0.054	-0.154**
			(0.058)	(0.067)	(0.058)	(0.066)
$\overline{Lev_i}$			0.288***	-0.491***	0.293***	-0.218***
			(0.070)	(0.079)	(0.071)	(0.077)
Initial conditions						
EXP_{i1}					0.702***	-0.324***
					(0.021)	(0.024)
IMP_{i1}					-0.217***	0.696***
					(0.027)	(0.019)
age_{i1}					-0.028	0.087
					(0.055)	(0.064)
emp_{i1}					-0.168***	-0.108***
					(0.015)	(0.017)
$wage_{i1}$					-0.016	0.061***
					(0.013)	(0.015)
TFP_{i1}					-0.041***	0.005
					(0.009)	(0.010)
Liq_{i1}					0.014	-0.130***
					(0.039)	(0.045)
Lev_{i1}					-0.040	-0.224***
					(0.048)	(0.053)
Observations	170,664		170,664		170,664	
Log pseudoL	-64,477		-62,796		-60,661	

Notes: Coefficients reported with robust standard errors in parentheses. All regressions include region, industry and year dummies. ***, ** and * denote significance at 0.01, 0.5 and 0.1 respectively.

Table A3: Decision to export and import: private firms vs. SOEs (coefficients)

	(1) PRI-low liquidity		(2) PRI-high liquidity		(3) SOE-low liquidity		(4) SOE-high liquidity	
Variables	export	import	export	import	export	import	export	import
$EXP_{i(t-1)}$	2.698***	-0.187***	2.460***	0.104	2.289***	-0.420	1.745***	0.778
	(0.042)	(0.071)	(0.088)	(0.167)	(0.198)	(0.279)	(0.408)	(0.541)
$IMP_{i(t-1)}$	-0.709***	1.336***	-0.534***	0.948***	-0.896***	1.573***	0.134	0.798**
	(0.079)	(0.044)	(0.138)	(0.096)	(0.273)	(0.161)	(0.722)	(0.359)
$age_{i(t-1)}$	-0.017	0.187	-0.006	0.405*	0.158	0.333	1.128	0.893
	(0.106)	(0.122)	(0.166)	(0.245)	(0.543)	(0.734)	(0.888)	(0.932)
$emp_{i(t-1)}$	0.039	0.159***	0.103	0.106	0.149	-0.061	0.157	-0.097
	(0.041)	(0.049)	(0.065)	(0.093)	(0.164)	(0.188)	(0.269)	(0.328)
$wage_{i(t-1)}$	-0.003	0.050	-0.019	0.084	0.043	-0.106	-0.115	0.000
	(0.036)	(0.042)	(0.051)	(0.080)	(0.123)	(0.147)	(0.176)	(0.233)
$TFP_{i(t-1)}$	0.035	0.030	-0.059	-0.046	0.050	0.058	0.185	0.058
	(0.027)	(0.032)	(0.040)	(0.063)	(0.105)	(0.089)	(0.163)	(0.197)
$Liq_{i(t-1)}$	0.145	0.043	0.007	0.305	-0.727	0.419	-0.472	1.012
	(0.097)	(0.119)	(0.155)	(0.231)	(0.490)	(0.555)	(0.931)	(0.824)
$Lev_{i(t-1)}$	-0.196	0.177	-0.093	0.211	-0.795	-1.063*	-0.459	0.123
	(0.127)	(0.156)	(0.181)	(0.278)	(0.618)	(0.608)	(1.107)	(0.946)
Observations	43,468		43,570		4,446		4,462	
Log pseudoL	-13,124		-11,001		-878.495		-729.165	

Notes: Coefficients reported with robust standard errors in parentheses. All regressions include region, industry and year dummies. Time averages and initial conditions are included but not reported here due to space limit. ***, ** and * denote significance at 0.01, 0.5 and 0.1 respectively.