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**Article**

## Global sourcing, firm size and export survival

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## Global sourcing, firm size and export survival

*Roger Bandick*

### Abstract

This paper investigates how firm size and global sourcing affect the export surviving probabilities. By using data on export and import transactions disaggregated by destination/origin for the entire Danish manufacturing firms between the period 1995–2006, the author is able to classify the firms into different size categories and to observe whether they continue or cease to export. Moreover, he is able to define whether the firms source intermediate inputs from high- or low-wage countries. The results, after controlling for the endogeneity of the international sourcing decision by using instrument variable and propensity score matching, indicate that firm size is positively correlated with the likelihood of continuing to export. Moreover, for small and medium size firms, global sourcing seems also to increase the probability of staying in the export market but only if they source from high-wage countries. However, sourcing inputs from abroad, no matter if it is from high- or low-wage countries, do not seem to significantly affect the export surviving probabilities for larger firms.

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## **1 Introduction**

Following the heterogeneous firm trade models (e.g., Melitz, 2003; Bernard et al., 2003; Bernard et al., 2007), firms are ranked according to their productivity level. Firms with slightly higher productivity than the cut-off level to survive serve the domestic market, and, due to the high start-up costs to become an exporter, only firms that ex-ante are sufficiently productive are able to enter the export market. Indeed, this is a common finding in the empirical literature, summarized by Wagner (2007); firms that are more productive, larger, capital, and skill-intensive are more likely to engage in the export market (self-selection into the export market). Previous literature, e.g. Bernard and Jensen (1999); Greenaway and Kneller (2007); Girma et al. (2004): also find evidence for positive ex-post performances once the firms start exporting (learning-by-doing).

Implicitly, given these results, we would expect high degree of persistency of the export status, that is, once the firm is able to bear the costs of entering the foreign market it will start to export, and, it will continue to do that for many years due to potential ex-post benefits (Baldwin and Krugman, 1989).

However, Besedes and Prusa (2011) found that the median survival rate of the manufacturing exporters of 46 developed and developing countries is only 1–2 years. This short-lived export episode has been found in other studies as well; Eaton et al. (2007) for Colombian exporters; Volpe and Carballo (2009) for Peruvian exporters; Ilmakunnas and Nurmi (2010) for Finnish exporters; and, Choquette (2019) for Danish exporters. Nguyen (2012) shows in numerical prediction that more than 30 percent of exporting firms fail. This rise the question why some exporting firms, although they have the required productivity level to enter that market, do not seem to be long-lasting while other equally productive firms survive much longer?

To answer this question, this paper goes beyond the role of firm's productivity by introducing two other important characteristics as explanatory variables, namely, the role of global sourcing and firm size. More precisely, the aim is to investigate whether firms' intra-industry imports of intermediate inputs from different regions (high- or low-wage countries) affect the export survival rates of small, medium and large firms.

The underlying assumption, following Roberts and Tybout (1997), is that once a firm has entered the export market, it will continue to export as long as the present and expected future profit is higher as compared to only serving the domestic market. In case of negative profits, the firm will continue to export as long as the losses do not exceed the sunk cost of exiting the export market. These outcomes, however, are conditioned on the information bundle the firm possess prior export entry in which are endogenously driven depending on the characteristics of the firm. Here, international sourcing engagement and firm size play major role in collecting market information, product adaptation and learning abilities, for which directly relates to export profits, sunk cost and probability to survive.

Yet theoretically, it is still unclear how global sourcing and firm size affect export survival. On the one hand, firms with international sourcing experience prior export entry may possess valuable market information that may help them to learn how to operate successively and generate profits. In this view, the more knowledge the firms have from their import experience prior export entry the less uncertainty they face and therefore less likely they will exit the export

market (Albornoz et al., 2012; Carrère and Strauss-Kahn, 2017; Nguyen, 2012). On the other hand, however, firms with better market information faces lower sunk cost entering and exiting new markets. In this view, the knowledge gained from import experience may reduce the export entry sunk cost in which may induce the firms to experiment with their export entries that ultimately may lead to higher exit probabilities, (Gullstrand and Persson, 2015; Li et al., 2017; Choquette, 2019).

Another dimension is that the learning ability from import experience and the level of market uncertainties faced are much dependent on the size of the firm and on the location of the sourcing activities. Small firms are usually more flexible and able to learn and respond rapidly to different shocks, (Beck et al., 2008). However, small firms are more vulnerable to these shocks due to difficulties of obtaining financial funds to either initiate, expand or maintain their export activities. As for different sourcing location, the scope of global sourcing may depend on the location of this activity since different partner countries provide different opportunities. Sourcing from low-wage countries gives the firms access to inputs produced at lower cost as compared to domestic inputs, which entails lower production cost and improving profitability and prolonged export opportunities. However, inputs imported from low-wage countries where institutions are weak may impose high transaction cost for the firms which may lead to lower profitability and ultimately to lower, or at its best no effect on export survival. Sourcing from high-wage countries, on the other hand, gives the firms access to high technological inputs that potentially are not available in the domestic market. Firms may import these advance inputs to complement their core activities, hence the production process is expected to become more efficient, the productivity to increase and the export opportunities to improve (Jabbour, 2010 and Wagner, 2011). However, since inputs from high-wage countries often are associated with high quality they tend to cost more, which eventually entails lower profitability and lower chances to survive.

Whether global sourcing and firm size leads to higher or lower survival in the export market is not only of academic interest. From the firms perspective, it is highly important to find out what opportunities and difficulties exist in the market they want to enter in order to be able to counteract and make all the necessary investment. Here, assessing the knowledge and experience in the international market plays essential role in avoiding short export episode, which ultimately means losses of entry sunk costs and potential future profits. From a policy perspective, it is important to identify what type of firms that potentially may face difficulties in the export market in order to implement accurate policies that help these firms to extend their export status. As it is important for the firms to make the necessary investments to prevent losing future export profits, it is equally important from a macro perspective to investigate the political reforms that are required to prevent losses of future jobs.

Only a few papers study the impact of global sourcing and firm size on export exit. Stirbat et al. (2015) show that import experience has strong positive influence on the survival of exporters. Diaz-Mora et al. (2015) show that Spanish small manufacturing firms with import experience have lower probability of quitting the export market as compared to firms without import experience. For larger firms, however, sourcing inputs from abroad do not seem to influence the export survival probabilities. Using the same data as Diaz-Mora et al. (2015), Córcoles et al. (2019) show that the most internationalized firms have a lower exit rate compared to other exporting firms. Creusen and Lejour (2011) find that the probability of

exiting the export market is lower for large Dutch firms. Lo Turco and Maggioni (2013) show that for Italian manufacturing firms, import has enhancing effect on the export probability but only if the import is from low-income countries. Choquette (2019) study the relationship between import-based market experience and market exit decision of 1920 Danish manufacturing exporters between the period 2001 and 2011. In line with sunk cost perspective, she finds that increased market knowledge triggers experimentation-like export behavior, which consequently leads to higher probability of market exit. However, in Choquette (2019), firms exit decision from a specific market do not necessary mean export failure but rather a transition from one market the firms have entered as experiment due to low entry sunk cost to another more sustainable market.

In this paper, I use different approach by defining export exit as total withdrawal of all markets, not only exit from one specific market, to better asses the implications of global sourcing and firm size on export market exit. Moreover, to the best of my knowledge, this is one of the first study that focus on the relation between imports of intermediate inputs and export survival by distinguishing the effect from different sourcing location and different size of firms simultaneously. I use data on export and import transactions that are disaggregated by destination/origin for the entire Danish manufacturing firms with at least one employee between the periods 1995–2006. To preview the results, controlling for several firm and industry specific characteristics that may affect the export survival rate, it seems that larger and medium size firms have 31 and 44 percent higher export surviving probabilities than smaller firms. The result seems also to indicate that for small and medium size firms, global sourcing increases the probability of staying in the export market, but only if the import is from high-wage countries. However, sourcing inputs from abroad, no matter if it is from high- or low-wage countries, do not seem to significantly affect the export surviving probabilities for larger firms. These results are robust controlling for the endogeneity of the sourcing decision by using IV and matching approach.

The rest of the paper is structured as follows. Section 2 discusses the theoretical framework and Section 3 outline the estimation strategy used in this paper. Section 4 describes the dataset and presents some preliminary indications how firm size and global sourcing affect the export survival probabilities. Section 5 presents the empirical results from estimating the hazard model controlling for the possible endogeneity by using the probability of importing as an instrument and by using a matched sample that is generated by propensity score matching approach. Section 6 concludes.

## **2 Theoretical framework**

To illustrate the strategic decision for a firm to either stay or exit the export market we begin with a minor simplification about revenue and cost functions, as outlined by Ilmakunnas and Nurmi (2010). The revenue from the export market ( $R_{it}^{EX}$ ) and domestic market ( $R_{it}^D$ ) can be defined as  $R_{it}^{EX}(X_{it}, z_t^{EX}, t)$  and  $R_{it}^D(D_{it}, z_t^D, t)$ .  $X_{it}$  and  $D_{it}$  are export and domestic sales,  $z_t^{EX}$  and  $z_t^D$  are vector of exogenous variables that either enhances or reduces the demand such for example business cycle, exchange rate, trade policy etc., and time  $t$  account for the accumulated

demand learning process the firms acquire while they stay additional year in the export and/or domestic market. The learning process is considered as endogenously driven depending on firms own action such for example collecting market information, product adaptation, engagement in different networks etc. that ultimately affect the speed of the learning process differently among the firms. The cost function can be defined as  $C_{it}(X_{it}, D_{it}, z_t^C, t)$  for exporting firms and  $C_{it}(D'_{it}, z_t^C, t)$  for non-exporting firms, where  $D'_{it}$  denotes domestic sales when the firm has no export sales and  $z_t^C$  is a vector of variables accounting for different exogenous shocks to input prices. Moreover, as in the revenue function, the time  $t$  is also included in the cost function to account for the learning process in which firms accumulate knowledge about their production process that help them to produce efficiently and to reduce their production costs over time. Again, the learning process is considered to be endogenously driven depending on firms own action in reducing their production costs including better technological implementation, closer cooperation with their supplier, sourcing for cheaper or domestically scarce inputs, improvement of their negotiating power etc.

Given the revenue and cost functions, we can derive the profit functions for firms with or without export;

$$\pi_{it}^{EX} = R_{it}^{EX}(X_{it}, z_t^{EX}, t) + R_{it}^D(D_{it}, z_t^D, t) - C_{it}(X_{it}, D_{it}, z_t^C, t) \quad (1)$$

$$\pi_{it}^D = R_{it}^D(D_{it}, z_t^D, t) - C_{it}(D'_{it}, z_t^C, t) \quad (2)$$

The difference in profit between being active in both the domestic and export market and only being active in the domestic market is then;

$$\pi_{it} = \pi_{it}^{EX} - \pi_{it}^D \quad (3)$$

In addition to Equation (3), when deciding to either stay or leave the export market, the firms need to relate their profits to the combined sunk costs associated with entering and exiting this market. For example, a firm that consider to exit at time  $t$  need to relate the current and future profits from exporting to the sunk cost they already paid when entering and the sunk cost they need to pay when exiting.

Following Roberts and Tybout (1997) notation, firms' decision to participate on the export market is then given by the following equation:

$$\begin{aligned} & \pi_{it} + \delta \{E_{it}[V_{it+1}(\emptyset_{it+1})|Y_{it} = 1] - E_t[V_{it+1}(\emptyset_{it+1})|Y_{it} = 0]\} \\ & \geq F_i^{EN} - [(F_i^{EN} - F_i^{EX})|Y_{it-1} > 0] \end{aligned} \quad (4)$$

where  $\pi_{it}$ , as above, measures the profit firm  $i$  earns in period  $t$  when it serves both the domestic and export market as compared to when it only serves the domestic market.  $\delta$  is discount rate,  $E_{it}[V_{it+1}(\emptyset_{it+1})]$  is expected present value of future profit where expectations are conditioned on the firm-specific information set  $\emptyset_i$ ,  $Y_i$  is a dummy variable equal to one if firm  $i$  is exporting and 0 otherwise and  $(F_i^{EN} + F_i^{EX})$  is the sum of sunk entry and exit cost of exporting.

Following Equation (4), the firm, once it has entered the export market, will continue to export as long as the present and expected future value of the difference in profits when it

exports as compared to when it does not is positive. It is also apparent from Equation (4) that the firm will leave the export market once the losses from staying in the export market exceed the cost of exiting it. The decision to either stay or exit the export market can then be summarized by the following dynamic discrete equation:

$$Y_{it+1} = \begin{cases} 1 & \text{if } \pi_{it} + \delta\{E_{it}[V_{it+1}(\Phi_{it+1})|Y_{it} = 1] - E_t[V_{it+1}(\Phi_{it+1})|Y_{it} = 0]\} > F_i^{EX} \\ 0 & \text{otherwise} \end{cases} \quad (5)$$

Whether it is profitable for a firm to stay or leave the export market depends not only on the domestic and export sales and sunk cost of entering and exiting but also on the vectors of exogenous variables,  $(z_t^{EX}, z_t^D$  and  $z_t^C)$  that account for demand and costs shocks, and on the accumulated demand and production learning processes the firms acquire over time. For example, the exogenous demand or costs shocks, which largely affect the profits, may alter the decision to stay or leave the export market depending if these shocks are more prevalent in the domestic market and whether they are positive or negative. Moreover, the more and faster the firms learn about their export demand and production costs the higher profits they will gain and the more likely they will stay in the export market.

Yet, how exogenous shocks and learning process affect the decision to stay or leave the export market depends much on the size of the firm. On the one hand, small firms are more flexible in terms of, for example, adaptation and strategy changes, and, due to their size, they are able to quickly learn about their demand and production process and also respond more rapidly to different shocks (Beck et al., 2008). On the other hand, however, small firms are more vulnerable to these shocks due to difficulties of obtaining financial funds to either initiate, expand or maintain their export activities. Moreover, small firms usually lack of both production capacity and monetary reserves that are necessary during changes in economic environment, and lack of employees that entirely devote their time to learn about the export activities.

Another aspect that might influence the sunk entry and exit cost, the effect of exogenous shocks and specially the learning process on the decision to continue to export or not is the degree of information and how integrated the firms are in the international market. One important channel for receiving information about the foreign market, as discussed by Fernandez and Tang (2014) and De Lucio et al. (2019), is to learn from other neighbor firms export experience. Also, equally important channel to obtain information about the export market, as discussed by Sjöholm (2003); Muûls and Pisu (2009) and Stirbat et al. (2015), is to be part of a foreign network and/or being engaged in the international market through global sourcing. From these channels, the firms acquire more information about the foreign market and by using this knowledge, they can reduce the sunk cost associated with exporting and learn more about the export demand. Foreign suppliers may also help the firms to get access to important market and customer information that would otherwise be inaccessible (Grant, 1991; Onkelinx and Sleuwaegen, 2010). Firms that source globally may also reduce their production costs and increase their efficiency by utilizing the relatively lower wages in the labor-endowed countries (Agrawal and Farrell, 2003) and/or by getting access to skills that are scarce in the domestic market (Farrell, 2005). Moreover, sourcing from abroad can give the firms flexibility to concentrate on their competitive advantage and potentially develop new capabilities (Doh, 2005) as well as reduce workload volatility, i.e. smooth the workload by assigning peak period

tasks to suppliers and having the work performed in-house during slow periods (Abraham and Taylor, 1996). Enhanced competitiveness and efficiency improvement that global sourcing may offer can most likely contribute to better chances to survive the export market (Farrell, 2005; Bertrand, 2011). In this view, the more knowledge the firms have from their import experience the less uncertainty they face and therefore less likely they will exit the export market (Albornoz et al., 2012; Carrère and Strauss-Kahn, 2017; Nguyen, 2012).

However, another strand of literature suggests that firms with better market information faces lower sunk cost entering and exiting new markets. In this view, the knowledge gained from import experience may reduce the export entry sunk cost in which may induce the firms to experiment with their export entries that ultimately may lead to higher exit probabilities, (Gullstrand and Persson, 2015; Li et al., 2017; Choquette, 2019). Moreover, as shown by Fernandez and Tang (2014), the strength of the signal about foreign market demand reflected by the number and performances of neighboring exporters have also positive effect on firm's probability of export entry. De Lucio et al. (2019) also find that the neighbor firms' learning experience from the export market have larger positive impact on new exporters rather than on entering new destination for an experienced exporter. The higher and precise signal may then induce more low productive firms to enter the export market, which eventually may lead to, on average, higher exit probabilities.

Furthermore, a substantial body of research has indicated that sourcing from abroad could turn to be costlier and riskier than expected (Dibern et al., 2008; Massini et al., 2010). As argued by Larsen et al. (2013), the hidden costs of managing the international sourcing activities include both ex ante transaction costs related to searching for foreign partner, market research, contractual and negotiating costs, and ex post transaction costs related to monitoring and coordination costs, especially if the clients and providers have different time zones (Manning et al., 2015). In addition to these costs, global sourcing firms may be subject to opportunistic behavior by their foreign supplier and lose control of the sourcing activities.

Hence, the scope of international sourcing on firm performance and, ultimately, export survival probabilities, depends on the trade-off between, on the one hand, efficiency improvement, better flexibility and cost reduction and, on the other hand, experimental entries, increasing transaction costs and impending sunk costs. The scope furthermore depends on the location of the sourcing activities as different partner countries provide different opportunities for the firms, including access to low-cost inputs and/or inputs embodied with high level of technology. This means that the distance in terms of technology, procedures, organizational structures etc. between the global sourcing firm and its foreign supplier need to be small in order to experience knowledge spillovers (Naghavi and Ottaviano, 2009). Sourcing from low-wage countries gives the firms access to inputs produced at lower cost as compared to domestic inputs which entails lower production cost and improving profitability. Furthermore, by sourcing labor-intensive inputs from low-wage countries, the firms can focus on their core competencies and skill-intensive activities, which potentially may lead to better and prolonged export opportunities. However, inputs imported from low-wage countries where institutions are weak may impose high transaction cost for the firms which may lead to lower profitability and ultimately to lower, or at its best no effect on export survival. Sourcing from high-wage countries, on the other hand, gives the firms access to high technological inputs that potentially are not available in the domestic market. Firms may import these advance inputs to complement



their core activities, hence the production process is expected to become more efficient, the productivity to increase and the export opportunities to improve (Jabbour, 2010 and Wagner, 2011). However, as discussed by Jabbour (2010), firms that source from high-wage countries will not be able to become specialized due to the complementarity between their own activities and the imported inputs. Hence, the net effect on firm performances will then depend on the relative importance, on the one hand, using technological advanced imported inputs and, on the other hand, the lack of specialization. Moreover, although the transaction and hidden costs are less likely to occur in high-wage countries due to strong institutions, these costs, when they appears, can potentially be very high due to the characteristics of the high-tech inputs that requires relatively more advanced and specific investment.

To summarize; given the discussion above that both firm size and global sourcing activities may influence firm's decision to stay or leave the export market, I will use these two as the main variables in the empirical analysis. The prediction is that the export survival rates most likely defer between small and large firms, as discussed above. Moreover, since engagement in the international market through sourcing activities may provide the firms important market and customer information that would otherwise be inaccessible, but at the same time may impose inefficiencies and impending sunk costs, the theoretical prediction of how global sourcing affect the export survival rate is rather unclear. It is also unclear, theoretically, how different sourcing locations affect the export survival rates. Sourcing from low-wage countries may entail either higher profitability due to access to low-cost inputs or lower profitability due to higher transaction costs, while, sourcing inputs from high-wage countries may entail either higher efficiency due to access to advance inputs or lower profitability due to high input prices. To clear out and to be able to distinguish between all these effects, I turn in the following sections to the empirical estimations.

### **3 Estimation strategy**

In terms of estimation strategy, a discrete time duration model is preferred in the empirical analysis since the data are collected annually. I will use complementary log-log model (cloglog) where the assumption is that the hazard ratio  $\theta(t, X)$ , the rate at which the firms exit the export market in interval  $t$  to  $t+1$ , depends on time at risk,  $\theta_0(t)$  (the so-called baseline hazard), and on explanatory variables affecting the hazard independently of time,  $\exp(\beta'X)$ . The discrete-time hazard function is then given by the following equation:

$$h(j, X) = 1 - \exp[-\exp(\beta'X + \gamma_j)] \quad (6)$$

where  $h(j, X)$  shows the interval hazard for the period between the beginning and the end of the  $j^{\text{th}}$  year after the first appearance in the export market and  $\gamma_j = \log \int_{\alpha_{j-1}}^{\alpha_j} \theta_0(t) dt$  capture, within each interval, period-specific effects on the hazard. The  $\beta$  parameters show the effects of the explanatory variables on the hazard rate. The covariate  $X$  includes variables at the firm and industry level. As discussed above, the two main variables in this analysis are firm size and a

dummy variable that equals to one for global sourcing firms. The final baseline hazard model can be written as:

$$h(j, X) = 1 - \exp \left[ \begin{array}{l} -\exp(\beta_0 + \beta_1 \text{Firm\_Size} + \beta_2 \text{Global\_Sourcing} + \\ + \beta_3 \text{firm\_controls} + \beta_4 \text{industry\_controls} + \gamma_j \end{array} \right] \quad (7)$$

Measuring global sourcing at the firm level is considered to be correlated with estimation errors due to endogeneity problems, i.e. firms that source from abroad are “better” than their counterparts in terms of productivity, size and human capital intensity (Sethupathy, 2013 and Görg et al., 2008). This is, however, not reflected in Equation (7) since the underlying assumption on coefficient  $\beta_2$  is that, conditional on firm and industry controls, international sourcing activity is exogenous. If this is not true, then the stochastic dependence between the global sourcing dummy and the error term may bias the estimates.

To alleviate this problem, I use two approaches where the first is an instrumental variable estimation and the second is a selection of a control group based on propensity score matching technique. For the former approach, I use the predicted probability for a firm to engage in global sourcing as an instrument. This is shown to be a valid strategy by Vella and Verbeek (1999) and was implemented by McGuckin and Nguyen (2001), Bandick and Görg (2010), Hujer et al. (1999) and Conyon et al. (2002).<sup>1</sup> In line with this approach, I generate a firm’s predicted value to source input from abroad from the following probit model:<sup>2</sup>

$$P(\text{Global\_Sourcing}_{it} = 1) = F(X_{it-1}, I_j, T_t) \quad (8)$$

where the dummy variable  $\text{Global\_Sourcing}_{it}$  equals to 1 if firm  $i$  source inputs from abroad in period  $t$  but not in  $t-1$  and 0 if the firm does not source inputs from abroad during these two periods.  $X_{it-1}$  is a vector of relevant firm-specific characteristics in year  $t-1$  which may affect the firms’ probability to engage in global sourcing in year  $t$ .  $I$  and  $T$  control for fixed industry and time effects. In the next section, I will discuss more in detail the set of instruments and also report the results from this probit model.

The aim of the second approach to control for the endogeneity problem is to find, for every global sourcing firm, a similar firm that is not involved in global sourcing. Thus, the matching technique allows me to construct a sample of global sourcing and non-global sourcing firms with similar characteristics such as productivity, size etc. Conditional on these characteristics I can estimate the firms’ probability (or propensity score) to engage in global sourcing by using the same probit model as in Equation (8). Once the propensity scores are calculated, I can select the nearest control firms for which the propensity score falls within a pre-specified radius as a match for every single firm that is engaged in global sourcing. This is done using the “caliper” matching method, i.e. the propensity score of the selected control is within a certain radius (caliper). As discussed by Smith and Todd (2005), it is important to set acceptable distance of the radius since if it is too broad many controls will be selected leading to bad matching while if

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<sup>1</sup> Vella and Verbeek (1999) have shown that this type of instrumental variables (IV) approach generates estimates comparable to Heckman’s (1978) well-known endogeneity bias corrected OLS estimator.

<sup>2</sup> In order to get accurate standard errors for the estimators using generated IV, I compute bootstrapped standard errors.

it is too small few controls will be selected and failure of the common support assumption. I follow the previous literature, i.e. Becker and Ichino (2002) and Heinrich et al. (2010), by setting the radius to 0.001 in the PSMATCH2 routine in Stata version 10 as described by Leuven and Sianesi (2003). In the analysis below I also use Kernel matching estimator as to check the robustness of the results.

Moreover, I check whether the balancing condition is verified, that is whether each independent variable does not differ significantly between global sourcing and non-global sourcing firms. Another condition that must be fulfilled in the matching procedure is the common support condition. This criterion implies that at each point in time, a new firm engaged in global sourcing is matched with non-global sourcing firms with propensity scores only slightly larger or smaller than the former firm.<sup>3</sup> The constructed matched sample is then used to estimate Equation (7), similar to Greenaway and Kneller (2007) and Bandick and Görg (2010).

## **4 Data description**

The dataset used in this paper are from two sources, Firm Statistics Register (FirmStat) and Danish Foreign Trade Register (TradeStat), which both have been assembled annually over the period 1995–2006 by Statistic Denmark.<sup>4</sup> The data cover the entire manufacturing firms with at least 1 employee. The information from FirmStat consist of general firm accounting data such as total wages and employment divided into different educational level, value added, output (measured in terms of sales), capital stock and industry code. Using the information from FirmStat we can calculate the labor productivity, defined as value added per employee, capital intensity, defined as capital stock over output, and skill intensity, defined as the share of employees with a post-secondary education. By using the information on number of employees, I divide the firms into three types of firms, large firms (more than 100 employees), medium-sized firms (between 50 and 100 employees) and small firms (up to 49 employees).<sup>5</sup>

TradeStat includes firm-level information on both export and import disaggregated by destination/origin and products that are measured at the eight-digit Combined Nomenclature (CN8). By using this data, I can define whether a firm is an exporter or not, simple by assigning

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<sup>3</sup> Note that some global sourcing firms may be matched with more than one non-global sourcing firm, while global sourcing firms not matched with a non-global sourcing firm are excluded.

<sup>4</sup> The micro register data from Statistics Denmark is restricted only to researcher within Danish authorized research environments and have permitted research proposal following the rules by the Danish ethical legalization laws. More information about the data availability can be found here: <https://www.dst.dk/en/TilSalg/Forskningservice>.

<sup>5</sup> The upper threshold defining the small firms is equivalent to Diaz-Mora et al. (2015). However, the size of medium- and large firms are lower as compared to Diaz-Mora et al. (2015) since the overall size of Danish manufacturing firms is much smaller as compared to Spanish manufacturing firms. Moreover, the share of firms crossing from one size group to another during the sample period is less than 1%. Still, as a robustness check, I re-define the different size group by changing the number of employees marginally, the main results in Section 5 remain unchanged.

a dummy variable that equals to one for firms that have positive export value.<sup>6</sup> I also assign each firm as an export survivor when the firm is identified as exporter in two subsequent periods. Firms that export one period and not in the following period are defined as export exiters. Since the interest of this paper is to evaluate the implications of global sourcing and firm size on export survival, I define export exit as when the firms withdrawal of all export markets, not only exiting from one specific market.<sup>7</sup> Firms that did not export the entire period and those that exit and reenters as exporter are excluded from the sample.

Moreover, the data from TradeStat indicate, for each trade flow, the value and whether the imported inputs are raw materials, semi-manufactured or intermediary. This classification ensures that import is covering only intermediate inputs, not final goods. The TradeStat, however, do not provide information whether the imported transaction is supplied by affiliated provider (intra-firm sourcing) or by unaffiliated provider (offshore outsourcing).<sup>8</sup> By using the same terminology as Feenstra and Hanson (1999) and Hummels et al. (2014), I define the international sourcing activities as narrow (intra-industry) if the purchased inputs belong to the same industry classification as that of the sourcing firm. The narrow measurement of the global sourcing activities is then calculated as the sum of imports in the same CN2 category as goods sold by the firm either domestically or in exports.<sup>9</sup> Given this information, I create a dummy variable that equals to 1 for global sourcing firms and 0 for firms that do not source inputs from abroad. Furthermore, by using the information on the country-of-origin, the imported inputs are separated to come from high- or low-wage countries. Non-OECD countries are defined as low-wage countries and members of OECD as high-wage countries. From this information, I divide the global sourcing dummy into two dummies; *Sourcing\_high\_wage<sub>it</sub>* that equals to 1 for firms that mainly (more than 50 percent of the total import value) source inputs from high-wage countries and *Sourcing\_low\_wage<sub>it</sub>* that equals to 1 for firms that mainly source inputs from low-wage countries.

Table 1.1 provides summary statistics on the number of firms per year that are engaged in export and/or global sourcing. There are a total of 142,013 observations in the dataset with an average of 11,834 firms over the period 1995–2006. The share of firms with export activity is about 30 percent, half of them are defined as small firms and one third of the exporting firms are also importer.

Table 1.2 provides information on the level of involvement of the global sourcing firms in purchasing foreign inputs and the mean number of sourcing destinations for the different type of

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<sup>6</sup> As robustness check in the regression analysis below, I also re-define exporting firms that have maximum export value of up to 1 percent of their total sales as non-exporter. This however, does not change the main results obtained in Section 5.

<sup>7</sup> Export exit in this paper is defined differently from that of Choquette (2019). Here export exit is withdrawal of all export markets while in Choquette (2019), firms exit decision from a specific export market do not necessary mean export failure but rather a transition from one market the firms have entered as experiment due to low entry sunk cost to another more sustainable market.

<sup>8</sup> Imports of intermediate inputs at the firm level may capture either reallocation of jobs and processes to foreign location or simply that the firm needs some inputs not available in the home country. To some extent, the results from Bandick (2016), that uses the same data as in this paper, indicate for the former since it is shown that employment growth (at least for low-skilled) is negatively affected by import of intermediate inputs.

<sup>9</sup> Narrow measurement based on CN4 category yields similar regression results.

global sourcing firms. As we would expect, there are large heterogeneity between and within the different type of firms in terms of global sourcing engagement. Relatively to their size, small firms seem to have higher mean of purchased inputs form low-wage countries, while medium firms have higher mean number of low-wage sourcing destinations and finally, large firms do seem to have higher sourcing intensity (as relative to the total sales) from low-wage countries.

*Table 1.1:* Number of exporting and global sourcing firms

Year	Total Firms	Exporting firms	Firms that only export			Global sourcing and exporting firms		
			Large Firms	Medium firms	Small firms	Large firms	Medium firms	Small firms
1995	12,735	4,499	361	366	2,430	228	191	923
1996	12,635	4,534	370	363	2,431	232	194	944
1997	12,270	4,176	368	338	2,207	240	187	836
1998	12,313	4,075	375	329	2,118	236	197	820
1999	11,958	3,951	353	302	2,018	238	197	843
2000	12,253	3,983	352	306	2,011	265	196	853
2001	12,006	3,914	344	289	1,946	263	211	861
2002	11,589	3,910	337	292	1,940	253	197	891
2003	11,374	3,897	318	283	1,959	237	197	903
2004	11,166	3,746	310	265	1,899	226	207	839
2005	10,917	3,567	305	255	1,831	218	181	777
2006	10,797	3,530	301	247	1,813	215	215	739

*Table 1.2:* Foreign sourcing intensity and the mean number of high- and low-wage sourcing countries for small, medium and large firms.

	Large firms	Medium firms	Small firms
Mean of purchased foreign inputs	806 (177)	122 (22)	9 (5)
Mean of purchased inputs from high-wage countries	930 (202)	142 (26)	11 (6)
Mean of purchased inputs from low-wage countries	124 (58)	20 (11)	2 (2)
Foreign inputs over total sales, percent	17.4 (0.85)	12.2 (0.16)	3.9 (0.71)
Inputs from high-wage countries over total sales, percent	19.4 (0.85)	13.8 (0.17)	4.8 (0.71)
Inputs from low-wage countries over total sales, percent	6.4 (0.06)	4.0 (0.06)	0.8 (0.10)
Mean number of sourcing countries	17.7 (6.4)	13.2 (7.4)	6.4 (5.4)
Mean number of high-wage sourcing destinations	20.1 (10.3)	14.7 (8.8)	7.6 (8.1)
Mean number of low-wage sourcing destinations	4.5 (3.3)	5.5 (6.5)	1.2 (2.5)

*Notes:* Stand dev. in parentheses.

To provide preliminary indications how firm size and global sourcing affect the export survival probabilities, we can use the unconditional Kaplan-Meier estimates given by the following equation:<sup>10</sup>

$$S(t) = \prod_{j|t_j < t} \frac{n_j - d_j}{n_j} \quad (9)$$

where  $S(t)$  denotes the probability of surviving in the export market past time  $t$ ,  $n_j$  stands for the number of firms that have survived in the export market and  $d_j$  for the number of firms that exited the export market at time  $t$ .

As Table 2 shows, there are some differences in export survival probabilities among the different types of firms. For instance, after five years, large and medium size importers had around 10 and 20 percent higher export surviving ratio than non-importers, respectively. At the end of the period, almost 62 and 59 percent of the large and medium size importers survived the export market whereas in comparison only 55 and 46 percent of the large and medium size non-importers survived the export market. As for the small firms, however, global sourcing do not seem to have had any role in determining the export surviving probabilities.

There is, however, a major drawback comparing the Kaplan-Meier survival functions since such an analysis does not take into account other factors that may affect the export survival ratio. One such variable is for example productivity where it is, by now, well documented that productive firms are more inclined to export. In Table 3, we observe that productivity and other variables that may affect the export survival probability are unequally distributed across the different types of firms.

A Standard t-test shows that all of global sourcing firms, independently on firm size and sourcing destination, are older, have higher skill intensity and sales than non-importers. Moreover, as compared to their non-importer counterparts, firms that import from high-wage countries seem to have higher productivity and capital stock, whereas large and medium firms that import from low-wage countries have lower productivity and capital stock. Finally, small firms sourcing from low-wage countries have higher productivity and capital stock as compared to small non-importing firms.

Since there are some differences between global and non-global sourcing firms and, also between different size of the firms, the results outlined in the next section will be based on estimating Equation (7), that is the semi-parametric complementary log-log model (cloglog) where various firm-, and industry-specific factors are controlled for. Moreover, in order to deal with the potential endogeneity problem, I will use instrumental variable estimation and propensity score matching technique, as discussed above.

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<sup>10</sup> The analysis time represents the number of years the firm remained in the export market.

Table 2: Kaplan-Meier estimates of the survivor function for exporting and global sourcing firm

Time	Firms that only export			Global sourcing and exporting firms		
	Large Firms	Medium firms	Small Firms	Large firms	Medium firms	Small Firms
>=5	76.2 (0.018)	69.3 (0.020)	64.6 (0.005)	87.3 (0.019)	79.5 (0.024)	64.3 (0.005)
>=12	55.0 (0.021)	45.9 (0.021)	34.0 (0.005)	61.8 (0.027)	58.9 (0.029)	34.0 (0.005)

Table 3: Firm characteristics of exporting and global sourcing firms, 1995–2006

Firm variables	Firms that only export			Global sourcing and exporting firms			Sourcing form high-wage and exporting firms			Sourcing form low-wage and exporting firms		
	Large firms	Medium firms	Small firms	Large firms	Medium firms	Small firms	Large firms	Medium firms	Small firms	Large firms	Medium firms	Small firms
Age	9.7	9.3	7.4	10.2	10.0	8.7	10.3	10.0	8.5	10.1	9.8	8.7
Skill share	17.3	14.5	14.4	19.2	16.9	16.0	20.2	17.2	16.7	18.2	16.1	15.4
Labor productivity	834	285	110	829	293	139	912	308	140	803	281	132
Capital stock	297	25	5	285	25	10	314	27	11	264	24	8
Sales	538	80	17	603	90	25	605	100	26	555	81	19

Notes: Skill share, defined as the share of employees with post-secondary education, are in percent. Capital stock and sales are in millions DKK.

## 5 Result

Before turning to the main results in this paper, I need first to discuss and outline the relevant firm-specific characteristics in year  $t-1$  that may affect firms' probability to source intra-industry intermediate inputs from abroad in year  $t$ , i.e. the variables to be included in the covariate  $X_{it-1}$  of Equation (8).

As discussed above and in line with Abraham and Taylor (1996) and Bandick (2016), the reasons for a firm to contract out activities are often influenced by three general motives; to save labor costs, to reduce workload volatility and to gain from economies of scale. For this reason, the probit model will include the following firm-level variables; log average skilled and unskilled wage costs to account for labor costs, growth (in terms of sales) as compared to the industry to account for workload volatility, and as a proxy for economies of scale, I will use log firm size (employment level), log level of sales, log capital stock and skill intensity. The result from the probit model is shown in Table 4.

Table 4: Firms probability to engage in global sourcing

Variables	Global sourcing		Sourcing	Sourcing
	Model (1)	Model (2)	high-wage	low-wage
Firm size	-0.918 (10.70) <sup>a</sup>	-0.920 (10.71) <sup>a</sup>	-0.486 (6.17) <sup>a</sup>	0.326 (4.58) <sup>a</sup>
Firm size <sup>2</sup>	0.112 (8.28) <sup>a</sup>	0.114 (8.38) <sup>a</sup>	0.064 (5.27) <sup>a</sup>	-0.067 (6.53) <sup>a</sup>
Sales	0.987 (36.71) <sup>a</sup>	0.952 (31.64) <sup>a</sup>	0.779 (28.06) <sup>a</sup>	0.095 (3.72) <sup>a</sup>
Skill intensity	0.895 (9.69) <sup>a</sup>	0.916 (9.88) <sup>a</sup>	0.910 (10.37) <sup>a</sup>	-0.199 (2.47) <sup>b</sup>
Capital stock	-0.009 (0.75)	-0.015 (1.17)	-0.003 (0.22)	0.033 (3.21) <sup>a</sup>
Growth relative to industry	0.201 (15.13) <sup>a</sup>	0.202 (15.17) <sup>a</sup>	0.160 (13.22) <sup>a</sup>	0.070 (7.03) <sup>a</sup>
Average skilled wage	0.121 (5.37) <sup>a</sup>	0.118 (5.22) <sup>a</sup>	0.154 (7.17) <sup>a</sup>	-0.051 (2.59) <sup>b</sup>
Average unskilled wage	-0.032 (1.73)	-0.041 (2.17) <sup>b</sup>	-0.017 (0.94)	0.090 (5.65) <sup>a</sup>
TFP		0.056 (2.62) <sup>a</sup>	0.062 (2.88) <sup>a</sup>	0.031 (1.32)
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Pseudo R <sup>2</sup>	0.332	0.332	0.282	0.047
LR chi2	10,852	10,860	9,847	1,592
Observations	30,919	30,919	30,919	30,919

Notes: The dependent variable in the first two columns is  $Global\_sourcing_{it}$  that equals to one if firm  $i$  is engaged in global sourcing (according to the narrow definition). In Column (iii) the dependent variable is  $Sourcing\_high\_wage_{it}$  that equals to one for firms that mainly (more than 50 percent of the total import value) source inputs from high-wage countries and in Column (iv) the dependent variable is  $Sourcing\_low\_wage_{it}$  that equals to one for firms that mainly source inputs from low-wage countries. Z-statistics are within parentheses. All the explanatory variables are lagged one year. TFP is estimated by using Levinsohn and Petrin (2003) methodology and skill intensity is the share of employees with post-secondary education at the firm level.

The result in Column (1) are in line with the predictions outlined by Abraham and Taylor (1996), labor cost, growth relative to the industry as proxy for workload volatility, log level of sales and skill intensity as proxy for economies of scale, are all positively related to firms decision to source from abroad. Firm size seems to have a U-shaped form, where small firms are less likely to engage in global sourcing, while the larger the firms are the more likely they source from abroad. In Column (2), I estimate an alternative model of Equation (8) including firms total factor productivity (TFP) estimated by using Levinsohn and Petrin (2003) method. The result seems to indicate that ex-ante productivity is also a significant determinant for the global sourcing decision. In the last two columns of Table 4, I estimate Equation (8) by having the two global sourcing dummies,  $Sourcing\_high\_wage_{it}$  and  $Sourcing\_low\_wage_{it}$ , as dependent variable, respectively. As in previous columns, the larger the firms are in terms of employment and sales, and the higher skill intensity and productivity the more likely they source from high-wage countries. However, the result in Column (4) indicate that the larger the firms are in terms of employment and the higher skill intensity the less likely they source from low-wage countries.

Hence, we draw the conclusion that global sourcing firms, at some extent, have ex-ante different characteristics than non-global sourcing firms. Therefore, it is highly important to control for these differences in the empirical analysis, otherwise the estimate of the causal effect of global sourcing could potentially be biased as is discussed above.



One way to deal with this problem is, as discussed above, to construct an instrumental variable by using the two different models of Table 4, shown in Column (1) and (2), to calculate the predicted probability for a firm to source inputs from abroad. The two alternative IV:s are then separately included in Equation (7) to, along with other firm-specific characteristics, determine the role of global sourcing on firms export survival probabilities. By using alternative models of Equation (8), I will be able to check whether the results of the hazard models below depend on the process by which the instrument was generated. As an alternative approach, we can create a valid counterfactual of firms that do not source inputs from abroad but have similar characteristics as those firms that do source inputs from abroad. This can be created by using the same set of variables as presented in Table 4, Model (1) and (2) to estimate the propensity scores and select the nearest control firms as a match for these global sourcing firms. After establishing that the propensity score matching procedure is reliable and robust by using a number of balancing tests (more details of these tests are found in Appendix) the matched sample can then be used to estimate the hazard model given by Equation (7).

However, in order to establish a benchmark how the surviving probability in the export market is affected by firm size and global sourcing, I first estimate Equation (7) without controlling for the possible endogeneity of firms decision to source from abroad. This result is presented in Table 5. All estimations are stratified by industry and year and the table report the hazard ratios (exponentiated coefficients). This means that a coefficient less than one implies that the respective independent variable increases the probability of survival while a coefficient greater than one implies negative effect on survival, *ceteris paribus*. Furthermore, the estimations in the first four columns of Table 5 are based on the entire sample where the omitted group are small firms and in Column (3) and (4) the omitted group also include non-global sourcing firms.

The result in Column (1) seems to indicate that larger and medium size firms have better export surviving probabilities than smaller firms. One explanation could be that the former type of firms, as shown in Table 3, are more productive and have higher capital stock and sales that can help them to overcome various obstacles in the export market. However, controlling for several firm and industry specific characteristics that potentially influence export survival rate positively, the result in Column (2) still suggests that larger and medium size firms have 31 and 44 percent higher export surviving probabilities as compared to smaller firms.

Beside firm specific characteristics, differences in export survival rates can also be explained by how integrated the firms are in the international market through global sourcing, as outlined in Section 2. In Column (3), I therefor include the dummy variable  $Global\_Sourcing_{it}$  that equals to 1 if firm  $i$  source inputs from abroad. In line with the prediction given by Stirbat et al. (2015) and the findings in Diaz-Mora et al. (2015), firms that source inputs from abroad have higher probability of surviving the export market as compared to those firms that do not source inputs from abroad. In Column (4), I divide the global sourcing dummy into two dummies;  $Sourcing\_high\_wage_{it}$  that equals to 1 for firms that mainly (more than 50 percent of the total import value) source inputs from high-wage countries and  $Sourcing\_low\_wage_{it}$  that equals to 1 for firms that mainly source inputs from low-wage countries. The result in Column (4) suggests that among the global sourcing firms only those that source from high-wage countries that experience better export survival probabilities. Those that source from low-wage countries,

on the other hand, do not seem to have different survival rate than firms that do not source inputs from abroad.

In Column (5) to (7), I separately analyze how global sourcing from different regions affect the export survival probabilities for the three different type of firms. The results in Column (5) and (6) indicate that, for small and medium size firms, sourcing form high-wage countries increases the export survival probabilities by about 30 percent as compared to firms that do not source inputs from abroad. Sourcing form low-wage countries, however, seem to have no significant effect on the export survival. Lastly, the result in Column (7), seems to indicate that global sourcing, no matter if it is from high- or low-wage countries, do not significantly affect the export surviving probabilities for larger firms.

*Table 5: Global sourcing, size and export survival. Complementary log-log model; global sourcing as exogenous*

Variables	All firms				Small firms	Medium Firms	Large firms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Firm size</b>							
_large	0.435 (4.15) <sup>a</sup>	0.687 (2.39) <sup>b</sup>	0.684 (2.40) <sup>b</sup>	0.684 (2.39) <sup>b</sup>			
_medium	0.496 (4.85) <sup>a</sup>	0.556 (2.27) <sup>b</sup>	0.533 (2.40) <sup>b</sup>	0.522 (2.46) <sup>b</sup>			
<b>Global sourcing</b>			0.733 (4.49) <sup>a</sup>				
_high-wage				0.645 (5.81) <sup>a</sup>	0.625 (6.02) <sup>a</sup>	0.718 (2.49) <sup>b</sup>	0.917 (0.98)
_low-wage				0.965 (0.40)	0.940 (0.71)	1.400 (0.53)	1.235 (0.15)
<b>Industry control</b>							
Empl.Growth		1.435 (0.54)	1.391 (0.47)	1.397 (0.47)	1.203 (0.33)	1.002 (1.58)	1.095 (0.32)
Other firms ceasing export		2.075 (3.63) <sup>a</sup>	2.090 (3.66) <sup>a</sup>	2.112 (3.72) <sup>a</sup>	1.975 (3.30) <sup>a</sup>	1.866 (6.67.) <sup>a</sup>	1.292 (2.22) <sup>b</sup>
<b>Firm controls</b>							
TFP		0.949 (2.22) <sup>b</sup>	0.951 (2.01) <sup>b</sup>	0.953 (1.92) <sup>c</sup>	0.956 (1.76) <sup>c</sup>	0.602 (3.80) <sup>a</sup>	0.830 (3.16) <sup>a</sup>
Capital intensity		1.116 (3.56) <sup>a</sup>	1.129 (3.89) <sup>a</sup>	1.135 (4.05) <sup>a</sup>	0.914 (2.04) <sup>b</sup>	0.944 (2.20) <sup>b</sup>	0.978 (1.14)
Skill empl.		0.806 (1.54)	0.829(1.34)	0.838(1.26)	0.913 (0.64)	0.892 (2.78) <sup>a</sup>	0.942 (1.00)
Number of export_market		0.710 (12.40) <sup>a</sup>	0.755 (8.93) <sup>a</sup>	0.776 (7.57) <sup>a</sup>	0.812 (6.11) <sup>a</sup>	0.532 (4.80) <sup>a</sup>	0.821 (2.14) <sup>b</sup>
Observations	22,502	22,502	22,502	22,502	11,094	7,342	4,066
Wald Chi Square	237 <sup>a</sup>	462 <sup>a</sup>	497 <sup>a</sup>	529 <sup>a</sup>	376 <sup>a</sup>	288 <sup>a</sup>	141 <sup>a</sup>

*Notes:* Estimations are stratified by industry and year. Industries are defined at the two-digit level (21 industries). Z-statistics in parentheses. **a, b, c** indicate significance at the 1, 5, and 10 percent levels, respectively.

Other interesting results from Table 5 is that firms with higher productivity and export destinations are more likely to survive in the export market while capital intensity seems only to have positive effect on the export survival for small and medium size firms. Moreover, the level of skill intensity is only important for medium firm's export survival. Finally, the export surviving probabilities for a firm is not affected by the level of growth in the industry, however it is negatively affected with growing number of other firms within the same industry ceasing the export market. In line with the spillover literature (i.e. Fernandez and Tang, 2014; De Lucio et al., 2019), it seems that the export performance of a firm is heavily affected by the performances of the neighboring exporters.

A more parameter efficient estimation as compared to estimating three different models as in the last columns of Table 5 is to have eight different interaction terms between size (small, medium, large) and global sourcing (none, high-wage, low-wage) in one estimation. More specifically, the model will then include these interaction terms; small firms sourcing from low-wage countries, small firms sourcing from high-wage countries, medium firms no-sourcing, medium firms sourcing from low-wage countries, medium firms sourcing from high-wage countries, large firms no-sourcing, large firms sourcing from low-wage countries and finally, large firms sourcing from high-wage countries. The omitted group of firms are no-sourcing small firms. The advantage in estimating only one equation is that we can easier interpret whether there are differences in export survival between the different type of firms given their size and global sourcing engagement. However, the disadvantage is that the firms are very different from each other in many dimensions (as shown in Table 3) that it would be inaccurate to draw correct conclusions about possible differences in the effect of global sourcing destination and export survival, even if we include many control variables to minimize the differences between them. Another disadvantage in estimating only one equation with all the interaction terms is that we would not be able to fully control for the endogeneity bias discussed above.

Still, if global sourcing is treated as exogenous, as in Table 5, we can estimate Equation (7) by different interaction terms as suggested above, and, with some caution, draw conclusion if there are differences between the firms in terms of the effect of global sourcing on export survival. The result, shown in Table A2; Column (1), is quite similar to those presented in Table 5. Also, in Column (2) of Table A.2, I check the robustness of the result by changing the threshold that defines the dummy variable of different global sourcing destination. The threshold is changed from 50 to 40 percent of the firms' total import value that comes from high-wage countries. The result seems to be robust to this small change.

The results in Table 5 and Table A.2 are, however, based on the assumption that firm's global sourcing decision is exogenously determined. As discussed by Görg et al. (2008) and shown in Table 3 and 4, this is unlikely to be the case since there are strong reasons to believe that only "better" firms, in terms of productivity, skill intensity etc., are engaged in global sourcing. Although this is, to some extent, accounted for by the inclusion of the large number of relevant firm characteristics, I explicitly correct for the possible endogeneity by using the probability for a firm to source inputs from abroad (as in Table 4) as an instrument and the matched sample (generated by propensity score-matching approach) when estimating the hazard model. The instruments for the two global sourcing dummies are the predicted values obtained

by estimating Equation (8) with *Sourcing\_high\_wage<sub>it</sub>* or *Sourcing\_low\_wage<sub>it</sub>* as dependent variable, respectively.

The result based on the first IV model (similar to Model 1 in Table 4) is reported in upper part of Table 6; Columns (1) to (3), while the lower part of the same table present the result based on the second IV model (similar to Model 2 in Table 4). Since, to my knowledge, there is no formal method of testing the exogeneity assumption in the context of a hazard model, we may use a standard Hausman test to get a rough indicator whether this assumption holds. These tests, reported at the bottom of Table 6, reject the assumption of exogeneity of the global sourcing dummy.

The results in Table 6, Columns (1–3) are similar to those found in Table 5. Again the results point out that smaller and medium size firms that source from high-wage countries face higher export survival ratio as compared to those that do not source from abroad while similar

Table 6: Global sourcing, size and export survival. Complementary log-log model; IV and Matching approach

Variables	Model (1)					
	IV			Matched sample		
	Small firms (1)	Medium firms (2)	Large firms (3)	Small Firms (4)	Medium Firms (5)	Large firms (6)
Global sourcing						
_high-wage	0.758 (2.08) <sup>b</sup>	0.749 (4.46) <sup>a</sup>	0.804 (1.56)	0.756 (5.15) <sup>a</sup>	0.894 (3.46) <sup>a</sup>	0.804 (1.16)
_low-wage	0.936 (0.20)	1.049 (0.28)	0.900 (0.65)	1.030 (0.20)	1.011(0.72)	1.080 (0.55)
Observations	12,573	8,321	4,608	9,061	5,483	2,085
Wald Chi Square	478 <sup>a</sup>	420 <sup>a</sup>	216 <sup>a</sup>	367 <sup>a</sup>	120 <sup>a</sup>	97 <sup>a</sup>
Hausman test (p-value)	0.019	0.014	0.021			
Linktest (hatsq)	0.008 (1.31)	0.005 (1.18)	0.027 (1.16)			
Model (2)						
Global sourcing						
_high-wage	0.849 (1.70) <sup>c</sup>	0.756 (2.61) <sup>a</sup>	0.930 (0.47)	0.755 (3.73) <sup>a</sup>	0.817 (2.31) <sup>a</sup>	0.881 (1.02)
_low-wage	0.911 (1.12)	0.927 (1.14)	1.380 (0.94)	1.118 (0.64)	0.851 (0.44)	1.287 (1.16)
Observations	12,573	8,321	4,608	9,061	5,483	2,085
Wald Chi Square	425 <sup>a</sup>	275	134 <sup>a</sup>	268 <sup>a</sup>	139 <sup>a</sup>	74 <sup>a</sup>
Hausman test (p-value)	0.023	0.014	0.021			
Linktest (hatsq)	0.006 (1.28)	0.004 (1.15)	0.023 (1.11)			

Notes: Similar as in Table 5, all industry and firm controls are included in all columns. Estimations are stratified by industry and year. Industries are defined at the two-digit level (21 industries). Z-statistics in parentheses. **a, b, c** indicate significance at the 1, 5, and 10 percent levels, respectively.

type of firms sourcing from low-wage countries do not have these positive effect on the export survival (as compared to firms that do not source from abroad). For larger firms, however, global sourcing no matter whether it is from high- or low-wage countries seems, as obtained in Table 5, to not affect the export survival probabilities.

While the relevance is to some extent shown in the IV-generating probit in Table 4, there is, to the best of my knowledge, no test of instrument validity in the context of this non-linear hazard estimation. Hence, the results above are reliable under the assumption of instrument validity, which cannot be tested. I therefore use an approach which does not depend on such an assumption. Similar to Greenaway and Kneller (2007) and Bandick and Görg (2010), I estimate Equation (7) on a matched sample generated by propensity score-matching procedure including firms that are similar to each other in many aspects but differ in terms of sourcing inputs from abroad or not.<sup>11</sup>

These results are presented in Table 6; Column (4–6). Again, the results in the upper part are based on a matched sample generated by using the propensity score model similar to Model 1 of Table 4 and the lower part by using Model 2 of Table 4. As in the previous columns the point estimate suggests that export surviving probabilities are higher in smaller and medium size firms that source from high-wage countries. For larger firms and firms sourcing from low-wage countries, however, export survival probabilities are not affected by global sourcing activities.

To check whether the econometric results are robust, I re-estimate Table 6 by excluding the lowest 10 percent of the global firms according to their share of foreign inputs over total sales. The results, shown in Table A.3 in the Appendix, seem to remain unchanged.

## **6 Conclusions and remarks**

The general conclusion from the heterogeneous firm trade literature is that, given the high start-up costs, only sufficiently productive firms are able to enter the export market and, once these firms become exporters, their performances will improve ex-post. Implicitly, we should then expect export hysteresis, that is, once the firm start to export it will remain as an exporter. However, the empirical literature on trade duration often finds that not all firms survive the export market and many of these are very short-lived as exporter.

To answer the question why some exporting firms do not seem to be long lasting while other survive much longer, I examine in this paper the role of global sourcing and firm size on export surviving probabilities. More precisely, I investigate whether firms' intra-industry imports of intermediate inputs from different regions (high- or low-wage countries) affect the export survival rates of small, medium and large firms. I use data on export and import transactions that are disaggregated by destination/origin for the entire Danish manufacturing firms with at least one employee between the periods 1995–2006. Moreover, since the interest of this paper is to evaluate the implications of global sourcing and firm size on export survival, I define export

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<sup>11</sup> In order to find out whether the propensity score matching procedure is reliable and robust, I perform a number of balancing tests suggested in the recent literature (e.g., Smith and Todd, 2005). More details of these tests are found in Appendix.

exit as when the firms withdrawal of all export markets, not only exiting from one specific market.

Controlling for several firm and industry specific characteristics that may affect the export survival rate, the result suggest that larger and medium size firms have 31 and 44 percent higher export surviving probabilities than smaller firms. The result seems also to indicate that for small and medium size firms, global sourcing increases the probability of staying in the export market, but only if the import is from high-wage countries. However, sourcing inputs from abroad, no matter if it is from high- or low-wage countries, do not seem to significantly affect the export surviving probabilities for larger firms. These results are robust controlling for the endogeneity of the sourcing decision by using IV and matching approach.

The findings of this paper have important implications for academic researchers, managers and policymakers. In order to evaluate the role of global sourcing on export survival accurately it is important for the academic researchers to consider the following issues. Firstly, since there is reason to believe that firms sourcing from abroad are inherently better in many aspects it is highly important to control for this self-selection to not falsely attribute the higher export survival rates entirely to global sourcing. Secondly, since the scope of global sourcing may differ where this activity is located it is important to separate between different sourcing locations as these may affect export survival differently. Thirdly, to avoid the problem that export exit may involve transition from one market to another, it is better to define the export exit decision as when the firms withdrawal totally from the export market.

As for the managers, global sourcing seems to play an essential role for export survival, at least for small and medium size firms. However, although it may be tempting to source inputs from low-wage countries to lowering the production costs, it should be recognized that such purchases might involve hidden costs that possibly overshadow the potential positive influence on export performances. The result in this paper clearly point at this direction. Firms that source inputs from high-wage countries, on the other hand, seem to have better export survival rate as compared to, in many other dimension, similar firms that do not source from abroad.

Finally, as for the policymakers, the result suggests that, comparing to other firms, small firms do potentially face difficulties in the export market. To avoid short export episode, small firms seems to need accurate policies that help them to engage in global sourcing, especially from high-wage countries.

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## Appendix A

### Balancing tests for the matching procedure

I perform a number of balancing tests suggested in the literature (e.g., Smith and Todd, 2005) to check the reliability and robustness of the propensity score matching procedure. The first test is to examine the standardized difference (or bias), that is, mean difference between global sourcing and control firm scaled by the average variance, for all the variables in the vector  $X$  in equation (8). This test is reported in *Table A.1 and A.2* for the two set of propensity score models. We should note that the lower the standardized bias the more balanced or similar the global sourcing and control firms are in terms of the variables included in the vector  $X$  of equation (8). Although there is no formal criterion, but a value of 20 of the standardized bias is considered to be serious. As seen in *Table A.1 and A.2* the standardized bias between the firms included in the matching sample is heavily reduced as compared to the unmatched sample and are all less than 10 %. As a second test I report, in the last column of *A.1 and A.2*, a formal paired t-test for the differences in the variables between global sourcing and control firms. While these differences seem all to be significant in the unmatched sample (not growth relative to industry), they are all insignificant in the matching sample which means that the matching procedure has created a sample of firms with no significant difference in terms of the variables under consideration.

*Table A.1a:* Balancing test for the matching sample, Model (1)

Variable	Sample	Mean		Standardized bias	Bias reduction	<i>t</i> -test	
		Treated	Control			<i>t</i>	$p >  t $
Sales	Unmatched	13.437	12.972	18.1		10.66	0.000
	Matched	13.437	12.959	9.2	49.2	1.34	0.113
Skill intensity	Unmatched	0.178	0.151	20.3		13.70	0.000
	Matched	0.178	0.170	6.2	69.6	1.54	0.124
Capital stock	Unmatched	16.758	16.461	20.0		13.30	0.000
	Matched	16.758	16.638	8.1	59.7	1.14	0.255
Growth relative to industry	Unmatched	-1.865	-1.631	-2.0		-1.42	0.155
	Matched	-1.865	-1.947	0.7	65.1	0.41	0.681
Average skilled wage	Unmatched	189.35	186.27	6.5		4.34	0.000
	Matched	189.35	188.38	2.0	68.5	1.24	0.217
Average unskilled wage	Unmatched	132.89	129.9	8.1		5.39	0.000
	Matched	132.89	131.26	4.4	45.4	1.61	0.108

*Table A.1b: Balancing test for the matching sample, Model (2)*

Variable	Sample	Mean		Standardized bias	Bias reduction	<i>t</i> -test	
		Treated	Control			<i>t</i>	$p >  t $
Sales	Unmatched	13.437	12.972	18.1		10.66	0.000
	Matched	13.437	12.959	9.2	49.2	1.34	0.113
Skill intensity	Unmatched	0.178	0.151	20.3		13.70	0.000
	Matched	0.178	0.170	5.9	70.8	1.53	0.126
Capital stock	Unmatched	16.758	16.461	20.0		13.30	0.000
	Matched	16.758	16.629	8.7	56.7	1.18	0.238
Growth relative to industry	Unmatched	-1.865	-1.631	-2.0		-1.42	0.155
	Matched	-1.865	-1.981	1.0	50.8	0.57	0.566
Average skilled wage	Unmatched	189.35	186.27	6.5		4.34	0.000
	Matched	189.35	188.36	2.1	67.8	1.27	0.204
Average unskilled wage	Unmatched	132.89	129.9	8.1		5.39	0.000
	Matched	132.89	131.25	4.5	45.0	1.64	0.108
Labor productivity	Unmatched	13.000	12.972	17.6		11.84	0.000
	Matched	13.000	12.959	9.8	44.6	1.58	0.113

*Table A.2: Global sourcing, size and export survival. Complementary log-log model; Global sourcing as exogenous, additional results.*

Variables	(1)	(2)
<b>Firm size</b>		
_large	0.826 (0.47)	1.023 (0.42)
_medium	1.160 (0.29)	1.123 (0.23)
<b>Global sourcing</b>		
_high-wage	1.891 (8.71) <sup>a</sup>	1.857 (8.40) <sup>a</sup>
_low-wage	1.166 (1.15)	1.144 (1.59)
<b>Interaction global sourcing and Firm size</b>		
Small Firm $\times$ high-wage	0.711 (23.10) <sup>a</sup>	0.716 (23.05) <sup>a</sup>
Small Firm $\times$ low-wage	0.806 (4.49) <sup>a</sup>	0.32 (4.91) <sup>a</sup>
Medium Firm $\times$ No_sourcing	0.630 (5.27) <sup>a</sup>	0.629 (5.22) <sup>a</sup>
Medium Firm $\times$ high-wage	0.423 (6.34)	0.427 (6.23)
Medium Firm $\times$ low-wage	0.647 (1.94) <sup>c</sup>	0.502 (1.74) <sup>c</sup>
Large Firm $\times$ No_sourcing	0.834 (1.16)	0.852 (1.15)
Large Firm $\times$ high-wage	0.651 (5.28) <sup>a</sup>	0.662 (5.44) <sup>a</sup>
Large Firm $\times$ low-wage	1.068 (0.51)	0.967 (0.18)
<b>Industry control</b>		
Empl.Growth	0.831 (0.22)	0.821 (0.23)
Other firms ceasing export	1.838 (3.02) <sup>a</sup>	1.836 (3.01) <sup>a</sup>
<b>Firm controls</b>		
TFP	0.972 (1.00)	0.973 (0.97)
Capital intensity	1.129 (3.94) <sup>a</sup>	1.129 (3.90) <sup>a</sup>
Skill empl.	0.802 (1.54)	0.804 (1.53)
Number of export_market	1.152 (4.10) <sup>a</sup>	1.147 (3.99) <sup>a</sup>
Observations	22,502	22,502
Wald Chi Square	992 <sup>a</sup>	997 <sup>a</sup>

*Table A.3: Global sourcing, size and export survival. Complementary log-log model; IV and Matching approach, Model (1), excluding global sourcing firms with less than 10 percent of their foreign inputs over total sales.*

Variables	IV			Matched sample		
	Small firms (1)	Medium Firms (2)	Large firms (3)	Small firms (4)	Medium Firms (5)	Large firms (6)
Global sourcing						
_high-wage	0.733 (2.10) <sup>b</sup>	0.698 (4.51) <sup>a</sup>	0.782 (1.64)	0.713 (5.32) <sup>a</sup>	0.826 (3.46) <sup>a</sup>	0.781 (1.52)
_low-wage	0.914 (0.22)	0.981 (0.64)	0.872 (1.32)	0.974 (0.89)	0.975(1.02)	0.982 (0.96)
Observations	11,316	7,489	4,147	8,155	4,935	1,877
Wald Chi Square	633 <sup>a</sup>	513 <sup>a</sup>	354 <sup>a</sup>	471 <sup>a</sup>	239 <sup>a</sup>	169 <sup>a</sup>
Hausman test (p-value)	0.018	0.011	0.019			
Linktest (hatsq)	0.009 (1.32)	0.005 (1.19)	0.028 (1.17)			