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DISCUSSION PAPER 13.18

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* We acknowledge the generous financial support from the China Scholarship Council (CSC), the Business School of The University of Western Australia and the Australian Research Council (DP1092913). We also thank Sizhong Sun and the participants of the 2010 PhD Conference in Economics and Business (ANU, Australia) and economics departmental seminar in the University of Macau and University of Western Australia for helpful comments and suggestions.

Abstract: As the studies that are concerned with export entry have proliferated, less attention has been devoted to the study of export survival in foreign markets. This paper explores the patterns and determinants of export survival using the survey data of the Chinese manufacturing firms for the period 1998-2007. The methods include non-parametric techniques and the estimation of a discrete-time duration model. Our results suggest that the probability of exit is higher for the exporters at the starting period. We also find that large, highly productive and more export-oriented firms are more likely to survive. In addition, foreign ownership is found to be an important determinant of export survival, while state ownership would increase the risk of export failure.

Keywords: Export survival·Duration·Survival analysis·China

JEL Classification: F14·D21·O14

1 Introduction

A large body of studies in the literature of industrial organization have focused on the analyses of firms' survival in domestic markets since their establishments (see a survey by Manjón-Antolín and Arauzo-Carod 2008). However, less attention has been paid to the study of the risk of exit in international markets until the work by Besedeš and Prusa (2006a). One valuable insight from this seminal work is that exporting is not a once-and-forever action. Firms do enter and exit foreign markets as well as domestic markets. They further concluded that for developing countries the key element in achieving faster aggregate export growth is higher survival rates for existing trade flows rather than introducing new trade flows. Brenton et al. (2009) also suggested that low survival rates would undermine the expansion of export flows from developing countries. In addition, Esteve-Pérezet al. (2008) showed that firms involved in exporting activities face significantly lower probability of failure than non-exporters. It is therefore important to understand not only the determinants of export entry but also the factors which make new exports sustainable as export survival affects not only aggregate export growth at the country level but also the sustainable growth at the firm level (Brenton et al.2010).

So far no survival studies have been carried out for Chinese exporters. This paper fills the void in the literature by providing an empirical analysis of the patterns and determinants of export survival in the context of China. In our analysis, we focus on the impact of the characteristics of individual firms on the survival probabilities in addition to mapping the patterns of export durations. In terms of statistical techniques, we apply non-parametric survival methods and estimate a discrete time duration model using a panel of Chinese manufacturing firms between 1998 and 2007, which corresponds to the country's pre- and post-WTO period. These methods can model both whether and when an event (i.e. exit) occurs, and hence the evolution of the risk over time (Esteve-Pérez et al., 2007). We also control for the interval-censored nature of the data and the existence of unobserved individual heterogeneity (such as unobserved managerial ability, firms' access to specific resources and assets). Esteve-Pérez et al. (2007) pointed out that ignoring unobserved individual heterogeneity may lead to strongly inconsistent estimates of the coefficients of the included covariates. To the best of our knowledge, these techniques have not been applied yet to a panel dataset which is made up by a representative sample of all Chinese manufacturing firms.

Our empirical analyses show that exporting is also a perilous activity for Chinese firms as it is for those in other countries. Nearly a half of the firms survive for less than three years in the export markets. Our results also suggest that large, highly productive and more export-oriented firms enjoy better survival prospects. We also find that foreign ownership is an important factor of export survival, while state ownership could increase the risk of export failure. Moreover, the external environment captured by the industry, region and time dummies is also shown to have important impacts on export survival. Therefore, our findings make an important contribution to the understanding of the determinants of export survival at the firm level from the perspective of a large and open economy.

The rest of the paper is organised as follows. Section 2 presents the related studies and Section 3 discusses the methodology of survival analysis and our estimation strategies. This is followed by Section 4 describing the choices of the explanatory variables and the dataset. Section 5 presents the empirical results, with Section 6 presenting the results of the sensitivity analysis. Section 7 concludes the paper.

2 Survival analysis of export duration

The theoretical and empirical studies modelling the export decisions of firms have proliferated over the past few years. It is assumed that the export participation depends fundamentally on a firm's expected profit from exporting, and this in turn is dependent on its productivity and whether it is sufficiently productive to cover the sunk entry costs (Melitz, 2003). Since structural modelling of the dynamic decision problem is fairly complicated, export decision is always treated as a discrete choice in most empirical studies. Researchers either estimate the participation using probit models with random effects to account for firm-specific time-invariant differences in the propensity to export (Roberts and Tybout 1997), or model the export decision simultaneously with a continuous productivity equation (Clerides et al, 1998). Others like Bernard and Jensen (2004) used the GMM technique to account for the state dependence of the exporting activity in dynamic linear probability models. Fung et al. (2008) and Gao et al. (2009) used similar methods to investigate the export participation of Chinese manufacturing firms. In addition to modelling export market entry, some economists also pay attention to export market exit problems. For example, Alvarez and López (2008) used plant-level data of a sample of Chilean manufacturing firms, but their analysis of the determinants of entry and exit patterns was confined to the sectoral level. Yet, all these works just explore the question why firms enter or exit export markets. They do not address the question about how long firms stay in export markets once they start exporting.

Going beyond the early studies focusing on the export entry, Besedeš and Prusa (2006a, 2006b) first looked at the issue of duration of trade relationships at the country-level using the U.S. import data. Other authors subsequently investigated the same topic in selected economies. Several important findings have been presented. The first finding concerns the length of trade duration. In most studies using data from several countries, it is reported that the duration of exports is in general very short (e.g. Besedeš and Prusa 2006a; Brenton et al. 2009; Besedeš and Blyde 2010). For example, Besedeš and Prusa (2006a) found that more than a half of all trade relationships lasted for only one year and about 80% were maintained for less than five years. The existing studies also examined the factors affecting the length of trade duration. Among them, Besedeš (2008) found that larger initial purchase, higher reliability and lower search costs resulted in longer trade relationships. Fugazza and Molina (2009) investigated a large dataset covering 96 countries from 1995 to 2004 and found that developed countries, differentiated products, exporting experience, and the volume of exports could improve export survival. These macroeconomic findings, however, are not very informative for policy design since most export intervention occurs at the microeconomic level, with support targeting specific industries or firms (Greenaway and Kneller 2007). This concern has given rise to a second set of studies at the firm level.

Bosco-Sabuhoro and Gervais (2006) first used the survival methods to analyse the factors determining the success or failure of Canadian establishments in foreign markets. They found that 42.2% of establishments exported for less than one year but the exit was found to vary in terms of firm characteristics, industry features, export market conditions, market structure, product attributes and business cycle. Esteve-Pérez et al. (2007) examined the Spanish case and found that 37.5% of the firms survived in export markets for less than four years but firms exporting to "closer" markets survived longer than those exporting to uncertain markets. In analysing the Peruvian new exporters, Volpe-Martincus and Carballo (2009) showed that in the case of a small developing country, geographical diversification could increase the probability of survival more than product diversification. Ilmakunnas and Nurmi (2010) applied duration models to examine Finnish manufacturing plants and they found that large, young, highly productive, and relatively capital-intensive plants were likely to survive longer in the export market. All these results indicate that exporting firms face the high risk of failure in their starting years and export survival is highly related to firm heterogeneity. While the literature on export duration in other economies is expanding, we have not so far seen any evidence of the manufacturing firms in China. Motivated by recent work on trade duration at the country- and firm-level, we hence employ survival analysis methods to examine the patterns and determinants of export survival in Chinese manufacturing sector.

3 Modelling export durations

The first step in conducting survival analysis is to construct duration data. In this paper, we are interested in the time span before an exporting firm ceased to export. However, when we construct export duration data using the database available, a censoring problem arises since we cannot observe the whole export history of all firms.[1] Some firms were still exporting at the final year of the sample period and we never know when they will stop exporting. Thus these observations are said to be 'right-censored'. 'Left-censored' spells also arise as some firms were exporting in the

[1] If we know the entry and exit time, such spells are called 'completed spells'.

first year of the sample period.[2] Under this situation, we actually do not have any information about the exact time when they started exporting. Unlike right censoring, left censoring cannot be easily handled using survival analysis techniques.[3] For this reason, following Besedeš and Prusa (2006b) and others, we adopt a common approach by excluding the left-censored export spells. Thus our analysis focuses on those which started exporting after 1998.

Table 1 Export duration patterns

No.	98	99	00	01	02	03	04	05	06	07	Patterns	
1	X	X	X	X	O	O	O	O	O	O	Left censored	Single spell
2	O	O	O	O	X	X	X	X	X	X	Right censored	Single spell
3	O	O	X	X	X	X	O	O	O	O	Completed	Single spell
4	O	X	X	O	X	O	O	X	X	O	Completed	Multiple spells

"X" denotes exporting that year. "O" denotes no exporting that year.
Source: Author's work.

In addition to the censoring problem, the existence of multiple spells is also a thorny issue. For example, firms may start exporting, exit, and re-enter foreign markets. In this case, the measurement of export duration becomes complicated. Besedeš and Prusa (2006b) treated multiple spells as independent observations in their studies. They also conducted the robustness checks by limiting their analysis to single spells and the first spells of the multiple spells (for definitions see Table 1), respectively. Fugazza and Molina (2009) adopted the same approach to deal with the multiple spells. In addition, Besedeš and Prusa (2006b) pointed out that some multiple spells might result from data errors especially for those with one year interval between two spells. This may be due to misreporting. Thus they suggested taking all the spells with a one-year gap as continuous spells and leaving two or more years intervals

[2]This definition of left censoring is most commonly used in social sciences. In the natural sciences, left-censored data are those for which it is known that exit from the state occurred at some time before the sample date (Jenkins 2005, p.5). Allison (1995, p.10) considers that left-censored observations in social sciences are actually right censored.
[3]The inclusion of left-censored spells without any correction for unobserved starting dates would result in biased estimates (see Hess and Persson 2010).

unchanged. Following this literature, we begin by taking the single spells and the first spells of multiple spells as the benchmark data and then check the robustness of the results by merging the one-year gap duration as gap-adjusted data.

There are three widely-used approaches in survival analysis, namely, nonparametric, semiparametric and parametric models (Cleves et al. 2008, p.91). The choice of methods depends on our assumption about the survivor function and the nature of the research dataset. Among these three methods, nonparametric analysis is often employed for the preliminary analysis of the survivor functions in the literature. No assumption about the distribution of the failure times is made and the effects of covariates are not modelled either. The semiparametric and parametric models are superior to the nonparametric one if we want to examine the determinants of duration patterns. In comparison with the parametric models (e.g. the exponential and Weibull models), the semiparametric models, such as the Cox (1972) proportional hazards model, are preferred because no assumptions about the shape of the hazard over time are required. The recent literature on the duration of trade is dominated by the application of the Cox proportional hazards model (e.g. Besedeš and Prusa 2006b; Besedeš 2008; Brenton et al. 2009; Fugazza and Molina 2009). In those models, the hazard rate, known as the probability of an export flow to cease in the interval $[t, t+\Delta t)$ given that it has lasted until time $\boldsymbol{t}$, is given by

$$h(t \mid X_{it}) = h_0(t)\exp(X_{it}^{'}\beta) \tag{1}$$

where $h_0(t)$ is a baseline hazard, which is an unknown, $\boldsymbol{X}$ is a vector of time-varying explanatory variables and β is a vector of parameters to be estimated.[4] Cox (1972) proposed a partial likelihood method to estimate the coefficients without specifying any functional form for the baseline hazard function. In this specification, the effect of explanatory variable is a parallel shift of the baseline function, which is estimated for all those firms that survive up to a particular period. However, Hess and Persson (2010) pointed out that there are at least three major problems with the Cox model when the observed durations of trade are grouped into yearly intervals. First, the Cox model was developed for continuous-time specification and it could lead to biased estimates when discrete data is used. Second, it is difficult to control for unobserved individual heterogeneity, which can result in spurious duration dependence and hence lead to biased estimates. Third, the assumption of proportional hazards in the Cox model is often violated in trade duration data. However, the discrete-time duration models can well deal with these problems and are also readily implemented using standard statistical software packages, such as Stata or LimDep.

Given the discrete nature of our dataset on a yearly basis, some of the most frequently used tools for the continuous-time data, such as the Kaplan-Meier (1958) product-limit estimator of the survivor function and the Cox proportional hazards model for estimating the hazard function are not appropriate. Hence we employ discrete-time duration models in our analysis following the work by Esteve-Pérez et al. (2007) Brenton et al. (2010), and Ilmakunnas and Nurmi (2010).

[4] $h_0(t)$ is the baseline hazard corresponding to $\exp(X_{it}^{'}\beta)=1$, namely, when the effects of the covariates are equal to 0.

We now define intervals of time $I_j = [t_j, t_{j+1})$ where $j = 1,....J$; d_j is the number of failures observed in interval I_j ; m_j is the number of censored spell endings observed in interval I_j ; N_j is the number of the firms facing the risk of failure at the start of the interval; n_j is the adjusted number of spells at risk of failure at the midpoint of the interval defined as [5]

$$n_j = N_j - \frac{m_j}{2} \tag{2}$$

Hence the lifetable estimator of the survivor function for the discrete-time survival data is given by

$$\hat{S}(j) = \Pr(T > j) = \prod_{k=1}^{j} (1 - \frac{d_k}{n_k}) = \prod_{k=1}^{j} (1 - h_k) \tag{3}$$

Where T denotes export duration until exit and h_k denotes the hazard rate in the interval I_j . The survivor function reports the probability of surviving beyond the year j .

In addition to the nonparametric analysis of the survivor function, we are also interested in the impact of certain explanatory variables on the hazard rate of exporting firms. Thus the discrete-time hazard rate of firm i in a given time interval $[t_j, t_{j+1})$ conditional on its survival up to the beginning of the interval and given the explanatory variables, is formally defined as

[5] Note that the 'adjustment' is used because the underlying survival times are continuous, but the observed survival time data are grouped (Jenkins 2005, p.59). Moreover, the formulas in this paper are heavily drawn from Jenkins (2005).

$$h_{ij} = P(T_i < t_{j+1} \mid T_i \geq t_j, X_{ij}) = F(X_{ij}^{'}\beta + \gamma_j) \tag{4}$$

Where X_{ij} is a vector of observed explanatory variables that are assumed to influence the hazard rate. The explanatory variables may be time-varying (although constant within intervals). β is a vector of parameters to be estimated. A positive (negative) coefficient indicates a positive (negative) impact on the value of the hazard. It correspondingly has a negative (positive) impact on the survival rate of the firm in the export market. γ_j is the interval baseline hazard rate and is a function of (interval) time $\gamma_j = \rho \ln(j)$ that allows the hazard rate to vary across periods. $F(\cdot)$ is an appropriate distribution function ensuing that $0 \leq h_{ij} \leq 1$ for all i, j . To estimate the model, a functional form of the hazard rate needs to be specified. Then the log-likelihood for the whole sample including the completed spells ($c_i = 1$) and right censored spells ($c_i = 0$) is given by:

$$\log L = \sum_{i=1}^{n} c_i \log(\frac{h_{ij}}{1-h_{ij}}) + \sum_{i=1}^{n}\sum_{k=1}^{j} \log(1-h_{ik}) \tag{5}$$

Allison(1995) and Jenkins (1995, 2005) show that the above log-likelihood function can be rewritten as a standard log-likelihood function for a binary panel regression model by introducing a binary dependent variable $y_{ij} = 1$ if the firm makes a transition (its spell ends) in year j , and $y_{ij} = 0$ otherwise. This implies that

$$\log L = \sum_{i=1}^{n}\sum_{k=1}^{j} [y_{ik} \log h_{ik} + (1-y_{ik}) \log(1-h_{ik})] \tag{6}$$

To be able to estimate the parameters, the hazard rate h_{ik} is usually assumed to follow a complementary log-log distribution or Cloglog (Prentice and Gloeckler, 1978):

$$h(X_{ij}) = 1 - \exp\left[-\exp(X_{ij}^{'}\beta + \gamma_j) \right] \tag{7}$$

$$\text{Or} \quad \log\left(-\log[1 - h(X_{ij})] \right) = X_{ij}^{'}\beta + \gamma_j \tag{8}$$

Moreover, some authorsaddressed the importance of controlling for unobserved individual heterogeneity, which is referred to as the '*frailty*' in the biostatistics literature (e.g. Brenton et al. 2009; Besedeš and Blyde 2010; Hess and Persson 2010). This is because the individual variation in the hazard rate cannot be wholly explained by the observed explanatory variables included in the model. Thus individual heterogeneity cannot be ignored. Otherwise it could lead to inconsistent and biased estimates of the effect of the explanatory variables in the hazard model (Jenkins 2005). Therefore, the unobserved heterogeneity should be taken into account. Then we can rewrite equation (7) by incorporating unobserved heterogeneity (ν_i):

$$h(X_{ij}) = 1 - \exp\left[-\exp(X_{ij}^{'}\beta + \gamma_j + \nu_i) \right] \tag{9}$$

$$\log\left(-\log[1 - h(X_{ij})] \right) = X_{ij}^{'}\beta + \gamma_j + \nu_i \tag{10}$$

Notwithstanding, the choice of the distribution for the unobserved heterogeneity has become another widely-discussed issue in the duration literature. In practice, it is always assumed to be Gamma or Gaussian distributed. In a recent simulation studies, Nicoletti and Rondinelli (2010) proved that these discrete hazard models are indifferent to the functional forms of the unobserved heterogeneity, such as parametric and nonparametric specifications.

4 The choice of variables and data issues

4.1 The explanatory variables

The choice of explanatory variables for the survival models is determined by prior expectation based on the existing literature and the availability of information from our dataset. Specifically, three broad groups of variables are considered. They reflect firm-specific characteristics, industry categories and macroeconomic conditions.

We first consider the effect of firm performance characterized by firm size and productivity. Firm size accounts for scale effects. Large firms may well exploit the economies of scale through exporting and production at lower unit costs, which make them more competitive in the foreign market. In comparison with small firms, large firms may also have better access to capital and skilled labour, and face better tax conditions, which in turn improve their chances of survival in export markets. We measure firm size by the number of employees and group all the firms into three groups, namely, the large, medium and small firms (for variable definitions, see Table 2). Recent studies of heterogeneous firms and international trade have shown that only highly productive firms could be profitable through exporting. More productive firms could be more profitable and have better survival prospects. We thus expect a positive relationship between firm productivity and their survivals in export markets. We measure productivity by the logarithm of output per worker each year and then divide the sample into three groups according to its magnitude.

Furthermore, Rauch and Watson (2003) and Besedeš (2008) showed that trade duration is positively related to the volume of trade. A firm making efforts to enter foreign markets would export a large share of its output and would thus be more likely to export continuously. The more a firm exports, the more it gains knowledge and information about export markets and thus it is more likely to survive in the international markets. We measure export intensity by the ratio of export value over its total sales and divide the firms into four categories evenly according to their export intensity.

The effects of ownership on export behaviour have received much attention in the literature. Differences in ownership may reflect different advantages of firms in terms of assets, technological skills, management expertise and internationalisation strategies. In particular, foreign firms are always found to be more export-oriented than domestic firms due to their better knowledge about foreign markets and strong links with foreign buyers. We thus expect foreign ownership to be associated with low risk of exit from the export market. We divide the firms into four groups according to their ownership, that is, foreign-owned enterprise (FOEs, mainly originated from OECD countries), Hong Kong, Macau, Taiwan enterprises (HMT), state-owned enterprises (SOEs), and other domestic firms (non-SOEs). SOEs are always thought to be less efficient and more locally-oriented than others. Their duration of survival may be short. We therefore include three ownership variables using the non-SOEs as the reference group in the model.

Recent work has also shown that product heterogeneity matters for trade duration. Besedeš and Prusa (2006b) found that the hazard rate was at least 18% higher for homogenous goods than that for differentiated goods in US import trade relationship. Görg et al. (2008) showed that firms with higher quality products were able to remain more competitive in international markets and hence survived longer. Unfortunately, we do not have a good measure to capture the heterogeneous characteristics of exporting products from our database. We thus group the firms into six broadly defined industrial sectors, namely, Food (*IND1*), Textiles and furniture (*IND2*), Paper and printing (*IND3*), Chemicals (*IND4*), Metallurgical (*IND5*), and Machinery and electronics (*IND6*). We include five industry dummy variables to control for the differences in product heterogeneity and the food industry is considered as the base group.

Table 2 Variable definitions and statistics

Var.	Definition	Mean	S.E.
SIZE1	Large firms with the no. of employees>2000)	0.052	0.223
SIZE2	Medium firms, 300<=employees<2000	0.417	0.493
SIZE3*	Small firms, employees<300	0.531	0.499
LP1	log(LP) belongs to the upper 1/3	0.040	0.197
LP2	log(LP) belongs to the medium 1/3	0.759	0.428
LP3*	log(LP) belongs to the lower 1/3	0.201	0.401
EXPT1	export intensity>75%	0.225	0.417
EXPT2	50%<=export intensity<75%	0.096	0.295
EXPT3	25%<=export intensity<50%	0.135	0.342
EXPT4*	export intensity<25%	0.544	0.498
FOE	foreign-owned enterprises (SOEs)	0.181	0.385
HMT	Hong Kong, Macau and Taiwan-owned enterprises	0.172	0.377
SOE	state-owned enterprises	0.061	0.240
NSOE*	non-SOEs	0.585	0.493
IND1*	food industry	0.069	0.253
IND2	textiles and furniture industry	0.206	0.404
IND3	paper and printing industry	0.048	0.214
IND4	chemicals industry	0.233	0.423
IND5	metallurgical industry	0.077	0.267
IND6	machinery and electronics industry	0.367	0.482
EAST	firm locating in East China	0.879	0.236
CETL	firm locating in Central China	0.068	0.252
WEST*	firm locating in West China	0.052	0.223
WTO	1 if the firm started exporting after 2001	0.715	0.452
Log(j)	Logarithm of time	0.992	0.735

***** denotes the reference group in the multivariate analyses

The macroeconomic conditions may also affect export survival of a firm. To account for this effect, we divide China into three areas, namely, east China, central China and west China and include region dummy variables to capture the firms' location.[6] Lu et al. (2009) showed that firms located in regions with better institutional environments were more likely to have better export prospects. The National Economic Research Institute (NERI) of China has developed an index that measures the levels of institutional development in the 31 provinces of China. The index shows that the eastern region of China enjoys a higher level of institutional development than central and western regions. Therefore, we can expect that firms located in east China could have longer export durations than those in other regions. Finally, we include another dummy variable, WTO, which equals one if a firm started exporting after 2001 and zero otherwise. The inclusion of this variable could shed light on whether firms face higher risk in the export markets after the country's entry into the WTO in 2001. In addition to the explanatory variables just described, we also include a variable to capture the pattern of duration dependence. It is defined as the log of time (interval).

4.2 Data description

Our analysis is based on the Chinese Annual Survey of Industrial Firms (CASIF) conducted by the National Bureau of Statistics of China (NBSC) between 1998 and 2007. Some features of this dataset make it suitable to examine the determinants of firms' export duration using survival methods. First, it cover all state-owned enterprises (SOEs) and other firms with annual sales more than five million RMB(equivalent to around 700 thousand USD). It is a representative sample of the population of Chinese manufacturing firms, which has been used by other economists (e.g. Cai and Liu, 2009). Although this dataset contains a large number of firms, the

[6]The eastern region includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, and Hainan. The central region includes Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan. The western region includes Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang.

rate of entry and exit is very high. As pointed out by Jefferson et al. (2008), firms may exit the dataset for three reasons, namely, closure, a decline in sales below five million RMB and changes in firm identifiers (IDs). Similarly, the entry of a firm may be due to the birth of a new firm or the expansion of sales up to the sales threshold. To prepare the sample of export duration, we match the firms across different years using the unique IDs to get a balanced panel data during the examined period. Then we can analyse their export persistence in a ten-year period.

Second, the CASIF provides rich information on firms' characteristics on a yearly basis, such as the number of employees, output, exports and location, which may help to unravel the factors determining the length of export spells. Nevertheless, some information is noisy and misleading largely due to misreporting. To obtain a "clean" sample for the multivariate analysis, we use the popular criterions identified in the literature by Jefferson et al. (2008) and Cai and Liu (2009) to remove the outliers and abnormal observations. These include (1) key variables are missing or have negative values (e.g. export values), (2) the number of employees must not be less than eight people and (3) the value of total assets must be greater than that of total fixed assets.

After cleaning, we further exclude all left-censored observations and focus on the first spells based on the discussion in the preceding section. We end up with a sample of 12,553 observations corresponding to 3,418 exporting spells, 75% of which ended during the sample period. The average export duration is three and half years. 11.2% of the firms exported continuously every year from 1999 to 2007. Summary statistics about the sample are presented in Table 2. Most exporting firms are found to be small and medium sized, which together accounts for 95% of the sample. About 22.5% of the firms exported more than 75% of their sales and 54.4% of the firms exported less than 25%. In terms of ownership, more than a half of the firms are non-state-owned enterprises. A larger part (80%) of the firms operated in textiles and furniture, chemical, and machinery and electronics sectors.

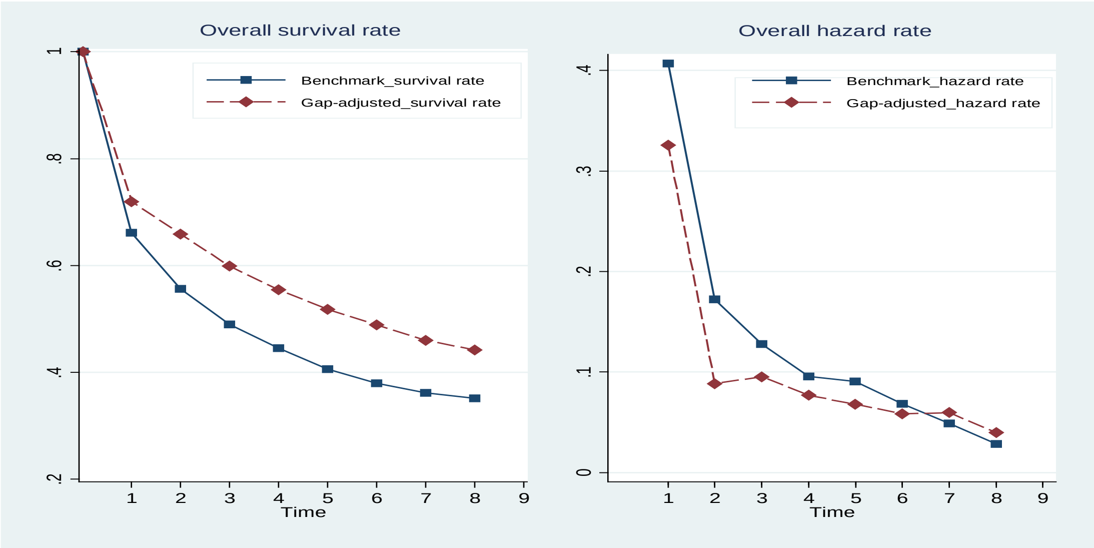
5 Empirical results

5.1 The results of non-parametric analysis

Before we formally investigate the effects of explanatory variables on export duration, we present the non-parametric estimates (i.e. lifetable estimates) of the survivor function for the whole sample. We further compare the differences of export survivals across the groups defined by the explanatory variables. The left-hand panel of Figure 1 shows the overall survival rate and the overall hazard rate is depicted in the right-hand panel.

In comparison with the bench mark data, the one-year gap adjustment shifts the distribution of the survival rate. The survival rates in gap-adjusted data are on average 10% points higher than those of the benchmark data. The hazard rate in gap-adjusted data is lower in early years but a little higher in later years than those in benchmark data. The results suggest that benchmark spells likely lead to underestimated duration, although they exhibit the same trend.

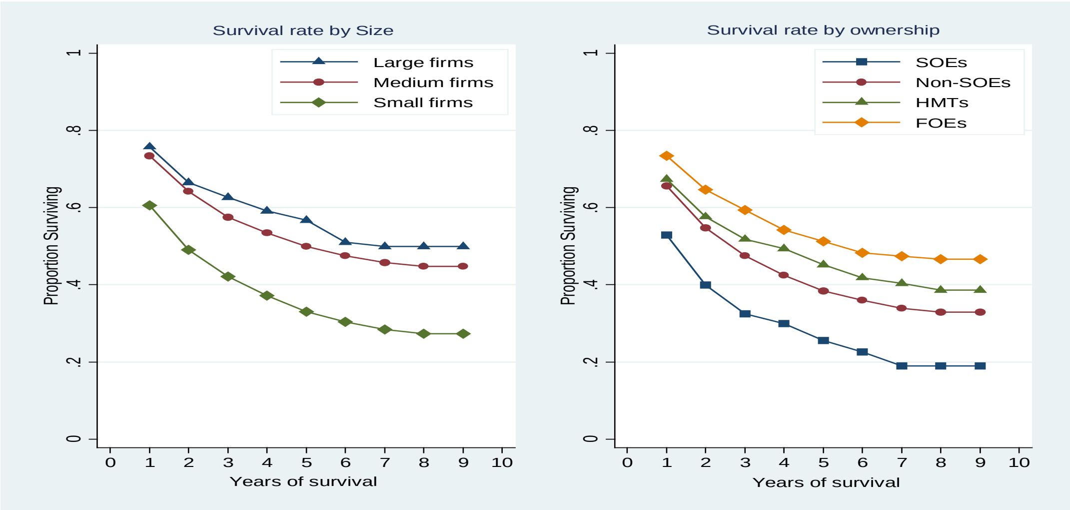
Fig.1 Overall survival and hazard rates



Source: Author's work based on the sample.

Further, we compare the differences in survival distribution across groups of firms as defined by the explanatory variables. According to the left panel of Figure 2, we found that large and medium firms have a higher survival rate at any time than that faced by small firms. As for ownership effects (shown in the right panel of Figure 2), it is shown that foreign-owned enterprises had the best survival prospect in the export markets, which are followed by HMTs and non-state-owned enterprises. The SOEs face the highest risk of exit. Similarly, we can also obtain the graphs for other groups, but they are not presented here for the sake of saving space.

Fig.2 Survival rates by firm size and ownership



Source: Authors' work based on the sample.

Finally we carry out a likelihood-ratio test of equality of hazard functions across groups of firms. The results, reported in Table 3, obviously indicate the existence of significant differences in survival across groups for each of the variables considered. After controlling for the effect of firm size, the results are similar to those obtained for all firms. However, it should be noted that the nonparametric analysis is a univariate approach without controlling for the effects of other explanatory variables. In the next section, we proceed to a formal investigation of the effects of the explanatory variables on the export hazard rate.

Table 3 Non-parametric tests for the equality of survival functions

	Likelihood-ratio test		
	All firms	Small firms	Large and medium
Size	176.75 (0.000)	-	-
Labour productivity	172.22 (0.000)	83.93 (0.000)	90.58 (0.000)
Export intensity	334.16 (0.000)	223.66 (0.000)	200.55 (0.000)
Ownership	94.34 (0.000)	39.49 (0.000)	104.97 (0.000)
Industry	21.82 (0.000)	22.37 (0.000)	20.74 (0.000)
Region	40.59 (0.000)	21.19 (0.000)	65.00 (0.000)
Entry time (WTO)	111.65 (0.000)	76.60 (0.000)	75.86 (0.000)

The table reports the statistics and the corresponding p-values (in parentheses) of the likelihood-ratio test of homogeneity of the survivor functions with the null hypothesis that the survivor functions across the groups defined by the independent variables are the same.

5.2 The results of semi-parametric analysis

Following the work by Hess and Persson (2010) and Ilmakunnas and Nurmi (2010), we estimate alternative discrete-time duration models, in which the hazard rate is assumed to be a complementary log-log (*cloglog*) form. It is in nature the discrete time format of the continuous time proportional hazards model. In order to control for unobserved heterogeneity, we further estimate two augmented *cloglog* models, in which the heterogeneity is assumed to be either Gamma or Gaussian distributed.

The estimation results in Table 4 imply three points. First, the likelihood-ratio test of Gamma variance in Model 3 reveals that we can strongly reject the null hypothesis that there is no unobserved heterogeneity. This result is confirmed when we use the Gaussian distribution instead of the Gamma distribution. These results show that it is appropriate to consider unobserved heterogeneity in our analysis. Second, in Model 1 which takes into consideration of duration dependence by including the variable log of time, the magnitude of the hazard ratios is much larger than that of those in Model 2.[7] It implies that the influence of other independent variables on the hazard rate could be underestimated without controlling for the patterns of duration dependence. Third, the hazard ratios in the models without frailty and those in the models with frailty show that, the impact of the covariates on the hazard rate could be underestimated too without consideration of the unobserved heterogeneity.

We can now move on to the interpretation of the estimates in our preferred specification, that is, Model 3, which uses the Gamma distribution to summarize unobserved individual heterogeneity. The effects of the covariates on the hazard are given by the *hazard ratios*. A unit change in an explanatory variable (from 0 to 1 for

[7]Models 1, 2 and 3 are estimated using the Stata programs “*pgmhaz8*” written by S. P. Jenkins. Model 4 is estimated using the Stata command “*xtcloglog”*.

dummy variables) leads to a proportional shift in the conditional probability of the failure. If the hazard ratio is smaller (greater) than one, it implies the explanatory variable has a negative (positive) effect on the hazard rate; other things being equal. Smaller values stand for smaller hazard and hence longer survival.

Table 4 Estimates of the discrete-time proportional hazard models

	Model 1		Model 2		Model 3		Model 4	
	Hazard Ratio	p-value	Hazard Ratio	p-value	Hazard Ratio	p-value	Hazard Ratio	p-value
SIZE1	0.485	0.000	0.362	0.000	0.445	0.000	0.378	0.000
SIZE2	0.619	0.000	0.501	0.000	0.590	0.000	0.535	0.000
LP1	0.640	0.003	0.362	0.000	0.634	0.005	0.597	0.007
LP2	0.781	0.000	0.585	0.000	0.791	0.000	0.768	0.001
EXPT1	0.482	0.000	0.344	0.000	0.450	0.000	0.384	0.000
EXPT2	0.533	0.000	0.394	0.000	0.494	0.000	0.432	0.000
EXPT3	0.611	0.000	0.485	0.000	0.583	0.000	0.524	0.000
FOE	0.810	0.003	0.769	0.000	0.791	0.003	0.740	0.005
HMT	0.964	0.587	0.932	0.293	0.968	0.672	0.962	0.683
SOE	1.222	0.017	1.236	0.010	1.297	0.011	1.347	0.019
IND2	0.868	0.086	0.736	0.000	0.905	0.316	0.851	0.266
IND3	0.896	0.358	0.790	0.045	0.940	0.662	0.893	0.546
IND4	0.853	0.035	0.697	0.000	0.906	0.302	0.865	0.286
IND5	0.908	0.320	0.820	0.035	0.971	0.803	0.943	0.714
IND6	0.769	0.000	0.616	0.000	0.807	0.015	0.754	0.034
EAST	0.774	0.000	0.641	0.000	0.795	0.007	0.725	0.022
CETL	1.037	0.705	0.880	0.163	1.124	0.345	1.112	0.528
WTO	1.066	0.184	1.374	0.000	1.122	0.073	1.180	0.039
log(j)	0.384	0.000			0.452	0.000	0.595	0.009
Log likelihood	-4,768.93		-5,137.07		-4,767.18		-4,765.59	
Observations	12,553		12,553		12,553		12,553	
RE	No		No		Yes/Gamma		Yes/Gaussian	
P-value of LR test for RE	-		-		0.000		0.000	

First of all, taking small firms with employees less than 300 as the reference group, we find that the hazard ratio for SIZE1 is 0.445, which means that large firms with more than 2000 employees are estimated to face a hazard rate that is only 44.5% of the hazard faced by small firms. Meanwhile, the medium firms are found to face a hazard rate that is only59.0% of the hazard faced by small firms. This finding is consistent with the prior prediction. It also confirms the result of previous studies such as Llmakunnas and Nurmi (2010) that the plant size has a negative impact on survival.

As for the effect of productivity, numerous theoretical and empirical researches suggest that productivity is one of the most important determinants of firms' export decision because only highly productive firms could be profitable in the export market, while less productive firms can only sell in the domestic market (Melitz, 2003). The results from our estimation show that more productive firms can also have a longer exporting life. The most productive firms are 37% less likely to exit than the least productive firms. Thus the findings tell us that firms' productivity is important not only for their export decisions but also for their survivals in the export markets once they become exporters.

Furthermore, we investigate the effect of firms' export intensity on their export durations. It is shown that the hazard ratio increases as export intensity decreases. It implies that the firms' hazard rate and export intensity have a negative relationship. For instance, the probability of exit for firms with more than 75% of their sales exported (EXPT1) is about 55% lower than that for firms with export intensity less than 25% (EXPT4). This result is consistent with the finding of Esteve-Pérez*et al.* (2007) who also found that more export-oriented firms enjoy better survival prospects. They argued that firms exported more have more knowledge about export markets, export channels, foreign demand and tastes. Thus they benefit from learning-by-exporting and are able to survive longer.

In terms of ownership effect, foreign-owned enterprises (FOEs) are found to have longer export spells. Relative to the non-SOEs such as the private wholly-owned and collectively-owned enterprises, FOEs are 20% less likely to exit. This may be because western investors usually enjoy better access to overseas markets and have more knowledge about foreign buyers due to their links with foreign businesses. Furthermore, foreign exporters always perform better in the international markets because of their advanced technology and management expertise. Lastly, foreign exporters always use developing countries, like China, as the export platform so they are more likely to target at the international markets and hence survive longer in those markets. Meanwhile, we find that there is no difference in hazard rates between HMT-enterprises and non-SOEs. But the state-owned enterprises are found to be less competitive in the international markets and they face 30% higher risk of exit than non-SOEs. One possible reason is that Chinese SOEs are often less efficient and more locally-oriented than other enterprises in China (Jefferson et al. 2003).

In terms of sectoral and regional variations, we only find that the estimated hazard ratios of IND6 and EAST are statistically significant and less than one. It suggests that firms operate in China's machinery and electronics industry have better survival prospects than those in other industries. From the official statistics, the exports of machinery and electronic products have long been a major contributor (over 50%) to China's export. About 70% of machinery and electronic products were granted full export tax rebates in recent years, which makes exporting more profitable and consequently leads to better exporting prospects. As for the firms located in East China, we find that they face 20% lower hazard in the export markets than those located in central and western China. This is mainly due to the differences in institutional environments across regions, which were reflected in various dimensions of marketization. Firms located in coastal regions of China with a higher degree of marketization have better access to key resources and institutional supports for exporting activities. Hence, firms located in different regions have different destiny in the foreign markets.

Finally, we examine the effect of China's WTO membership and the pattern of duration dependence. The estimation results show that exporting firms are 12.2% more likely to exit the foreign markets after the country's entry into the WTO in the late 2001. This is probably due to the higher degree of competition faced by the exporting firms in the post-WTO period, which in turn reduces their chance of surviving in the exporting markets. In terms of the coefficient of the log of time, we find it is less than one and also statistically significant, which indicates that the baseline hazard descends with the elapsed survival time. That is, the exporters with longer exporting duration tend to export continuously. There are at least two reasons underlying such persistence in the exporting status. First, exporting firms are less likely to stop exporting as accumulated sunk costs rise over time. Once they exit, they will face a higher re-entry cost. Second, firms may learn by exporting and hence improve their productivity performance. All these can enhance the firms' likelihood of exporting (Esteve-Pérez at al. 2007).

6 Sensitivity analyses

The main findings in the preceding section are derived using a *cloglog* model under the assumption of proportional hazards (PH). This assumption states that all the firms face the same baseline hazard. Thus the estimates based on the *cloglog* framework are easy to be explained. However, the proportional hazard assumption may fail to hold, and if so, it could lead to distortions in the estimated covariate effects (Brenton et al. 2009; Hess and Persson 2010). To check the sensitivity of our findings to different methods used, we hence re-estimated the model using two discrete-time non-proportional hazard (non-PH) models, namely, the logit and probit models. Although Hess and Persson (2010) demonstrated that non-proportional hazard specifications including random effects show better results than *cloglog* specifications, the interpretation of the estimated coefficients is no longer straightforward. Yet, the estimated coefficients of the non-PH models can still provide some insight into the direction and to some extent the magnitude of the effects (Besedeš and Blyde 2010).

Table 5 shows the estimated coefficients of the discrete-time non-PH models using logit and probit estimators. The results further confirm the importance of controlling for unobserved heterogeneity in survival analysis. It shows us that about 65% of the total variance is contributed by the panel-level variance component. The negative coefficients suggest that the firms with certain characteristics face less hazard and hence have higher probability of survival. The positive estimates means the covariate increase the hazard. The larger absolute value suggests the greater magnitude of the effect of the covariate on the hazard rate. Firms with larger size, higher labour productivity and greater export intensity endure less risk of exit in the export markets. In addition FOEs are more likely to have longer export durations than the reference group, non-SOEs, while the SOEs face higher hazard and have shorter export durations. Moreover, firms operating in the machinery and electronics industry and those locating in east China enjoy better survival prospects. We also observed that Chinese exporters face higher hazard after the country's entry into the WTO. In summary, all findings are consistent with those we obtained in the preceding section. Hence we conclude that our findings are robust to different methods.

Table 5 Estimates of the discrete-time non-proportional hazard models

	Model 5		Model 6		Model 7		Model 8	
	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value
SIZE1	-1.128	0.000	-0.635	0.000	-1.501	0.000	-0.831	0.000
SIZE2	-0.755	0.000	-0.423	0.000	-0.929	0.000	-0.514	0.000
LP1	-1.076	0.000	-0.600	0.000	-0.653	0.016	-0.357	0.017
LP2	-0.552	0.000	-0.314	0.000	-0.306	0.007	-0.165	0.009
EXPT1	-1.136	0.000	-0.617	0.000	-1.514	0.000	-0.840	0.000
EXPT2	-1.007	0.000	-0.555	0.000	-1.272	0.000	-0.701	0.000
EXPT3	-0.786	0.000	-0.436	0.000	-0.986	0.000	-0.543	0.000
FOE	-0.277	0.000	-0.154	0.000	-0.522	0.001	-0.295	0.001
HMT	-0.065	0.377	-0.031	0.442	-0.070	0.648	-0.041	0.636
SOE	0.307	0.002	0.170	0.002	0.495	0.013	0.271	0.016
IND2	-0.217	0.019	-0.146	0.005	-0.119	0.558	-0.071	0.536
IND3	-0.131	0.332	-0.091	0.230	-0.058	0.840	-0.041	0.797
IND4	-0.266	0.002	-0.167	0.001	-0.073	0.696	-0.050	0.635
IND5	-0.100	0.367	-0.082	0.192	0.068	0.774	0.026	0.848
IND6	-0.400	0.000	-0.243	0.000	-0.296	0.097	-0.174	0.082
EAST	-0.389	0.000	-0.252	0.000	-0.398	0.024	-0.230	0.019
CETL	-0.014	0.898	-0.040	0.525	0.353	0.157	0.191	0.171
WTO	0.391	0.000	0.224	0.000	0.315	0.006	0.165	0.011
Log likelihood	-5,127.81		-5,127.62		-4,765.52		-4,764.24	
Observations	12,553		12,553		12,553		12,553	
ρ	-		-		0.643		0.650	
RE	No		No		Yes/Gaussian		Yes/Gaussian	
P-value of LR test for RE	-		-		0.000		0.000	

Models 5 and 6 are estimated using pooled logit and probit models, respectively, and Models 7 and 8 are estimated using panel logit and panel probit models, respectively. ρ measures the proportion of the total variance contributed by the panel-level variance component.

Furthermore, we examine the sensitivity of the results to the sample and data used by estimating a discrete-time proportional hazards model. Following Besedeš and Prusa (2006b), we assume one-year gap between spells is a measurement error and then merge the one-year-gap spells. But, if the firms reported zero exports in two consecutive years for the first time in the examined period, they are considered to exit export markets permanently. Although we showed that the distribution of the survival rates shifts upward in comparison with the benchmark data, the effects of the explanatory variables on the hazard rate are practically the same as those presented above, but the coefficient of the HMT ownership dummy becomes statistically significant while that of the state ownership dummy is no longer significant (see Model 9 in Table 6).

Table 6 Robustness checks

	Model 9 (Gap-adjusted)		Model 10 (LMEs)		Model 11 (Small firms)		Model 12 (Domestic)		Model 13 (Foreign)	
	H.R.	p.v.	H.R.	p.v.	H.R.	p.v.	H.R.	p.v.	H.R.	p.v.
SIZE1	0.496	0.000					0.449	0.000	0.667	0.197
SIZE2	0.536	0.000					0.590	0.000	0.612	0.000
LP1	0.680	0.018	0.716	0.221	0.583	0.018	0.598	0.036	0.695	0.097
LP2	0.798	0.000	0.764	0.011	0.808	0.019	0.719	0.000	0.926	0.520
EXPT1	0.460	0.000	0.453	0.000	0.414	0.000	0.451	0.000	0.460	0.000
EXPT2	0.471	0.000	0.473	0.001	0.461	0.000	0.505	0.000	0.442	0.000
EXPT3	0.601	0.000	0.609	0.002	0.539	0.000	0.586	0.000	0.563	0.000
FOE	0.758	0.000	0.812	0.143	0.742	0.008				
HMT	0.816	0.010	0.937	0.657	0.964	0.731				
SOE	1.155	0.173	1.254	0.094	1.229	0.338				
IND2	0.729	0.002	0.679	0.010	0.966	0.829	0.922	0.528	0.941	0.686
IND3	0.866	0.315	0.644	0.052	1.107	0.643	0.993	0.970	0.861	0.429
IND4	0.797	0.016	0.661	0.004	1.032	0.840	1.022	0.861	0.763	0.062
IND5	0.781	0.041	0.622	0.019	1.166	0.407	1.131	0.437	0.805	0.278
IND6	0.705	0.000	0.504	0.000	1.002	0.987	0.972	0.812	0.585	0.000
EAST	0.711	0.000	0.716	0.008	0.745	0.036	0.783	0.019	0.715	0.025
CETL	0.982	0.888	1.074	0.690	0.984	0.937	1.159	0.318	1.007	0.978
WTO	1.225	0.002	1.081	0.468	1.223	0.060	1.162	0.074	1.040	0.683
log(j)	0.450	0.000	0.469	0.000	0.527	0.000	0.516	0.000	0.357	0.000
Log likelihood	-5,220.88		-1,827.06		-2,950.15		-3,333.28		-1,429.01	
Observations	16,379		5,226		7,327		8,116		4,437	
RE	*Yes/Gamma*		*Yes/Gamma*		*Yes/Gamma*		*Yes/Gamma*		*Yes/Gamma*	
P-value of LR test for RE	0.000		0.000		0.000		0.000		0.000	

H.R. denotes hazard ratio; p.v. denotes p-value.

Finally, in order to reduce the degree of heterogeneity of the firms, we break down the data into two different sub-samples according to their size, namely, the LMEs (larger and medium-size enterprises) and small firms. We re-estimate the specifications separately for these two groups using random effect *cloglog* model. We find that the coefficients of LP1, FOE and WTO are no longer significant for LMEs (Model 10), but still significant for small firms (Model 11). These results indicate that the productivity effects on export survival for LMEs may be non-linear. The assumed superiority of foreign ownership seems to matter less when the firms are large. Moreover, the large and medium enterprises seem to face similar risk before and after the WTO entry while the risk of failure for the small firms increases if they entered export markets after the country's entry into the WTO. In addition, for the small firms, we find that state ownership is insignificant (Model 11). This may be due to the fact that most SOEs are LMEs in our sample and thus state ownership is irrelevant for small firms. Alternatively, if the sample is divided into foreign-owned (including HMTs) and locally-owned firms, it is found that the size variable has a non-linear positive effect on export duration for foreign firms. Domestic exporting firms are found to be influenced by trade liberalization (WTO entry) in terms of their entry time while foreign firms are not (as shown in Models 12 and 13).

7 Concluding remarks

This paper has provided the empirical evidence of the duration pattern and its determinants of Chinese manufacturing enterprises in the export markets. Our results confirm a popular finding that exporting firms face high risk of exit in their starting years. In addition to the nonparametric analysis the differences in the survivor functions across groups, we also employ alternative discrete-time duration models to examine the factors explaining the export survival of Chinese manufacturing firms.

Our main results are as follows. First, we find that small firms endure significantly higher risk of failure than large and medium firms. LMEs have a higher survival rate in the foreign markets. Second, our results indicate that the survival probability is higher for more productive firms. Moreover, firms with higher export intensity would continue to export for a longer period. Third, foreign-owned exporting firms are less likely to exit the markets than HMT-enterprises and non-state-owned enterprises, while the state-owned enterprises endure higher risk of failure in the export markets. Finally, we compare the hazard rates for the firms operating in different industries as well as regions. The results suggest that firms operating in machinery or electronics and locating in east China face lower risk of exit than others.

The findings from this study have important implications for both Chinese entrepreneurs and policy makers. First, our results may help managers and entrepreneurs to assess more accurately their chance of success in international markets before they decide to go abroad. Second, policy makers should not only devote resources to the creation of new exporters but also need to care about the survival of new exporters especially in their starting period in order to sustain export growth. If new exporters exit shortly, economic and social costs may be high. Policies should be targeted at improving access to foreign markets and providing export infrastructure in order to reduce firms' persistence cost in foreign markets. Finally, we should acknowledge one major limitation of the study. This research is based on secondary data. It has constrained our measures of the accurate export duration. Future research should be done if we could get the first-hand data about entry and exit time of firms in export markets.

References

Allison, Paul D,1995. *Survival analysis using the SAS system-A practical guide*. Cary, North Carolina: SAS Press.

Alvarez, Roberto , and López, Ricardo A., 2008. 'Entry and exit in international markets: evidence from Chilean data. *Review of International Economics*,16 (4):692-708.

Bernard, Andrew B., and Jensen, J. Bradford, 2004. 'Why some firms export?', *The Review of Economics and Statistics*, 86 (2):561-569.

Besedeš, Tibor , and Prusa, Thomas J., 2006. 'Ins, Outs, and the Duration of Trade', *Canadian Journal of Economics*, 39 (1):266-295.

Besedeš, Tibor, and Prusa, Thomas J., 2006. 'Product differentiation and duration of US import trade', *Journal of International Economics*, 70:339-358.

Besedeš, Tibor, 2008, A search cost perspective on formation and duration of trade. *Review of International Economics*, 16 (5):835-849.

Besedeš, Tibor , and Blyde, Juan, 2010, 'What drives export survival? An analysis of export duration in Latin America', Inter-American Development Bank, *mimeo*.

Bosco-Sabuhoro, Jean, Larue, Bruno, and Gervais, Yvan, 2006, 'Factors determining the success or failure of Canadian establishments on foreign markets: A survival analysis approach. *The International Trade Journal*, 20 (1):33-73.

Brenton, Paul, Martha Pierola, and von Uexkull, Erik, 2009, 'The life and death of trade flows: understanding the survival rates of developing-country exporters', In *Breaking into New Markets: Emerging Lessons for Export Diversification*, ed R. Newfarmer, W. Shaw and P. Walkenhorst. Washington, DC: World Bank

Brenton, Paul, Saborowski, Christian, and von Uexkull, Erik, 2010, 'What explains the low survival rate of developing country export flow?' *The World Bank Economic Review*, 24 (3):474-499.

Cai, Hongbin, and Liu, Qiao, 2009, 'Competition and corporate tax avoidance: Evidence from Chinese industrial firms', *The Economic Journal*, 119 (537):764-795.

Clerides, Sofronis, Lach, Saul, and Tybout, James, 1998, 'Is learning by exporting important? Micro-dynamic evidence from Colombia, Mexico and Morocco', *Quarterly Journal of Economics*, 113 (3):903-947.

Cleves, Mario A., Gould, William W., Gutierrez, Roberto G., and Marchenko, Yulia U., 2008, *An introduction to survival analysis Using Stata (second edition)*. Taxas, U.S.A.: Stata Press.

Cox, David R., 1972, ‘Regression models and life-tables’, *Journal of the Royal Statistical Society*, 34 (2):187-220.

Esteve-Pérez, Silviano, Máñez-Castillejo, Juan A., Rochina-Barrachina, María E., and Sanchis Llopis, Juan A., 2007, ‘A survival analysis of manufacturing firms in export markets’, In *Entrepreneurship, Industrial Location and Economic Growth*, ed J. M. Arauzo-Carod and M. C. Manjón-Antolín: Edward Elgar.

Esteve-Pérez, Silviano, Máñez-Castillejo, Juan A., and Sanchis-Llopis, Juan A., 2008, ‘Does a "survival-by-exporting" effect for SMEs exist?, *Empirica*, 35 (1):81-104.

Fugazza, Marco , and Molina, Ana C., 2009, ‘The determinants of trade survival’, *HEID Working Paper No.05/2009, Graduate Institute of International and Development, Geneva*.

Fung, Hung-gay, Gao, Gerald Yong, Lu, Jiangyong, and Mano, Haim, 2008. ‘Impacts of competitive position on export propensity and intensity: An empirical study of manufacturing firms in China’, *The Chinese Economy,* 41:51-67.

Gao, Gerald Yong, Murray, Janet Y., Kotabe, Masaaki, and Lu, Jiangyong, 2009, ‘A "strategy tripod" perspective on export behaviour: Evidence from domestic and foreign firms based in an emerging economy’, *Journal of International Business Studies*, 41 (3):377-396.

Görg, Holger, Kneller, Richard, and Muraközy, Balázs, 2008, ‘What makes a successful exporter?’.*GEP Research Paper 2008/01, The University of Nottingham.*

Greenaway, David , and Kneller, Richard, 2007, ‘Firm heterogeneity, exporting and foreign direct investment’. *The Economic Journal*,117:F134-F61.

Hess, Wolfgang , and Persson, Maria, 2010, ‘The duration of trade revisited: continuous-time vs. discrete-time hazards’, *Working Papers 2010:1, Lund University, Department of Economics, Sweden.*

Jefferson, Gary H., Hu, Albert G.Z., Guan, Xiaojing, and Yu, Xiaoyun, 2003. ‘Ownership, performance, and innovation in China's large- and medium-size industrial enterprise sector’, *China Economic Review*, 14:89-113.

Jefferson, Gary H., Rawski, Thomas G., and Zhang, Yifan, 2008, ‘Productivity growth and convergence across China's industrial economy’, *Journal of Chinese Economic and Business Studies*, 6 (2):121-140.

Jenkins, Stephen P., 2005, *Survival Analysis* (The Lecture Notes Manuscript).

Kaplan, E. L., and Meier, Paul, 1958, ‘Nonparametric estimation from incomplete observations’, *Journal of American Statistical Association*, 53 (282):457-481.

Lu, Jiangyong, Xu, Bin, and Liu, Xiaohui, 2009, ‘The effects of corporate governance and institutional environments on export behaviour in emerging economies: evidence from China’, *Management International Review,* 49 (4):455-478.

Manjón-Antolín, Miguel C. , and Arauzo-Carod, Josep-Maria, 2008, ‘Firm survival: methods and evidence’, *Empirica*, 35 (1):1-24.

Melitz, Marc J., 2003, ‘The impact of trade on intra-industry reallocations and aggregate industry productivity’, *Econometrica*, 71 (6):1695-1725.

Nicoletti, Cheti , and Rondinelli, Concetta, 2010, ‘The (mis)specification of discrete time duration models with unobserved heterogeneity: A Monte-Carlo study’, *Journal of Econometrics*, 15 (1):1-13.

Prentice, R. L. , and Gloeckle, L.A., 1978, ‘Regression analysis of grouped survival data with application to breast cancer data’, *Biometrics*, 34 (1):57-67.

Rauch, James E., and Watson, Joel, 2003, ‘Starting small in an unfamiliar environment’, *International Journal of Industrial Organization,* 21 (7):1021-1042.

Roberts, Mark J., and Tybout, James R., 1997, ‘The decision to export in Colombia: An empirical model of entry with sunk costs’, *The American Economic Review*, 87 (4):545-564.

Volpe-Martincus, Christian , and Carballo, Jerónimo, 2009, ‘Survival of new exporters in developing countries: Does it matter how they diversify?’ *IDB Working Paper Series No.140,* Inter-American Development Bank.

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