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Abstract

Exporters are supposed to be the most productive firms and therefor are expected to be able to afford the fixed cost to export. However, between 2008 and 2014, almost 10% of French exporters were in bankruptcy. This paper investigates this paradox by assessing the difference in characteristics among exporters between incumbents and exiting firms. We use French manufacturing firm-level data between 2000 and 2014. To identify exports' sunk costs, we use a conditional difference-in-differences design, and we estimate total factor productivity via the method developed by Levinsohn and Petrin (2003). Then, we estimate the probability of default for exporting firms via a probit model using panel data with the methodology developed by Mundlak (1978) to control for unobserved heterogeneity. Our results indicate that firms' default seems to be substantially explained by their performance and their sunk costs rather than the way they export, such as the number of products shipped or the number of destinations, as well as by their export status.

JEL codes: D20, F14 Keywords: International trade, Bankruptcy, Firm performance, Sunk costs

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1 Introduction

In his seminal paper, Melitz (2003) establishes a positive correlation between performance and exportation. Only the top-performing firms can support the additional sunk costs related to this export activity. Empirically, data support this kind of firm selection. Bernard and Jensen (1999) confirm that high-performing firms become exporters and that exporters grow more quickly than non-exporters. Consequently, exporting firms should not encounter economic and financial difficulties and should not be subject to bankruptcy. However, from a sample of 35,276 French exporting firms followed over the 2008-2016 period, we observe that more than 9% of them have dealt with an insolvency procedure. This fact is paradoxical with the relationship between export status and the heterogeneity in firm performance highlighted in the literature.

A company, when producing, can face some financial difficulties. These challenges emerge when the firm has trouble finding a way to reimburse its creditors, e.g., banks or suppliers. Additionally, if a firm's current assets are no longer sufficient to pay its current liabilities, we say that the firm is in insolvency.[1,2] When this situation occurs for 45 consecutive days, a collective procedure is triggered (see Appendix A). This date is know as the date of default. This procedure is classified as a reorganization procedure if the court believes that the firm only needs better management of its assets to face its liabilities; otherwise, it is a liquidation procedure. These procedures are called collective or insolvency procedures (for more detailed information, see Section 3.1).

The literature has not studied the relationship between failing companies and exports as thoroughly as other strands of research. Very few studies mainly analyze this issue, focusing on the entry and exit of export markets and their impact on firm survival. Girma et al. (2003) examine the consequences of export market exit on firm performance. They find a negative effect of export market exit on all outcomes, and this negative effect is persistent over time. Wagner (2013) highlights a strong relationship for German firms between imports and two-way trade and firm survival. He draws conclusions about the existence of a trader survival premium: the risk of exit is lower for importers and for firms that both import and export. In addition, Vicard (2014) focuses on the relationship between the export decision and the probability of firm survival. He finds that exporting does not prevent firms from default but increases the probability of going into bankruptcy for former exporters. Another crucial point is that the competitiveness of exporters must be considered in comparison with the foreign local firms and exporting firms of other countries. While we cannot control directly for the competition existing in each market, controlling for the "difficulty" of the foreign market, as Rauch and Trindade (2002) and Chaney (2014) do, allows us to infer its impact.

The presence of sunk costs can explain the persistence of exporters' status. Consequently, firms may remain active in the export markets as long as the value of continuing to export exceeds the exit costs. In addition, Bernard and Jensen (1999) highlight that in switching to domestic activity only, exporters exhibit bad performances afterward. In leaving export markets, firms face difficulties, which can cause a risk of future loss opportunity and generate a lack of action among firms to decide to withdraw from these markets, in which they are not efficient enough. Moreover, we cannot

[1] Current assets is a group of assets the firm can easily and rapidly transform into cash, such as receivables from customers or discountable bills.
[2] Current liabilities are liabilities requiring immediate payment, such as wages, charges or overdue bills.

exclude the fact that producing and selling products involve risk, especially if the destination market is a foreign country. Therefore, following O'Brien and Folta (2009) and Ghosal (2010), we will use real options models to take into account this risk of exporting production.

Finally, when firms are competitive enough to export, they may face a loss of performance over time. As Ericson and Pakes (1995) highlight, if a firm's investments – in R&D, for example – are not successful enough, the firm can be in a position where it has lost its productivity advantage. Thus, the firm will not be efficient enough, so it will have to exit the market. The empirical literature on firm failure has highlighted the existence of a "shadow of death", which refers to a lower productivity per exiting firm relative to incumbents even several years before the firm's exit (Griliches and Regev, 1995; Kiyota and Takizawa, 2007; Blanchard et al., 2014). A key factor of exit is firm-level productive efficiency, meaning that lower productivity characterizes an exiting firm. This negative relationship between productivity and failure is robust (see, among others, Bellone et al., 2006; Foster et al., 2008; Blanchard et al., 2012; Brandt et al., 2012). Similarly, exporting firms with lower productivity are unlikely to leave export markets immediately (and suddenly), and failing exporters should be less efficient than incumbents.

In this paper, we aim to explain why a firm that exports and is therefore considered a high-performing firm enters into a bankruptcy procedure, a sign of financial and economic difficulty. While we know that exporters can sustain this activity because they can withstand the additional sunk costs linked to that activity, we know very little about their dynamics once in difficulty. Why does a firm in distress continue to export? How can we explain why such firms remain active in export markets while only the most productive firms are supposed to operate abroad?

An important contribution of this paper, thanks to a proven methodology, is that it distinguishes for the first time the part of the sunk costs due to export activity. We can then use it to control for its actual effect on the default probability. First, we estimate the sunk costs of export activity with propensity score matching (PSM). Then, we evaluate the likelihood of default in the following three years. In our empirical strategy, we control for firm assets, both tangible and intangible, the concentration of the market, and the minimum efficient scale in a panel probit model. We control for the possible correlation between regressors and random individual effects with Mundlak's approach. We also take firm characteristics into account since Bernard and Jensen (2007) show that after controlling for the size, age, and factor intensities, plants are more likely to close if they are part of a large firm, part of a multi-plant firm or part of a multinational firm.

We find that while firm performance plays a crucial role in default occurrence, the sunk costs linked to export activity lower the probability of survival. The findings of Albornoz et al. (2016) suggest that exporting fixed costs, as well as sunk costs, are higher in more distant destinations but are lower when the origin and the destination countries share common characteristics (such as a common border, a common language or a similar level of GDP). We will use the assets, both tangible and intangible, of the firm as a proxy for sunk costs (Kessides, 1990). While there exists a difference in how defaulting and incumbent firms perform, we find either no significant difference in sunk costs or a short-term effect. In line with the real options model, we also find that defaulting exporters are in an inaction zone in the years prior to the triggering of legal procedures.

We organize the paper as follows: we present the model in Section 2, and then we describe our empirical strategy and the data in Section 3. Section 4.1 presents some stylized facts, and in Section 4.2, we give our results and some robustness checks. In the last section, we finally conclude with our results.

2 Literature review

Firms' productivity, exports, and market exit are intertwined and are well documented. The literature on exporters, default firms and exporters in distress is quite vast. However, it agrees that firms' performance impacts their ability to stay in the market, both domestic and foreign. Moreover, we see links between these three strands. First, exporters are the best performing firms. Second, defaulting firms are the least common firms. Third, default should not be possible for exporters, except if we take into consideration the active learning process. Firms that become less efficient over time reach a point were they have to exit, even if they were efficient enough to export. Similarly, the literature describes the sunk costs associated with their activities as exit barriers. In three strands of research, exporter productivity, defaulting firms and defaulting exporters, we will see how these factors are analyzed.

2.1 Exporters' productivity

Melitz (2003) points out that firm productivity is an important matter in regard to production destination strategies. The more efficient a firm is, the more it can handle additional sunk costs, and it can sell its product in more distant locations. Otherwise, it sells only on the domestic market. If selling on the domestic market is still too difficult, then the firm leaves the market. This sunk cost encompasses a range of costs, such as the costs of searching for commercial opportunities abroad, complying with customs procedures, or finding local retailers. However, since Melitz's setup uses homogeneous destination countries, the additional sunk costs linked to the export activity do not depend on the difficulty the firm faces in selling on the market. Only the distance of the destination matters. With his model of international trade, Chaney (2016) highlights a relationship between liquidity constraints and the difficulty of exporting. The presence of liquidity constraints creates difficulties in financing the sunk costs of exporting. Thus, less productive firms exit the market when they face those constraints.

Bernard and Jensen (1999), using both total factor productivity (TFP thereafter) and labor productivity, assess how export status and productivity growth interact. They show that high-performing firms become exporters and exporters grow more quickly than non-exporters. They also demonstrate that the productivity growth of incumbent exporters is slower than that of new exporting firms. They explain this deceleration of productivity growth by two potential factors. First, it may come from an excessive acceleration from the new exporters, which is only temporary. Second, the productivity of firms exiting the export market can lower the productivity of other exporters. Bernard et al. (2011), in a general equilibrium model, show that the number of products a firm exports matters. The more liberalized a market is, the more firms will specialize in the production of products they sell in the market. Similarly, as a firm exports to more destination markets, the more it exports products.

2.2 Defaulting firms

The decision to export can be made rationally by a top-performing firm. However, according to the literature, a firm learns if it is performing well enough to continue its activity or not. Jovanovic (1982) and Hopenhayn (1992) construct models in which the firm has a defined but unknown and unalterable productivity parameter. It has to produce in order to know whether it is efficient enough to produce or if it has to exit. Following Ericson and Pakes (1995), we can consider that firms are engaged in a process of active learning to improve tier productive performances, although uncertainty exists on the outcome of investment. In addition, according to the notion of active learning developed by Ericson and Pakes (1995), firms can invest to raise their productivity. However, uncertainty exists regarding the outcome of the investment. If a firm faces an unsatisfactory outcome in response to the innovation made and if it occurs multiple times, then it will become, relative to other firms, a less-performing firm. This dynamic approach is more interesting in our case than in the static one. A whole tranche of literature focuses on those situations where all firms, exporting or not, can face a loss of performance. The literature on firm failure has highlighted the existence of a "shadow of death", which refers to a lower productivity per exiting firm relative to incumbents even several years before the exit. Griliches and Regev (1995) were the first to highlight this phenomenon, where firms that will exit face a loss of productivity multiple years earlier; both Kiyota and Takizawa (2007) and Blanchard et al. (2014) find the same fact.

Kiyota and Takizawa (2007), using a duration model approach, confirm the findings of Griliches and Regev (1995) of a shadow of death for Japanese firms. They also point out the importance of taking into account the unobserved heterogeneity in order to avoid underestimating the impact of performance indexes, such as productivity and firm size, on the probability of remaining on the market. Blanchard et al. (2014) try to explain the probability of exiting the market with the standard efficiency indexes (productivity and size, for example) but also with sunk costs of the firm. They conclude that the shadow of death exists for French firms, but they also find that sunk costs prevent exit. Consequently, market exit does not represent a sudden event; however, a much longer and downward trend of efficiency seems robust.

A key factor of exit is firm-level productive efficiency at the moment of failure, not just past trends. Empirically, a robust negative relationship exists between productivity and failure. Bellone et al. (2006), for example, use the same methodology as Kiyota and Takizawa (2007) with a duration model and draw conclusions about both the dynamics and the level of productivity. First, incumbent firms that are exiting face a lower efficiency level, measured by TFP, profitability, and size. Second, years before exit, firms face a negative trend for all efficiency indicators, concluding those regarding the existence of the shadow of death.

The study by Foster et al. (2008) estimates both physical and value TFP. Using the IV methodology, they find that plants with lower productivity levels, either in value or in quantity, are more likely to exit than others. However, they do not take into account the fact that we cannot assess whether the plant's decision to exit is a selection process-related event as straightforwardly as for firm-level exit. The plant's parent company decides plant closure and is more an optimization strategy than a situation that an establishment endures.

Blanchard et al. (2012) compute TFP and sunk costs at the firm level and Herfindahl's concentration index at the industry level. They then run a pooled and random effect panel probit. They find a positive and significant correlation between the probability of survival and productivity, age, and sunk costs. Therefore, the more efficient a firm is, the lower its probability of leaving the market. Similar to age, a firm learns if it is fitted for production after it starts to produce.

For this reason, after the first five years, the exit rate declines. In addition, if a firm is not very efficient when entering the market, by innovating and improving its level of productivity, it can stay in the market, as Ericson and Pakes (1995) demonstrate with the active learning process. Brandt et al. (2012) also find a negative and robust correlation between exiting firms and productivity.

2.3 Defaulting exporters

Event though broad strands of literature focus on exporting and defaulting firms, the extant research has paid little attention to the relationship between exporting and firm closure. Bernard and Jensen (1999), for example, find that firms that exported in the previous year have a lower probability of market exit than non-exporters. However, they take into account the possible endogeneity of the export choice by taking the lag of the exporting status. We can argue that it does not perfectly take into consideration the export decision, which can lead to a selection bias of the prior exporting status. This bias can then lead to a possible bias in the estimation of the impact on the survival of export activities.

Other related studies focus on the entry and exit of export markets and their impact on firm survival. Girma et al. (2003) examine the consequences of export market exit on firm performance. Based on the PSM methodology, the authors estimate the probability of exiting export markets using TFP as the productivity index; employment; the share of output exported; the number of years as an exporter, expressed in logarithm form; and industrial dummies. They match firms on the predicted probability, and then conducted a difference-in-differences estimation to assess the effect of leaving the export market on productivity, employment, and output. They find that exiting export markets immediately negatively impacts all firm outcomes. However, only productivity does not suffer as a result of exiting in the long run. The authors explain that firms gain experience from previous exports through a “learning by doing” effect. Firms compete against better-performing firms and therefore learn about those firms’ best practices. Nevertheless, due to the lack of domestic opportunities, output faces the largest, most significant, and most durable fall. In addition, the negative effect is also persistent for employment.

The study by Wagner (2013) highlights a stronger relationship for German firms between imports and firm survival. He shows that when he disentangles exporters from exporters and importers (two-way trade), being an exporter does not protect significantly against market exit after controlling for firm size, labor productivity, and multiproduct characteristics. In other words, there are trader survival premia: the risk of exit is lower for importers and for firms that both import and export than for exporters. He explains these results with the choice of diversification for exporting firms only. These companies do not want to suffer the economic cycle of the domestic market if it is not favorable. Therefore, they expand to counteract this risk. However, that does not mean they are more efficient than other firms. In contrast, importers, especially two-way traders, are more integrated into the international market than exporters, which is a sign of efficiency.

In the case of Vicard (2014), the paper focuses on the relationship between export decisions and the probability of firm survival. In this paper, firms can fall into three categories: a firm can be only domestic, a new exporter, or an incumbent exporter. He uses a PSM to match new exporters with domestic firms before they enter into the export market. He finds that incumbent exporters have a lower probability of default in comparison with new exporters, mainly because the new exporters face a higher probability of leaving the export market. In addition, after exiting export markets, exporters have a higher probability of default than similar domestic firms, highlighting that exporting contains risk. In other words, exporting does not prevent firms from defaulting, but it increases the probability of going into bankruptcy for former exporters compared to similar domestic-only firms that do not choose this path. These firms return to their level of productivity and factors of production from before they began to export, but they still have a higher level of debt as a result of the export activities they stopped. Therefore, they cannot sustain this level of indebtedness and also exit the domestic market.

The question remains of why a significant share of exporters are involved in a collective procedure. The existence of sunk exit costs can explain the persistence of exporters' status. Consequently, firms may remain active in export markets as long as the value of continuing to export exceeds the exit costs. Bernard and Jensen (1999) highlight that in switching to domestic activity only, exporters exhibit bad performances afterwards. In leaving export markets, firms face difficulties. A level of sunk costs that is too high can cause these difficulties, which are illiquid assets that are no longer available for use.

The literature has not been able to disentangle sunk costs due to domestic activity and those due to foreign activity. We can ask whether the additional sunk costs act as a barrier to exit or if they increase the financial difficulties faced by firms. The idea behind this question is that the assets invested in sunk costs will not be available if the firm faces difficulties reimbursing its creditors. The firm's situation may worsen, and it will end with an insolvency. In this paper, we propose a new methodology to separate sunk costs due to domestic activity and those due to foreign activity and see how they interact with the default probability.

3 Empirical strategy

3.1 Data

To implement our analysis, we use two central databases. The first one we use is the official bulletin of civil and commercial announcements database (BODACC thereafter), which gives us information about the firms that were in default between 2008 and 2016. In France, the BODACC provides information on legal procedures. There are three different procedures for companies in distress (from the least intrusive to the most intrusive): the safeguard procedure, the reorganization procedure, and the liquidation procedure. The safeguard procedure, introduced in 2005, is relatively new. This procedure aims to allow firms that face a critical situation but are not declared insolvent to maintain their business activity and level of employment while also regulating liabilities. At the end of the safeguard plan, the procedure can be converted to a reorganization or liquidation procedure depending on the situation of the debtor. The judicial administrator can have an active or a passive role: the decision power of the debtor will be reduced at the expense of the administrator in case of an active mission. This procedure can last ten years at most for all companies except for farming companies (fifteen years).[3]

The liquidation procedure, similarly to the reorganization procedure, can be triggered only if the firm is in a state of insolvency. It can be opened either after the reorganization procedure if it fails or after a safeguard procedure if the company became unable to reimburse its creditors or directly opened after the insolvency if the firm is considered impossible to save. It lasts for two years maximum and is completed only if liabilities are completely reimbursed or if assets are extinguished. Safeguard procedures can be started without insolvency, so the court has to state if the company needs its help. This rule is not as clear as the insolvency rule. For this reason, we will focus on the liquidation and reorganization procedures.

The second database includes annual French customs data over the period 1993-2015, which provides us with firm-level data on trade.[4] French customs uses the European Combined 8-digit Nomenclature (CN8).[5,6] We classify markets according to their ease of access. We consider a market easy to access when it is part of the European Union and difficult otherwise.[7]

In addition, for firm-level information, we use the Unified Corporate Statistics System, the File approaching the results of the Elaboration of Annual Statistics of Companies, the Annual Declaration of Social Data and the Financial Links between Enterprises Survey (FICUS, FARE, DADS, and LiFi, respectively). First, we use FICUS and FARE to obtain information about the accountability of French firms. Those databases contain comprehensive information about, for example, assets, materials, revenue, and value-added. The data began in 2000 and ended in 2014. Then, we use the DADS database, which groups all the information about firms' human capital. FICUS and FARE contain this information as well, but DADS is more reliable since the data are more accurately gathered. We use the labor variable from this database to estimate the production function. Since the literature pointed out the impact of being part of a group, we use LiFi, which illustrates the financial links between firms, to evaluate firms' group membership. We restrict our sample to firms that have more than five employees and €5,000 of tangible assets so that we do not have to deal with the measurement problem due to small firms. We also restrict our sample to the 2006-2014 period.

[3]A simplified safeguard procedure exists for large firms. To be eligible, the firm has to have at least 20 employees, a turnover greater than €3,000,000 before taxes, or a balance sheet greater than €1,500,000. The plan must be voted by creditors who detained at least two-thirds of the total debt. Note that a regular simplified procedure is different from a financial simplified safeguard procedure (which concerns firms deeply indebted to banks, with the majority of their financial creditors' supports).

[4]Exports at the product level are available for more than 230 trading partners.

[5]Some flows are exempt from declarations.

[6]Within the European Union, French exporters declare their shipment if their cumulated export value for a given year exceeds €460,000. This threshold has changed over the period: the limit was F250,000 from 1993 to 2001, F650,000 from 2001 to 2006 (€100,000), €150,000 from 2006 to 2011, and €460,000 since 2011. This threshold can be an important limitation when the number of firms is the main concern. Concerning exports to non-European countries, the threshold is lower (€1,000).

[7]We distinguish markets this way because there is not enough heterogeneity to differentiate firms otherwise. In our database, almost all firms export to an easy market, defined by Chaney (2014) as a foreign market (or its neighbor) in which some French firms already operate (because of trade networks).

3.2 Key variables

3.2.1 Economic performance index

A broad range of indexes and proxies such as labor productivity or total factor productivity (TFP thereafter), also known as multifactor productivity, are generally utilized to assess firms' performance. The latter is the firm productivity that we cannot explain by the observable inputs; it is the contribution to the output of other inputs not used in the production function as well as the technological efficiency.

$$Y = f(X_1, ..., X_n) \tag{1}$$

A common form used in the literature is the Cobb-Douglas production function.

$$Y = A_{it} K_{it}^{\alpha_K} L_{it}^{\alpha_L} \tag{2}$$

Levinsohn and Petrin (2003) use a control function methodology to control for both the simultaneity and the selection bias in the OLS estimator of the production function.[8] To do so, they propose a two-step estimator, with a proxy that allows for identifying the labor and the capital intensity, the intermediates inputs. In the first step, they use a semi-parametrical function, with the non-parametric part estimated by a third-order polynomial function of intermediates and capital. This step estimates the labor elasticity, and then, the results are injected in the second step, which estimates the capital elasticity. Then, the estimation of the production function can be computed for each firm to find the value of log(A_{it}), which is the variable tfp_{it}. Knowing that TFP is the intrinsic productivity of the firm (i.e., the part that does not rely on capital and labor) makes it an interesting measure of firms' efficiency.

	(1) Food products, beverages, and tobacco	(2) Other industrial products, coking and refining	(3) Electrics, electronics, and informatics products	(4) Transporting materials	(5) Clothing industries	(6) Wood and paper industries
l	0.537***	0.613***	0.554***	0.637***	0.652***	0.617***
	(0.012)	(0.007)	(0.015)	(0.031)	(0.014)	(0.015)
k_{-1}	0.185***	0.300***	0.357***	0.246***	0.341***	0,229***
	(0.013)	(0.011)	(0.025)	(0.050)	(0.035)	(0.024)
# of obs	65,419	153,000	34,424	8,797	16,286	34,537

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1: Estimation of total factor productivity, 2006 – 2014

The estimations in the Table 1 show heterogeneity between manufacturing sectors on how production factors impact the value added. The electricity, electronics and informatics products sector is the most capital-intensive industry, while the clothing industry is the most labor-intensive sector and the second most capital intensive. On the other hand, the food products, beverages and tobacco industry is less capital and labor intensive. Moreover, all these industries comprise

[8] For more details, see Appendix B.

roughly two-thirds of labor and one-third of capital, which is consistent with the literature.

3.2.2 Export sunk costs: an identification using propensity score matching

Theoretically, we can make a clear distinction between the sunk costs supported by firms to access the domestic market and those supported to access the export market (Melitz, 2003; Yi and Wang, 2012). By contrast, in the data, we can control only for the presence of overall sunk costs, but it is not possible to disentangle them. However, we can think of the sunk costs directed to the export activity as the difference between the global sunk costs of the exporting firm and the sunk costs linked to the domestic market. This difference can be estimated due to the matching methodology, which allows comparison between treated firms and their constructed counterfactuals. In addition, knowing that the decision to export is not a random process, matching the firms will allow us to randomize the treatment allocation. Using this property, we can subtract the sunk costs of non-exporters, which are statistically identical to exporters. We will consider this difference to be the sunk costs directly linked to export activity.

This methodology will allow us to compute the two kinds of sunk costs for each exporting firm each year. Thus, because we will calculate it by firm and by year, Mundlak's methodology (Mundlak, 1978) allows us to control the individual unobserved heterogeneity in our primary model. The critical steps are the matching methodology used and the variable choice. We will perform PSM, and the model retained will be discussed later.

The literature frequently uses the method of PSM proposed by Rosenbaum and Rubin (1983). This is a convenient methodology because it allows us to obtain a single index built from the observed characteristics of firms to match treated firms with non-treated firms. Its central component is the choice of independent variables, so we have complete independence between the unobserved characteristics and the outcome, the sunk costs related to firms' export activity. Consequently, we must use all the explanatory variables of the decision to export in the model to discriminate the sunk costs related to exports.

Hence, we can see this approach as a way to explain the difference in export status between two firms that are statistically identical, where the decision to export is a random process. This probability is estimated with a probit using the data available between 2006 and 2014.

$$\mathbb{P}\left(Export_{it}=1 \mid X_{it}\right)=\Phi\left(\beta_0+X_{it}^{\prime}\beta+\bar{X}_{i.}^{\prime}\gamma+S_{it}^{\prime}\delta+\varepsilon_{it}\right) \tag{3}$$

Since the choice of the covariates is crucial to obtaining a good quality of matching, we follow Roberts and Tybout (1997) and Vicard (2014) to predict the export choice. We use a set of industry dummies at the two-digit NACE level (S_{it}), a dummy of foreign ownership, and a dummy of importer status. We also use the logarithm of continuous variables, such as the lag of the productivity index of the firm, age, tangible assets, and the number of employees. Except for the age variable, we also use each variable's first difference to control the dynamic of the firm. Growing and more efficient firms should have an increased probability of being exporters. We use a probit model with Mundlak's methodology to control for individual unobserved heterogeneity. Then, we match the firms by year, using the five nearest neighbors, with a caliper of 0.01. We estimated six models, as shown in Table 6 and in Appendix F.1. In the first and fourth models, the models are estimated without the first differences variables, while in the other models, they are estimated with the first differences variables. Moreover, we estimate the first three models without and the following models with the Mundlak methodology. We obtain the following results in Table 6.

The major difference between them is the significance of the coefficients. With the Mundlak method, the coefficients are not as large, and some are no longer significant. For example, being part of a group with foreign capital is not significant when we control for the individual unobserved heterogeneity. Moreover, firms' age has a negative effect on the last three models, while it was positive in the first three. This situation leads to an overestimation of the contribution of those variables.

Variables‡	(1) All manufacturing industries	(2) Food products, beverages, and tobacco	(3) Other industrial products, coking and refining	(4) Electrics, electronics, and informatics products	(5) Transporting materials	(6) Clothing industries	(7) Wood and paper industries
Foreign group$_{it}$	0.078	0.186	0.097	0.075	0.174	-0.279	0.056
	(0.064)	(0.182)	(0.083)	(0.174)	(0.382)	(0.315)	(0.180)
Importer$_{it}$	0.649***	0.470***	0.740***	0.628***	0.534***	0.942***	0.324***
	(0.032)	(0.108)	(0.042)	(0.093)	(0.167)	(0.141)	(0.078)
Log TFP$_{it-1}$	0.015	-0.037	0.029	-0.010	-0.066	-0.039	0.028
	(0.013)	(0.042)	(0.018)	(0.037)	(0.068)	(0.065)	(0.033)
Log number of employees$_{it-1}$	0.481***	0.774***	0.390***	0.574***	0.530**	0.840***	0.478***
	(0.051)	(0.153)	(0.069)	(0.174)	(0.221)	(0.218)	(0.128)
Log liabilities$_{it-1}$	0.083***	0.063	0.083***	0.057	0.199	0.141	0.083
	(0.023)	(0.071)	(0.031)	(0.073)	(0.127)	(0.103)	(0.057)
Log age$_{it-1}$	-0.123**	-0.734***	-0.152*	-0.066	0.623**	-0.104	0.002
	(0.060)	(0.200)	(0.080)	(0.188)	(0.311)	(0.288)	(0.160)
ΔLog TFP$_{it-1}$	-0.015*	0.032	-0.022*	-0.016	-0.029	0.045	-0.030
	(0.009)	(0.026)	(0.012)	(0.023)	(0.036)	(0.044)	(0.024)
ΔLog number of employees$_{it-1}$	-0.217***	-0.431***	-0.209***	-0.139	-0.491**	-0.196	-0.065
	(0.043)	(0.114)	(0.059)	(0.149)	(0.212)	(0.189)	(0.106)
ΔLog liabilities$_{it-1}$	-0.029	0.040	-0.051*	-0.039	0.034	-0.058	-0.008
	(0.022)	(0.065)	(0.030)	(0.076)	(0.120)	(0.102)	(0.054)
ΔForeign group$_{it}$	-0.016	-0.115	-0.007	-0.024	-0.459*	0.139	0.025
	(0.049)	(0.131)	(0.067)	(0.153)	(0.257)	(0.225)	(0.129)
ΔImporter$_{it}$	-0.158***	-0.132*	-0.181***	-0.152**	-0.182	-0.289***	-0.049
	(0.021)	(0.072)	(0.028)	(0.067)	(0.114)	(0.089)	(0.053)
Constant	-9.324***	-13.332***	-7.432***	-8.437***	-6.419***	-6.447***	-7.888***
	(0.179)	(0.624)	(0.541)	(0.512)	(0.824)	(0.587)	(0.431)
# of obs	228,939	48,296	111,700	25,311	6,575	11,714	25,343
# of firms	36,371	7,847	17,793	4,067	1,081	1,940	4,117
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AUC	0.899	0.906	0.879	0.895	0.906	0.896	0.819
Log-likelihood	-59,364	-7,753	-31,963	-5,514	-1,805	-2,832	-9,033

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Probit models for propensity score matching

‡ We introduce intra-individual means of variables as regressors to control for possible correlation between co-variables and unobserved individual heterogeneity, following the methodology proposed by Mundlak (1978).

Interestingly, the growth in productivity index, liabilities, and number of employees are negatively correlated with the probability of export. Furthermore, becoming an importer decreases the probability of becoming an exporter. Being part of an international group does not seem to have an impact, including on the performance of the firm. However, being an

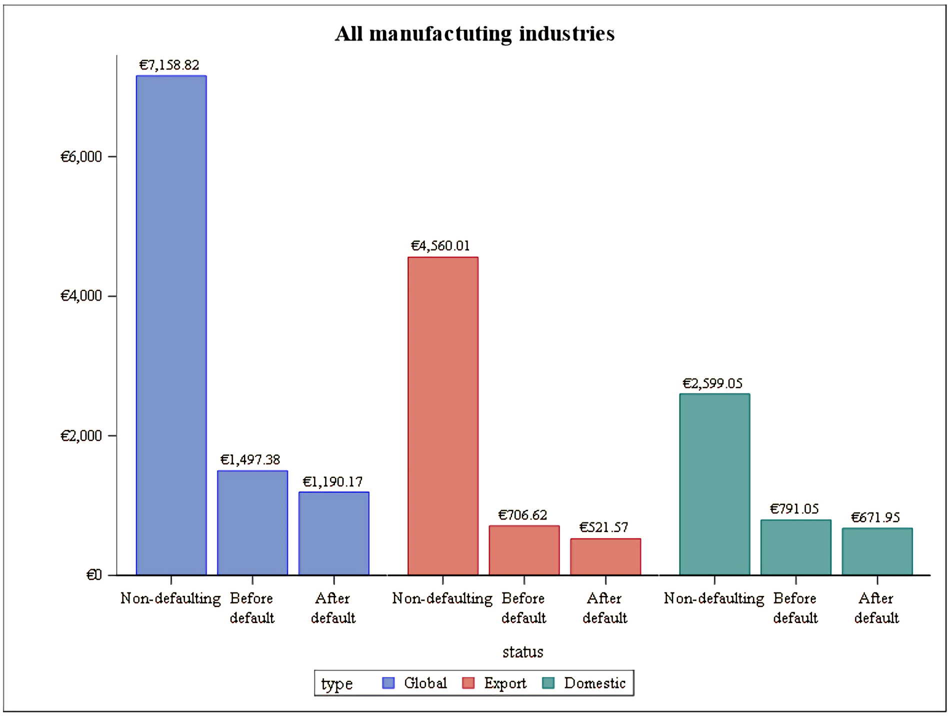


Figure 1: Average amount of sunk costs – All manufacturing industries

importer and being a big company in terms of both employment and liabilities significantly raise the probability of being an exporter, while the age of the firm decreases it.

However, the models estimated with Mundlak's method do not differ fundamentally. All the variables share the same signs and significance, and the areas under the curve are not different. Since our models have a high rate of good prediction, the quality of our matching should be good. The pseudo-log-likelihoods differ quite a lot. The value added of the Mundlak methodology seemed crucial.

The essential hypothesis behind the PSM is the non-omitted variable hypothesis. One way to control for this possible bias is to compute the area under the curve (AUC) of the receiver operating characteristic (ROC) curve. The closer it is to 1, the better the model predicts the treatment's assignment. We have a consistent result with an AUC of approximately 0.9. In model (5), we obtain a 90% good prediction throughout the different models. We can be confident in this assumption of non-omitted variables. However, each industry differs from another, even when dealing with the manufacturing sector. Simply adding industry fixed effects to the model cannot take into account these specificities. For this reason, we estimate this model for every sector at the same industry level we use to estimate our productivity index. The results are shown in Table 2.

Even if we do not have the same prediction rate for every sector, the AUC never drops below 80%, which is a good prediction rate. Moreover, as shown in Table 7, the number of firms matched is also critical. The number of observations is lower since we use some lagged variables' first difference in our model and, for non-continuous exporters that do not export continuously, all the observations cannot be matched.[9] When the domestic sunk costs are assessed, we subtract

[9]For those observations, we infer a value for the domestic sunk cost that is equal to the minimum of the domestic sunk costs average and the sunk costs observed.

these computed sunk costs from those already observed.[10] The sunk costs linked to export and the domestic market differ between firms in distress and continuing firms and between firms in distress before and after triggering the procedure, as shown in Figures 1 and 11 and Table 5. Therefore, the firms in distress, while they have less sunk costs than overall incumbents, seem to have an excess of costs before triggering the procedure, and they try to eliminate it, either to reimburse their creditors with them in the case of a liquidation procedure or to lower their liabilities. Since the gap between incumbents and defaulting firms is quite large, it seems to point to a negative relationship between sunk costs and default. Nonetheless, we do not take into account other variables influencing the default. The following control variables will be considered.

3.3 Control variables

We obtain our control variables by calculating them if they are not already available. We can compute deflated firms' assets (both tangible and intangible), the industry's concentration index, and the minimum efficient scale. We utilize Herfindahl's concentration index. It is computed at the two-digit NACE level as follows:

$$\sum_{i=1}^{N_t^j} \left(\frac{Y_{it}}{\sum_{i=1}^{N_t^j} Y_{it}} \right)^2 \times 1000 \tag{4}$$

where Y_{it} is the output of firm *i* at time t. It ranges between 0 and 1000, the latter being the less competitive sector possible and 0 being the value for the market with the most competition. The minimum efficient scale is defined by Comanor and Wilson (1967) for each sector as

$$\frac{\frac{1}{N_\Omega} \sum_{i \in \Omega} Y_{it}}{\sum_i Y_{it}} \tag{5}$$

where Ω is the subsample of the largest firms accounting for 50% of the output in each sector. Finally, T is the vector of the time dummies. For the concentration index and the MES, we utilize the deflated value-added as a measurement of the output from FICUS and FARE. Using the LiFi database, we can construct a dummy variable of a group membership. If a firm is part of a group, either as the group's head or as the subsidiary, then the group variable is equal to 1, and 0 otherwise. In our sample, 11,902 firms out of 31,975, which means approximately 37% of our sample, are part of a group.

We also try to consider the risk of operating in the export market. Following Ghosal (2010), we estimated the root mean square error of a model that explains export turnover by its lags. However, we do not have enough observations by firm to use some basic time-series models, such as autoregressive models, so we had to estimate this model using OLS. However, this estimation is far from satisfactory because of both the method and the number of periods available.[11] Therefore, we prefer to use the number of destination countries and the share of easy destination countries. The idea behind this approach is quite straightforward, since the more a firm exports to different countries, the more this export activity will generate sunk costs to sustain this activity. These sunk costs have various sources, e.g., the adjustment costs induced by entering into a market with different regulations and consumer preferences. This approach of using customs data with the information available at the firm-product-destination level is an innovative way to tackle real options models.

[10] We use the maximum of 0 and the difference between the two sunk costs.

[11] We tried to use it in our estimations, but due to data limitations, it does not seem to be a fitting measure of the risk we can use in our case.

3.4 The probit model

We aim to explain why a substantial share of export firms are insolvent. To estimate the impact of exporting on the probability of default, we use the following probit regression model:

$$\mathbb{P}\left(Default_{it}=1 \mid X_{it}\right)=\Phi\left(\beta_0+\beta_1 tfp_{it}+sunk\_costs'_{it}\theta+Z'_{it}\gamma+\alpha_i+\varepsilon_{it}\right) \quad (6)$$

where tfp_{it} is the performance index we will use for firm *i* at year *t*, $sunk\_costs'_{it}$ is the vector containing the amount of sunk costs related to the export activity and the one related to the domestic activity of firm *i* at year *t*. Z_{it} is the vector of control variables; for example, $Group_{it}$ is a dummy equal to 1 if the firm is part of a group and 0 otherwise. $Conc_{it}$ is the Herfindahl concentration index, and mes_{jt} is the minimum efficient scale of the industry *j* at the year *t*, in logarithm form. We will also use the number of products exported by the firm, $nproduct_{it}$, and the number of destination countries, $ncountry_{it}$. We will use this model with Mundlak's methodology. Since we cannot use within transformation due to the incidental parameters problem[12], Mundlak allows us to control for possible correlation between our observable explanatory variables and the unobserved heterogeneity. Moreover, to control for the shadow of death effect, we will use lags of the sunk costs, the performance index, and being part of a group (either foreign or not). Furthermore, since those two previously explained interest variables are generated regressors, we have to estimate our standard errors using bootstrapping. However, some difficulties may arise.

First, how can a defaulting firm be considered? The French National Institute of Statistics (INSEE) considers the default as the entry into a legal procedure (either liquidation or reorganization). Nonetheless, we cannot strictly apply this definition at year *t*. Although firms have to give information about their accounting, most of them do not provide this information several years before (most of them two to three years). For this reason, missing values arise in our samples before the date of entrance in the BODACC. Consequently, the default will be defined as entering a legal procedure in the following three years (see Figure 2). We use this definition in consideration of the number of firms disappearing from the database in the years before the default. Thanks to this definition, we can consider a larger number of defaults in our analysis. In Figure 2, we take the example of a firm that appears as defaulting in the BODACC database two years after we last see it in other databases. Second, how can we assess the performance of a firm? The third and last difficulty is how to

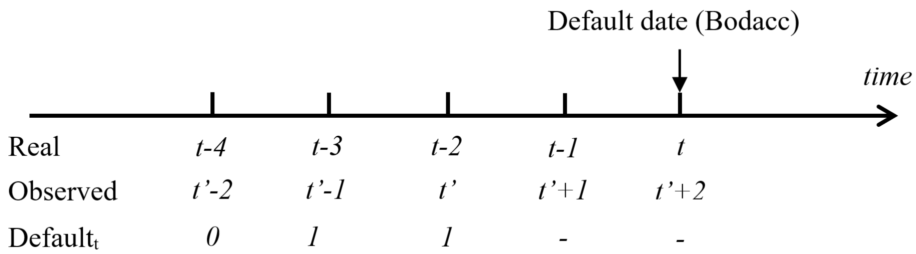


Figure 2: Example of the computation of the default variable

distinguish the sunk costs based on the market, either domestic or export? The methodologies we exposed in the previous

[12]For more information, see Wooldridge (2010) Part IV, Chapter 15 Section 8.2, or Greene (2004).

sections allow us to overcome them (see Section 3.2.1 and Appendix B for TFP and Section 3.2.2 for sunk costs).

4 Results

4.1 Statistics

After the estimation of the productivity index, we can compare the productivity of the different categories of firms. We categorized firms in terms of whether they are in default or not, whether they export or not, the destination of the products shipped, and whether defaulting firms are observed before or after the procedure has been triggered. We also created five quintiles of productivity by sector to see the distribution of the firms. As the figures in Appendix C show, non-defaulting firms that do not export and the ones that stopped exporting either a long time ago (i.e., between 10 and 15 years) or a short time ago (i.e., 5 years) have similar distributions of productivity, which is skewed towards the less efficient firms in the first two quintiles. Current exporters also have similar distributions. They are skewed towards the most productive firms in the last two quintiles. We also find that short-term export status history has a larger impact on productivity than long-term export status history. For example, in Figure 5, firms that continuously exported for two years have a higher productivity than firms that exported two years ago, stopped exporting the year after and exported again in year *t*. Moreover, when we consider the last year of exporting, whether firms are continuous exporters or not, the distribution of productivity is more skewed towards the 5th quintile when they export in *t* instead of when they export for the last time in *t-1* or before. Therefore, there seems to exist not an exporter productivity premium but a continuous exporter productivity premium, and current export status is more relevant than previous export status.

Now, non-exporting firms and those that exported at least once since the beginning of the period have a very different distribution of productivity than firms that have more regular export activity. Non-exporters have a relatively even distribution between the 1st and the 4th quintiles, but a bit less for the 5th, while exporters have a distribution skewed toward the 4th and 5th quintiles. This finding confirms the higher productivity of exporters compared to purely domestic firms, as exposed first empirically by Bernard and Jensen (1999) and then theoretically by Melitz (2003). Nevertheless, considering the default in the three next years (see Section 3.4), the distributions of productivity between non-exporters and exporters are similar. In this case, more than 60% of firms are in the first two quintiles. Nevertheless, more than 20% of exporters – considered the most efficient firms – are involved in a collective procedure or become involved in one in the following three years. Does export status protect from difficulties? Alternatively, does the way they export matter the most?

It appears counterintuitive that one-fifth of exporters are among the less-performing firms. A possible explanation could be that the too high level of sunk costs prevents exporters from leaving this market. This hypothesis is plausible since we see that being subject to an insolvency procedure creates a significant difference in the average number of products exported. The same phenomenon also occurs for the number of destination countries. Notably, we observe, on average, significant decreases of 1.31 (resp. 0.75) products exported (resp. destination countries) per firm after the collective procedure is triggered. Therefore, for the firms in distress, the destination of export seems crucial, as pointed out by Bernard et al. (2011) and Fontagné et al. (2018). However, it should be noted that when a firm is involved in an insolvency procedure, an administrator named by the court is in charge. Therefore, the decision to decrease the number of destinations and products exported can be made by the administrator. The administrator can also decide to focus on some core products in those difficult times. Thus, we see a gap between defaulting and non-defaulting firms. This gap also exists for the export sunk costs, as shown in Figures 1 and 11. Therefore, are the levels of sunk costs too high for firms to sustain their activity, particularly export activity? Does the gap between non-defaulting and defaulting firms in terms of sunk costs prevent exit? This will be discussed in the next section.

In Figure 10, we see that exporting firms that are not in default export more products than defaulting firms before the default arises. The same conclusions arise concerning the number of destination countries. It appears that exporters involved in a collective procedure do not perform as well as the other firms in the export market. Firms becoming less efficient compared to domestic and other export firms have no choice but to exit the market. If we go further into detail, we can see that the destination can be another factor. Now, we will compare the average number of products exported before and after the procedure is triggered, and depending on the export destination, we can see different things. First, if the firms are exporting to neighboring countries, the number of products shipped does not decrease significantly. This phenomenon is even truer if the destination countries are EU bordering countries. Similarly, if the destination is a non-bordering EU country, the decrease is not significant, either. Therefore, if the destination countries are within the EU, regardless of whether they are bordering or not, the reduction in the number of products exported is not significant. In contrast, if the destinations are non-bordering countries outside the EU, then the decline is both important and significant. A plausible explanation is the sunk costs. We can see that the costs to export to the nearest neighbor are low enough and thus are not significantly different from the domestic market. Hence, these firms do not have any incentive to leave. Conversely, it may seem too costly to continue serving markets that are outside the EU and far from France. Therefore, these findings suggest that firms refocus their activities towards less costly ones. However, this step seems to happen only after insolvency, while in this paper, we are focusing on the determinants of insolvency.

To summarize, exports to the ”easy” market are still sustainable for firms in distress, but they reduce their exports to more difficult destinations. This can be a sign of less competitiveness towards other French exporters, but also indigenous firms in the foreign market. Moreover, the firms in distress that are trying to disengage themselves progressively from those difficult destinations, as shown in Figure 10, gradually reduce their amount of sunk costs linked to the export market, but only after the triggering of the procedure. Thus, the sunk costs will act as exit barriers. If this assumption is verified, then we will have a good explanation of why exporters are still exporting while being in a collective procedure, and the theoretical background will remain valid. Otherwise, it will mean that other variables are at stake and are not controlled for with those statistical analyses. To confirm this hypothesis, we must find a way to infer the part of the sunk costs linked to the export market and then evaluate the dynamic of the sunk costs years before the entry into a collective procedure. Doing so will help exporting firms reduce sunk cost pressure, but it is not enough to stop their export activities.

Variables[a]	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All						Continuous		
	With exporter status			Without exporter status					
tfp_{it}	-0.177***	-0.174***	-0.112***	-0.182***	-0.202***	-0.139***	-0.183***	-0.183***	-0.143***
	(0.025)	(0.024)	(0.037)	(0.030)	(0.029)	(0.033)	(0.028)	(0.033)	(0.036)
tfp_{it-1}	-0.064***	-0.059***	-0.070**	-0.065***	-0.067**	-0.083***	-0.071**	-0.076***	-0.104***
	(0.025)	(0.022)	(0.034)	(0.025)	(0.027)	(0.030)	(0.030)	(0.029)	(0.036)
tfp_{it-2}		0.013	0.038		0.015	0.040		0.010	0.026
		(0.028)	(0.031)		(0.026)	(0.028)		(0.026)	(0.033)
tfp_{it-3}			0.058*			0.060**			0.044
			(0.032)			(0.030)			(0.036)
Sunk costs:									
$Export_{it}$	0.064***	0.062***	0.051**	0.048**	0.055**	0.043	0.120***	0.117***	0.123***
	(0.022)	(0.022)	(0.025)	(0.023)	(0.024)	(0.027)	(0.026)	(0.034)	(0.038)
$Export_{it-1}$	0.035***	0.024**	0.045**	0.035***	0.026**	0.045***	0.037**	0.021	0.096***
	(0.013)	(0.010)	(0.019)	(0.011)	(0.010)	(0.012)	(0.017)	(0.014)	(0.033)
$Export_{it-2}$		0.030***	0.019*		0.026***	0.018*		0.029**	0.031**
		(0.011)	(0.011)		(0.009)	(0.011)		(0.014)	(0.014)
$Export_{it-3}$			0.022**			0.016			-0.003
			(0.011)			(0.013)			(0.013)
$Domestic_{it}$	0.137***	0.133***	0.112**	0.141***	0.153***	0.134***	0.148***	0.142***	0.127***
	(0.036)	(0.035)	(0.044)	(0.037)	(0.033)	(0.041)	(0.036)	(0.047)	(0.038)
$Domestic_{it-1}$	0.030	0.025	0.093**	0.028	0.024	0.098**	0.024	0.028	0.095**
	(0.032)	(0.028)	(0.042)	(0.031)	(0.033)	(0.039)	(0.036)	(0.030)	(0.039)
$Domestic_{it-2}$		-0.017	-0.023		-0.019	-0.025		-0.044	-0.057
		(0.025)	(0.027)		(0.023)	(0.030)		(0.029)	(0.039)
$Domestic_{it-3}$			0.006			0.001			-0.015
			(0.035)			(0.033)			(0.032)
$Exporter_{it-1}$	-0.111	-0.075	-0.129						
	(0.093)	(0.077)	(0.125)						
$Exporter_{it-2}$		-0.091	-0.092						
		(0.081)	(0.096)						
$Exporter_{it-3}$			-0.038						
			(0.088)						
Group:									
$Foreign_{it}$	-0.305***	-0.309***	-0.349**	-0.335**	-0.296**	-0.332**	-0.333**	-0.336***	-0.307*
	(0.102)	(0.112)	(0.161)	(0.137)	(0.126)	(0.143)	(0.135)	(0.110)	(0.165)
$Foreign_{it-1}$	-0.549***	-0.513***	-0.520***	-0.572***	-0.531***	-0.542***	-0.523***	-0.493***	-0.564***
	(0.086)	(0.104)	(0.123)	(0.094)	(0.104)	(0.133)	(0.107)	(0.097)	(0.141)
$Foreign_{it-2}$		-0.100	-0.369***		-0.087	-0.382***		-0.090	-0.347**
		(0.087)	(0.121)		(0.070)	(0.133)		(0.079)	(0.147)
$Foreign_{it-3}$			-0.120			-0.098			-0.095
			(0.087)			(0.079)			(0.113)
All_{it}	0.160**	0.183**	0.179**	0.154**	0.203***	0.201**	0.217**	0.235***	0.291**
	(0.076)	(0.079)	(0.089)	(0.071)	(0.077)	(0.090)	(0.104)	(0.085)	(0.120)
All_{it-1}	0.328***	0.199***	0.157*	0.349***	0.186**	0.147*	0.309***	0.192***	0.118
	(0.084)	(0.071)	(0.087)	(0.073)	(0.073)	(0.087)	(0.103)	(0.074)	(0.108)
All_{it-2}		0.413***	0.314***		0.414***	0.309***		0.384***	0.328***
		(0.077)	(0.079)		(0.067)	(0.091)		(0.090)	(0.110)
All_{it-3}			0.361***			0.375***			0.450***
			(0.098)			(0.090)			(0.119)
$Conc_{it}$	0.001	0.001	0.002	0.001	0.000	0.002	0.003	0.003	0.007
	(0.004)	(0.005)	(0.006)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
mes_{it}	0.684	0.750	1.442	0.732	0.726	1.428*	0.378	0.427	1.269
	(0.732)	(0.754)	(0.883)	(0.671)	(0.722)	(0.830)	(0.812)	(1.109)	(1.072)
Constant	6.024	6.508	10.70	7.647	9.982	12.610	15.220*	15.520	22.180**
	(7.384)	(7.336)	(9.188)	(7.003)	(7.266)	(8.326)	(8.281)	(10.980)	(10.310)
# of obs	103,898	103,898	87,554	103,898	103,898	87,554	75,509	75,509	63,741
# of firms	20,679	20,679	19,835	20,679	20,679	19,835	11,771	11,771	11,558
Sector & Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bootstrap	100	100	100	100	100	100	100	100	100

Robust standard errors in parentheses
*** p<0.01, ** p<0.5, * p<0.1

Table 3: Probability of being involved in a legal procedure in the next 3 years – Model 1

[a] We introduce intra-individual means of variables as regressors to control for a possible correlation between co-variables and unobserved individual heterogeneity, following the methodology proposed by Mundlak (1978).

4.2 Probit estimations

Productivity decreases the probability of being in default (Table 3). Additionally, its effect is more significant when the time of default is closer. This result confirms both our statistics (see Appendix C) and the previous findings of the existing literature: the decline in productivity is a robust finding in the shadow of death literature (Griliches and Regev, 1995; Kiyota and Takizawa, 2007; Blanchard et al., 2014).

The estimates provide a counterintuitive result that the more important sunk costs are, the higher the probability of being in default in the short term. According to the theoretical literature, sunk costs prevent exit because they cannot be refunded if the firm leaves the market. However, here, sunk costs do not seem to act as a barrier to exit. One explanation is that the inertia of export activity can be defined as an opportunity cost of leaving a market. Since firms invest in these foreign markets, they do not want to lose potential opportunities to sell their products. Doing so will shrink firms' potential market size. This phenomenon should be heightened when exports are the firms' main source of revenue. The proportion of illiquid assets will be too high for firms in distress. Just before they become involved in a collective procedure, their assets cannot be converted into liquid assets, causing a default of payment. Contrary to what Figure 1 shows, the assets included in the sunk costs of exporters in distress seem to be larger than those of similar continuing exporters.

The issue surrounding the important portion of assets invested in sunk costs leads to another explanation: the illiquidity of assets invested in the sunk costs. When a firm is not in good shape, it wants to convert its assets in cash to meet the due dates of receivables. However, if the amount of sunk costs is too high, the firm may be trapped in an illiquidity situation, where it cannot reimburse its creditors within 45 days. After this due date, the legal procedure is triggered, either by a creditor, a prosecutor, or the court itself. It is not the decision of the firm's leadership. This explanation seems robust since the sunk costs related to the domestic market have the same effect on the default probability: the estimated coefficients are either positive and significant or non-significant. Therefore, sunk costs do not act as a barrier to exit but raise the difficulty of the firm's survival. This result can also be viewed as a sunk cost fallacy. [13]

A last plausible explanation is the sunk cost fallacy. It is generally assumed that the more a firm invests, the more it tries to be profitable. Nevertheless, if it does not succeed as expected, the firm will invest more in those sunk costs. The idea behind this phenomenon is quite simple but is not based on rational behavior. If the investment is not profitable, the firm should stop spending to avoid losing more money. As O'Brien and Folta (2009) note, the sunk cost fallacy is based on the assumption that people are not able to make decisions in their own best interest. In an incomplete information economic environment, where we only know the potential outcomes and not the real outcomes, agents have to decide based on bounded rationality. Hence, we can accept this assumption.

Contrary to the findings of Bernard and Jensen (1999), we find no evidence of a significant impact of past exporter status on the probability of being involved in a collective procedure. Weak exporter heterogeneity may explain this finding: more than half of firms are continuous exporters. A way to address this limitation is to focus only on exporting firms. In

[13] However, because we focus only on the variables that cause entry into in a collective procedure and not what happens afterwards, we cannot draw conclusions regarding the cause of this reduction of export sunk costs.

Variables[a]	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	European Union countries						OECD countries					
	Number of destinations			Share of destinations			Number of destinations			Share of destinations		
tfp_{it}	-0.183***	-0.186***	-0.139***	-0.184***	-0.182***	-0.142***	-0.184***	-0.187***	-0.141***	-0.179***	-0.180***	-0.142***
	(0.032)	(0.030)	(0.040)	(0.032)	(0.031)	(0.042)	(0.0329)	(0.0378)	(0.0427)	(0.0279)	(0.0291)	(0.0448)
tfp_{it-1}	-0.073**	-0.079***	-0.101**	-0.072**	-0.076***	-0.103***	-0.074***	-0.081***	-0.105**	-0.070**	-0.075***	-0.103***
	(0.028)	(0.028)	(0.040)	(0.033)	(0.025)	(0.038)	(0.025)	(0.029)	(0.043)	(0.031)	(0.029)	(0.038)
tfp_{it-2}		0.009	0.025		0.011	0.025		0.008	0.023		0.011	0.026
		(0.029)	(0.035)		(0.030)	(0.034)		(0.033)	(0.036)		(0.028)	(0.038)
tfp_{it-3}			0.044			0.044			0.043			0.044
			(0.042)			(0.039)			(0.033)			(0.051)
Sunk costs:												
Export$_{it}$	0.116***	0.114***	0.121***	0.118***	0.113***	0.120***	0.117***	0.115***	0.121***	0.118***	0.115***	0.121***
	(0.032)	(0.031)	(0.034)	(0.028)	(0.027)	(0.037)	(0.034)	(0.026)	(0.032)	(0.030)	(0.028)	(0.034)
Export$_{it-1}$	0.035**	0.020	0.096***	0.036**	0.021	0.093**	0.036***	0.020	0.094**	0.036**	0.021*	0.093***
	(0.015)	(0.015)	(0.036)	(0.018)	(0.014)	(0.040)	(0.014)	(0.014)	(0.039)	(0.017)	(0.012)	(0.032)
Export$_{it-2}$		0.028*	0.032*		0.029**	0.031**		0.029*	0.032*		0.029*	0.031*
		(0.016)	(0.018)		(0.013)	(0.016)		(0.016)	(0.019)		(0.018)	(0.017)
Export$_{it-3}$			-0.001			-0.003			-0.002			-0.003
			(0.014)			(0.019)			(0.016)			(0.015)
Domestic$_{it}$	0.143***	0.137***	0.119***	0.149***	0.141***	0.126**	0.142***	0.137***	0.119**	0.145***	0.138***	0.125***
	(0.042)	(0.046)	(0.046)	(0.035)	(0.043)	(0.056)	(0.041)	(0.037)	(0.047)	(0.039)	(0.039)	(0.043)
Domestic$_{t-1}$	0.019	0.025	0.088**	0.023	0.029	0.093**	0.019	0.024	0.088*	0.022	0.027	0.092*
	(0.032)	(0.036)	(0.040)	(0.039)	(0.032)	(0.046)	(0.037)	(0.036)	(0.050)	(0.039)	(0.043)	(0.047)
Domestic$_{it-2}$		-0.051*	-0.060*		-0.045	-0.057*		-0.053	-0.062**		-0.046	-0.058
		(0.026)	(0.032)		(0.031)	(0.030)		(0.033)	(0.029)		(0.031)	(0.036)
Domestic$_{it-3}$			-0.019			-0.015			-0.022			-0.015
			(0.037)			(0.033)			(0.037)			(0.035)
Destination countries:												
Inside EU/OECD$_{it}$	0.020*	0.021*	0.012	0.124	0.119	0.038	0.083**	0.086**	0.084	0.413	0.420	0.196
	(0.012)	(0.011)	(0.012)	(0.134)	(0.118)	(0.156)	(0.037)	(0.039)	(0.054)	(0.280)	(0.259)	(0.336)
Inside EU/OECD$_{it-1}$	0.012	0.009	0.010	-0.146	-0.114	-0.013	0.024	0.019	0.032	0.051	0.057	0.057
	(0.010)	(0.008)	(0.012)	(0.136)	(0.100)	(0.119)	(0.034)	(0.039)	(0.035)	(0.283)	(0.258)	(0.293)
Inside EU/OECD$_{it-2}$		0.009	0.007		-0.040	0.003		0.012	-0.012		0.113	0.0451
		(0.009)	(0.010)		(0.098)	(0.104)		(0.038)	(0.043)		(0.246)	(0.216)
Inside EU/OECD$_{it-3}$			0.010			-0.224*			0.004			-0.215
			(0.010)			(0.118)			(0.044)			(0.290)
Outside EU/OECD$_{it}$	0.015	0.015	0.015				0.009	0.009	0.006			
	(0.010)	(0.013)	(0.012)				(0.008)	(0.007)	(0.009)			
Outside EU/OECD$_{it-1}$	0.006	0.002	-0.002				0.015*	0.009	0.007			
	(0.005)	(0.004)	(0.005)				(0.008)	(0.007)	(0.008)			
Outside EU/OECD$_{it-2}$		0.005	-0.003					0.013*	0.008			
		(0.003)	(0.004)					(0.008)	(0.008)			
Outside EU/OECD$_{it-3}$			0.014***						0.018**			
			(0.004)						(0.009)			
# of obs	75,509	75,509	63,741	75,509	75,509	63,741	75,509	75,509	63,741	75,509	75,509	63,741
# of firms	11,771	11,771	11,558	11,771	11,771	11,558	11,771	11,771	11,558	11,771	11,771	11,558
Sector & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bootstrap	100	100	100	100	100	100	100	100	100	100	100	100

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Probability of being involved in a legal procedure in the next 3 years – Effect of EU destination countries – Continuous exporters only

[a] We introduce intraindividual means of variables as regressors to control for a possible correlation between covariables and unobserved individual heterogeneity, following the methodology proposed by Mundlak (1978).

columns (7) to (9) of Table 3, we find the same effects for all the variables; we can then accept the robustness of this result: past export status does not have any significant effect on default.

Considering that the export activity towards easy and difficult markets can help illustrate how firms deal with risk, as in real options models, we do not find a decrease in exports to "more difficult markets". In Table 4 We first estimate a model with the number of products exported both inside and outside the European Union (columns (1) to (3)). Then, we estimate another model with the share of exports to an easy market in the total exports made by the firm every year (columns (4) to (6)). The results show no impact of either the number or the share of the destination market, except for the number of markets in t, which is slightly significant.[14]. Nevertheless, the heterogeneity of economic activities and opportunities within EU countries can be too large to consider all of them as easy markets. Therefore, as a robustness check, we also consider OECD countries, which should be more similar in terms of economic development, as easy destination countries. Again, only the number of destinations at the time of default has a positive impact on the default probability. Since the results reported in the other half of Table 4, i.e. Columns (7) to (12), illustrate the same phenomenon, our findings appear robust.

Considering that only the number of destination estimations in t is significant, our findings are in line with the predictions of real options model theory. As O'Brien and Folta (2009) notes, the inertia we find here can be logically explained, especially when sunk costs are high. When facing great uncertainty and a high amount of sunk costs, poorly performing firms will not exit the market. Exiting the market means losing the stock of the wide variety of sunk costs, such as "strategic asset stocks", as defined by Dierickx and Cool (1989), and knowledge, i.e., the innovation savoir-faire, steadily accumulated through the company's exporting history. Thus, exiting and re-entering the market when the economic environment is more favorable also means losing competitiveness compared to the pre-exit situation, even if the firm does not perform well (Dierickx and Cool, 1989; O'Brien and Folta, 2009). For this reason, firms will stay in an inaction zone, hoping for better times. In light of our findings, it seems that the incompleteness of information, and thus the range of possible outcomes, is important enough for those firms to stay in a supposedly more difficult and risky business. This description seems to be in line with the first explanation of the positive relation between the default and export sunk costs: the inertia of export activity. However, when the firm is in default, the manager does not make decisions anymore. An administrator nominated by the court now owns the decision power to save the company. The administrator needs to improve the firm's situation as quickly as possible. For these reasons, it is logical to reduce the number of markets to which the firm exports in order to focus on the company's historical export market, as shown in Appendix D. We observe a similar phenomenon for the amount of sunk costs after the triggering of the procedure (Figure 1 and Figure 11).

In Table 4, the signs and significance of our productivity index and the sunk costs linked to the export market and domestic market coefficients do not change compared to Table 3. We still find a positive correlation between firms' default probability and their level of sunk costs and a negative correlation with their productivity. Therefore, the slight decrease in destinations when a firm is, or will be, in default, as seen in Section 4.1, does not seem to hold when we take into account

[14]Control variables are not displayed here but are similar to those in the primary model shown in Table 3

multiple factors, such as productivity or sunk costs.[15]

Regarding the control variables, we also note that group affiliation has a significant impact on firms' default. When firms are affiliated with a group (either foreign, domestic, or both), it raises the likelihood of default. However, being part of an international group lowers the probability of being in default, and it is highly significant. This finding is counterintuitive when we consider the "footloose" literature (see, among others, Mata and Portugal, 2002; Bernard and Sjoholm, 2003; Görg and Strobl, 2003; Alvarez and Görg, 2009). Multinational firms should have a higher probability of exiting than domestic firms. However, because we are considering a rather particular subsample, exporters, it is only logical to not have the same conclusions as studies that consider all firms.

Conclusion

In this paper, we have identified that a representative portion of French exporters are in insolvency proceedings. This is a paradox, as it is well documented in the literature that only high-performing firms export. Higher economic performance allows firms to sustain additional costs, including sunk costs linked to export activity. As export sunk costs are at the core of this analysis, we propose an original approach based on a matching method to identify these sunk costs. Firm performance is measured through firms' total factor productivity, which is obtained from the estimate of production function by industry.

Furthermore, control for selection bias due to the lack of control for firm heterogeneity in gravity equations, as Helpman et al. (2008) do, is not enough. From the model developed by Melitz (2003) there is a cut-off point from which the firms are efficient enough to export. It exists a cut-off point, where the firms are efficient enough to export (extensive margin). Moreover, due to higher transport costs, the farthest the destination is, the higher the cut-off point is and more efficient the firms need to be (intensive margin). However, our results suggest that the mechanisms at work are more complex.

From our findings, we can conclude that if the economic performance of the firm is essential for its survival, the larger the sunk costs are, ceteris paribus, the higher the probability of default is. When we take into account the performance and the control variables, sunk costs do not prevent exit; instead, they tend to accelerate it. In addition, when firms are at the precipice of becoming involved in an insolvency procedure, they do not tend to reduce the number of export destinations until it is already too late to do so. Therefore, due to the high uncertainty of export activity, they are in an inaction zone, as the real options model predicts. Our contribution is the addition of the accountancy-based decision to enter into an insolvency procedure. Because the firm's economic decisions are no longer made by the firm but by the court and its advisors, they are no longer relevant.

Export decisions contain many risks, and firms may be interested in insuring their exports. This insurance prevents them from suffering from unexpected exogenous events that jeopardize their survival. However, insuring low-performing firms will raise the overall risk and thus the amount all firms will have to pay to be covered. This higher amount will raise the cost of exporting and weaken firms that would have been well managed enough to continue their activity. In addition, since the investment in sunk costs is too illiquid, it can induce a misallocation issue. As Foster et al. (2001) note, exit has

[15] We also try to assess the dynamics of products exported, but the models estimated do not seem conclusive.

a significant role in reallocation. Since exporters have higher sunk costs than domestic firms, they can hinder the market's selection process, even if some exporters are involved in a collective procedure.

However, our paper has limitations. For example, we discriminate the sunk costs considering only two markets: domestic and export markets. We do not discriminate among export markets. Moreover, we do not distinguish the products that firms export. Some products may face fiercer competition than others. Moreover, an analysis of the interaction between the product and the destination country can improve our understanding of firms' behaviors within the international competition context. However, since we focus our study on firm-level data, this approach was outside the scope of this study; however, it could be developed in future work.

References

Albornoz, F., Fanelli, S., and Hallak, J. C. (2016). Survival in export markets. *Journal of International Economics*, 102:262–281.

Alvarez, R. and Görg, H. (2009). Multinationals and plant exit: Evidence from chile. *International Review of Economics & Finance*, 18(1):45–51.

Bellone, F., Musso, P., Quéré, M., and Nesta, L. (2006). Productivity and Market Selection of French Manufacturing Firms in the Nineties. *Revue de l'OFCE*, 97 bis(5):319.

Bernard, A. B. and Jensen, J. B. (1999). Exceptional exporter performance: cause, effect, or both? *Journal of International Economics*, 47(1):1–25.

Bernard, A. B. and Jensen, J. B. (2007). Firm Structure, Multinationals, and Manufacturing Plant Deaths. *Review of Economics and Statistics*, 89(2):193–204.

Bernard, A. B., Redding, S. J., and Schott, P. K. (2011). Multiproduct firms and trade liberalization. *The Quarterly journal of economics*, 126(3):1271–1318.

Bernard, A. B. and Sjoholm, F. (2003). Foreign owners and plant survival. Technical report, National Bureau of Economic Research.

Blanchard, P., Huiban, J.-P., and Mathieu, C. (2012). The determinants of firm exit in the French food industries. *Review of agricultural and environmental studies*, 92(2):193–212.

Blanchard, P., Huiban, J.-P., and Mathieu, C. (2014). The shadow of death model revisited with an application to French firms. *Applied Economics*, 46(16):1883–1893.

Brandt, L., Van Biesebroeck, J., and Zhang, Y. (2012). Creative accounting or creative destruction? Firm-level productivity growth in Chinese manufacturing. *Journal of Development Economics*, 97(2):339–351.

Chaney, T. (2014). The network structure of international trade. *American Economic Review*, 104(11):3600–3634.

Chaney, T. (2016). Liquidity constrained exporters. *Journal of Economic Dynamics and Control*, 72:141–154.

Comanor, W. S. and Wilson, T. A. (1967). Advertising market structure and performance. *The Review of Economics and Statistics*, 49(4):423–440.

Dierickx, I. and Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management science*, 35(12):1504–1511.

Ericson, R. and Pakes, A. (1995). Markov-perfect industry dynamics: A framework for empirical work. *The Review of Economic Studies*, 62(1):53–82.

Fontagné, L., Secchi, A., and Tomasi, C. (2018). Exporters' product vectors across markets. *European Economic Review*, 110:150–180.

Foster, L., Haltiwanger, J. C., and Krizan, C. J. (2001). Aggregate productivity growth: lessons from microeconomic evidence. In *New developments in productivity analysis*, pages 303–372. University of Chicago Press.

Foster, L., Haltiwanger, J. C., and Syverson, C. (2008). Reallocation, firm turnover, and efficiency: Selection on productivity or profitability? *The American Economic Review*, 98(1):394–425.

Ghosal, V. (2010). Quantifying the role played by sunk capital costs in real-options models. *Scottish Journal of Political Economy*, 57(3):343–358.

Girma, S., Greenaway, D., and Kneller, R. (2003). Export Market Exit and Performance Dynamics: A Causality Analysis of Matched Firms. *SSRN Electronic Journal*.

Görg, H. and Strobl, E. (2003). 'footloose'multinationals? *The Manchester School*, 71(1):1–19.

Greene, W. (2004). The behaviour of the maximum likelihood estimator of limited dependent variable models in the presence of fixed effects. *The Econometrics Journal*, 7(1):98–119.

Griliches, Z. and Regev, H. (1995). Firm productivity in Israeli industry 1979–1988. *Journal of Econometrics*, 65(1):175–203.

Helpman, E., Melitz, M., and Rubinstein, Y. (2008). Estimating trade flows: Trading partners and trading volumes. *The quarterly journal of economics*, 123(2):441–487.

Hopenhayn, H. A. (1992). Entry, exit, and firm dynamics in long run equilibrium. *Econometrica: Journal of the Econometric Society*, pages 1127–1150.

Jovanovic, B. (1982). Selection and the evolution of industry. *Econometrica*, 50(3):649–670.

Kessides, I. N. (1990). Market Concentration, Contestability, and Sunk Costs. *The Review of Economics and Statistics*, 72(4):614–622.

Kiyota, K. and Takizawa, M. (2007). The shadow of death: Pre-exit performance of firms in japan. Hi-Stat Discussion Paper Series d06-204, Institute of Economic Research, Hitotsubashi University.

Levinsohn, J. and Petrin, A. (2003). Estimating Production Functions Using Inputs to Control for Unobservables. *Review of Economic Studies*, 70(2):317–341.

Mata, J. and Portugal, P. (2002). The survival of new domestic and foreign-owned firms. *Strategic Management Journal*, 23(4):323–343.

Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71(6):1695–1725.

Mundlak, Y. (1978). On the Pooling of Time Series and Cross Section Data. *Econometrica*, 46(1):69.

O'Brien, J. and Folta, T. (2009). Sunk costs, uncertainty and market exit: A real options perspective. *Industrial and Corporate Change*, 18(5):807–833.

Rauch, J. E. and Trindade, V. (2002). Ethnic chinese networks in international trade. *Review of Economics and Statistics*, 84(1):116–130.

Roberts, M. J. and Tybout, J. R. (1997). The decision to export in Columbia: An empirical model of entry with sunk costs. *The American Economic Review*, pages 545–564.

Rosenbaum, P. R. and Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1):41–55.

Vicard, V. (2014). Export: risky business?

Wagner, J. (2013). Exports, imports and firm survival: first evidence for manufacturing enterprises in Germany. *Review of World Economics*, 149(1):113–130.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

Yi, J. and Wang, C. (2012). The decision to export: Firm heterogeneity, sunk costs, and spatial concentration. *International Business Review*, 21(5):766–781.

Appendices

A Legal procedures

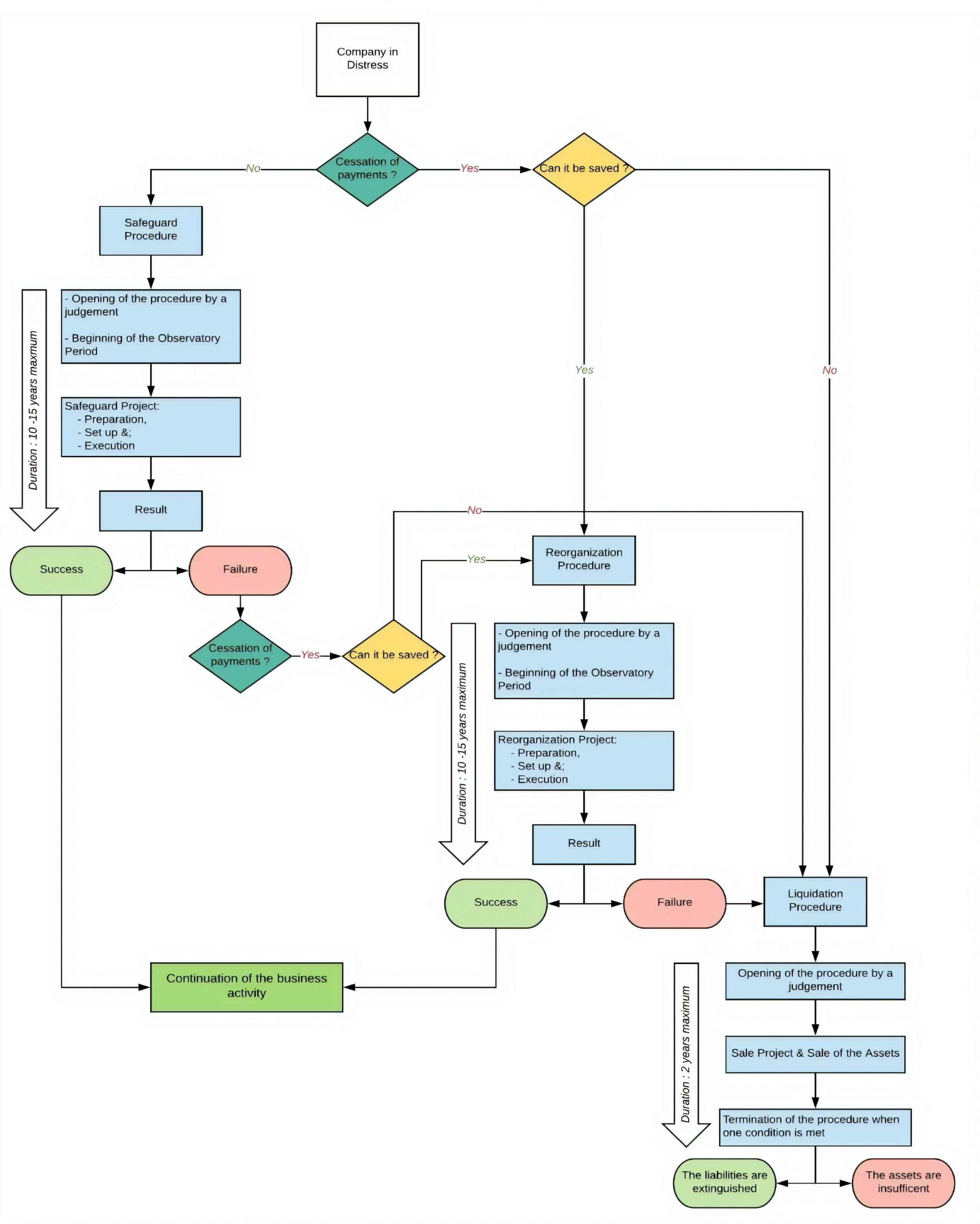


Figure 3: French system of legal procedures

B Total factor productivity

TFP is the firm productivity we cannot explain by the observable inputs. It is the contribution to the output of other inputs not used in the production function and to technological efficiency.

$$Y = f(X_1, ..., X_n) \tag{7}$$

A common form used in the literature is the Cobb-Douglas production function.

$$Y = A_{it} K_{it}^{\alpha_K} L_{it}^{\alpha_L} \tag{8}$$

where L and K are production factors (labor and capital, respectively), and A is the TFP.

Since we can log-linearize this function, we can use linear estimators. However, the estimation of the production function raises some econometric issues. The first is the simultaneity problem. If the firm knows its unobserved productivity, then the amount of input used and productivity must be correlated. Hence, the OLS estimator of input elasticities will be biased. Another problem is that the exit of firms will be endogenous. We can link firm productivity to how well the company performs in the market. We can also link this performance to the firm's exit from the market. Therefore, the firm cannot randomly decide to exit; it should be a consequence of its productivity. In this case, the exit is not exogenous, which is the other reason why OLS will be biased. To control for these biases, Levinsohn and Petrin propose a solution using a control function. They do not instrument endogenous regressors but add a proxy variable to control for bias.
Contrary to Olley and Pakes (1996), they propose using materials instead of investment as a proxy. The number of firms using materials is much greater than the number of investing firms. Except for this difference in the proxy used, the two papers use the same methodology: a two-step, semi-parametrical estimator. The log-linearized production function takes the following form:

$$y_{it} = \alpha_0 + \alpha_L l_{it} + \alpha_K k_{it} + \alpha_m m_{it} + \omega_{it} + \varepsilon_{it} \tag{9}$$

where y_{it}, l_{it}, k_{it}, and m_{it} are, respectively, the output, labor, physical capital and intermediate inputs of firm i in year t, which operate in industry j (omitted for readability), while $\alpha_0 + \omega_{it}$ is the TFP. Here, we allow the variation of technology across industries. The demand for m_{it} depends on the firm's capital and productivity:

$$m_{it} = m_{it}(k_{it}, \omega_{it}) \tag{10}$$

Levinsohn and Petrin also show that we can invert the intermediate demand function, so ω_{it} depends on k_{it} and m_{it}:

$$\omega_{it} = \omega_{it}(k_{it}, m_{it}) \tag{11}$$

In the first step, they estimate labor elasticity, solving

$$y_{it} = \alpha_L l_{it} + \phi_{it}(k_{it}, m_{it}) + \varepsilon_{it} \tag{12}$$

where

$$\phi_{it}(k_{it}, m_{it}) = \alpha_0 + \alpha_K k_{it} + \omega_{it}(k_{it}, m_{it}) \tag{13}$$

They use a third-order polynomial approximation in k_{it} and m_{it} in place of $\phi_{it}(k_{it}, m_{it})$. At this step, the labor elasticity is estimated. The second stage identifies the capital elasticity. We assume that TFP follows a first-order Markov process,

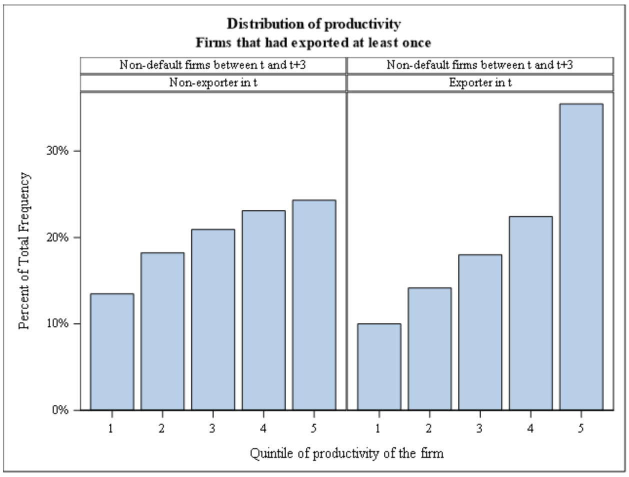
$$\omega_{it} = E[\omega_{it}|\omega_{it-1}] + \xi_{it} \tag{14}$$

where ξ_{it} is a productivity shock.

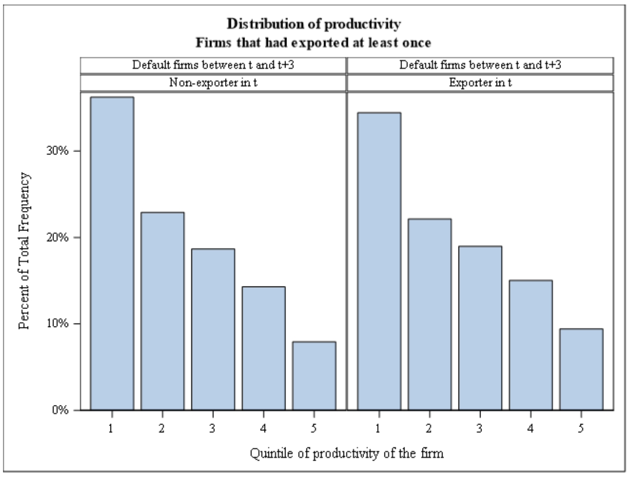
Finally, $\hat{\alpha}_k$, the estimation of α_k is the solution to the minimization of the squared sum of the sample residuals of the production function, given as

$$\min_{\alpha_k^*} \sum_{it} (\widehat{\varepsilon_{it} + \xi_{it}})^2 = \min_{\alpha_k^*} \sum_{it} (\hat{\alpha}_l l_{it} - \alpha_k^* k_{it} - E[\omega_{it}|\omega_{it-1}])^2 \tag{15}$$

C Distribution of firms according to their productivity

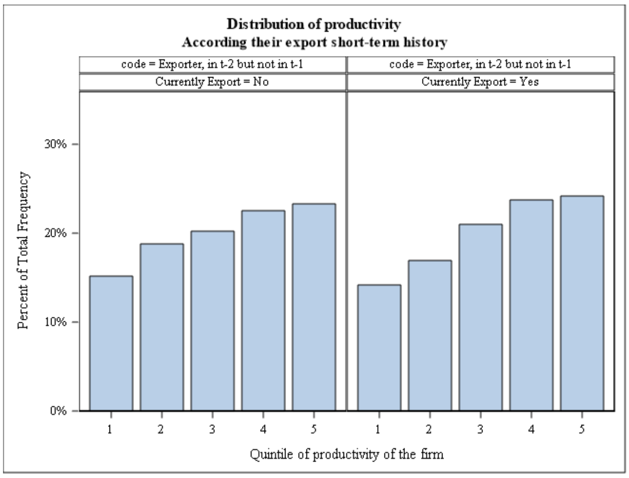


(a) Non-default firms

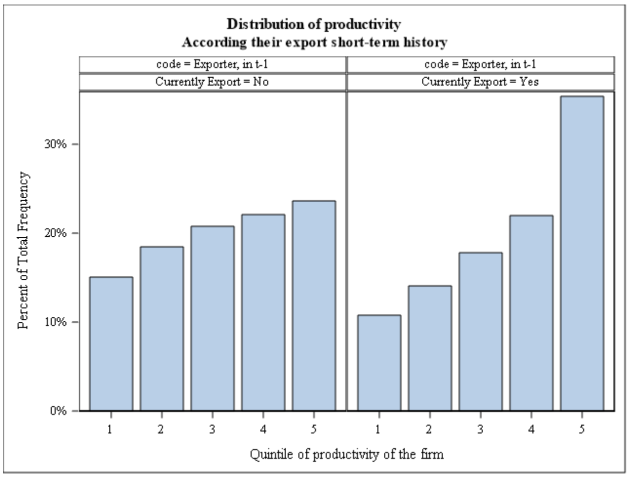


(b) Default firms

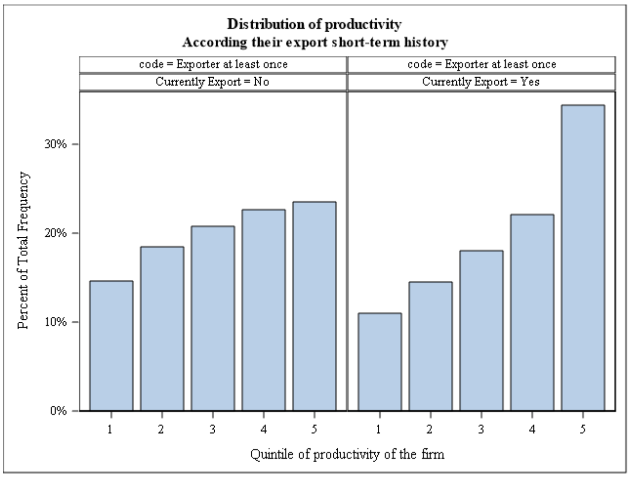
Figure 4: Distribution of productivity for exporting firms, whether they export or not



(a) Firms that exported two years ago

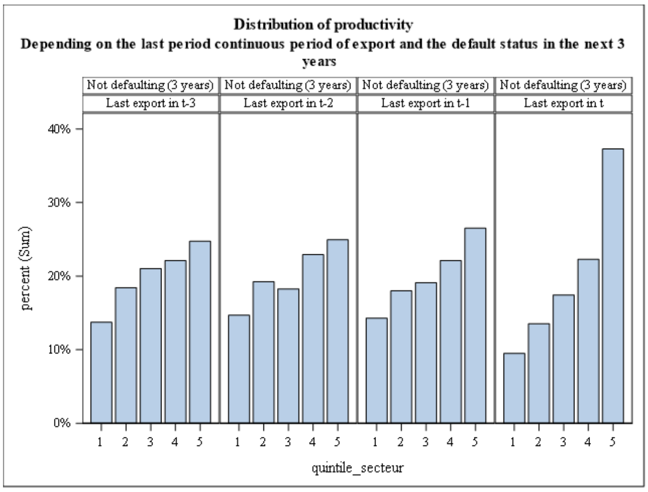


(b) Firms that exported one year ago

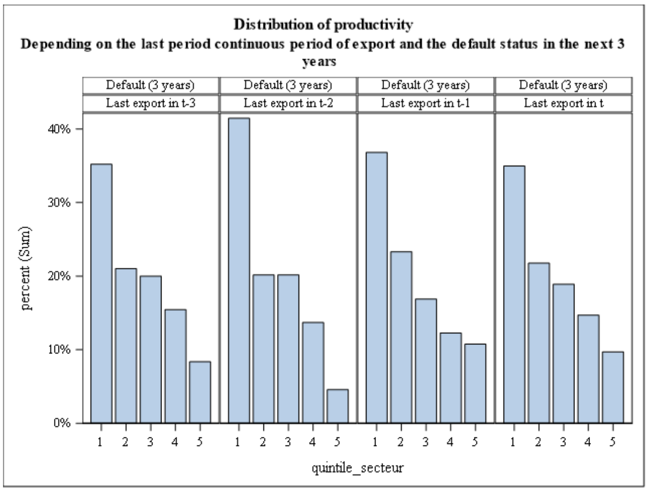


(c) Firms that had exported

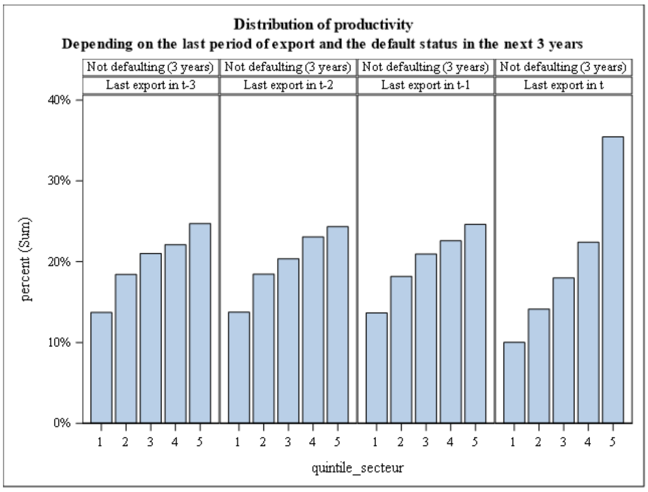
Figure 5: Distribution of productivity depending on the short-term history of whether they export or not



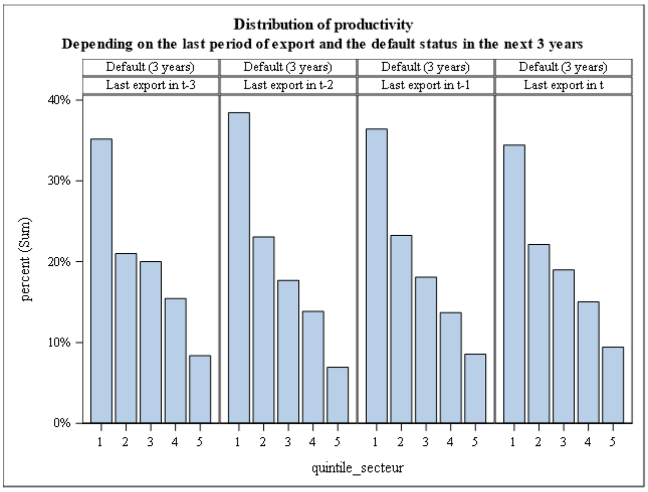
(a) Non-defaulting exporters (continuous)



(b) Defaulting exporters (continuous)

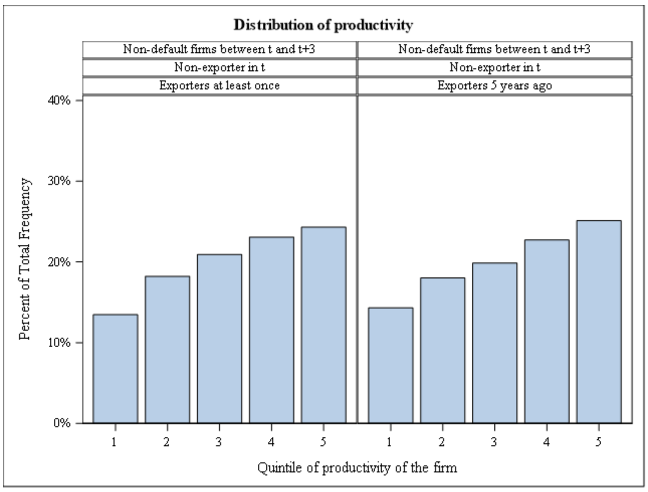


(c) Non-defaulting exporters

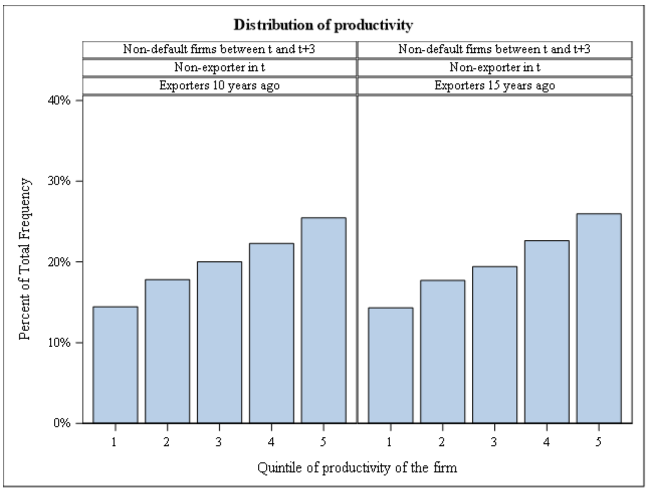


(d) Defaulting exporters

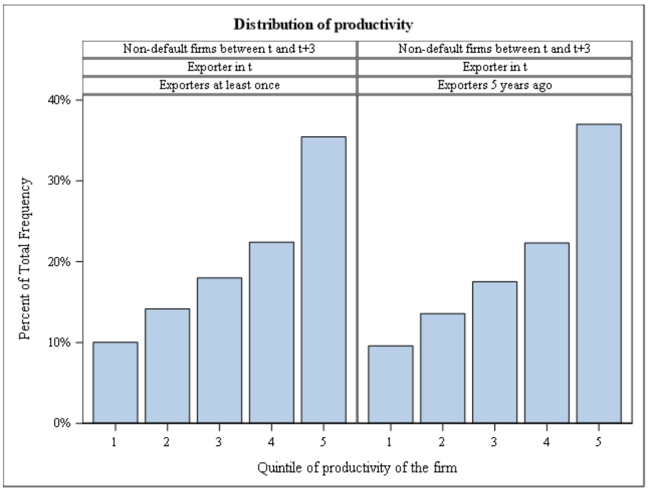
Figure 6: Distribution of productivity depending on last exporting year, continuous or not



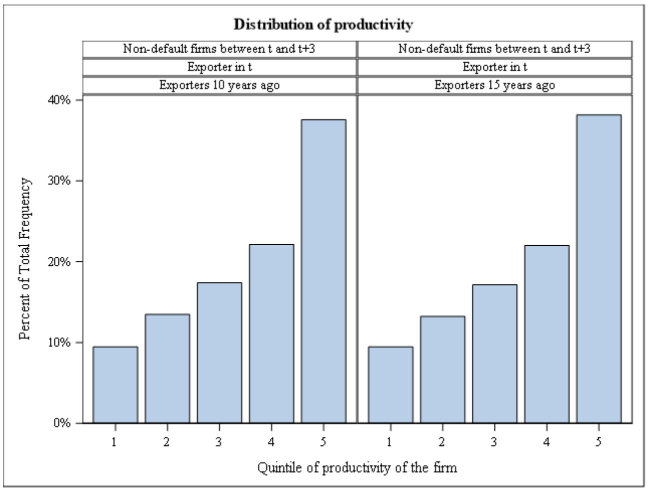
(a) Do not in t – at least once and 5 years ago



(b) Do not in t – 10 and 15 years ago

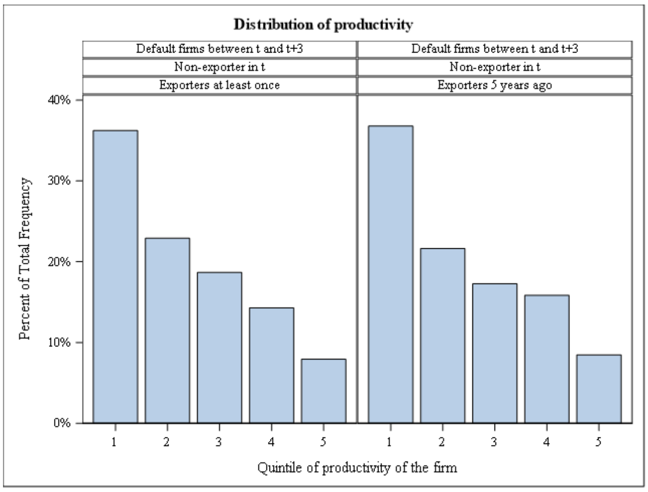


(c) Do in *t* – at least once and 5 years ago

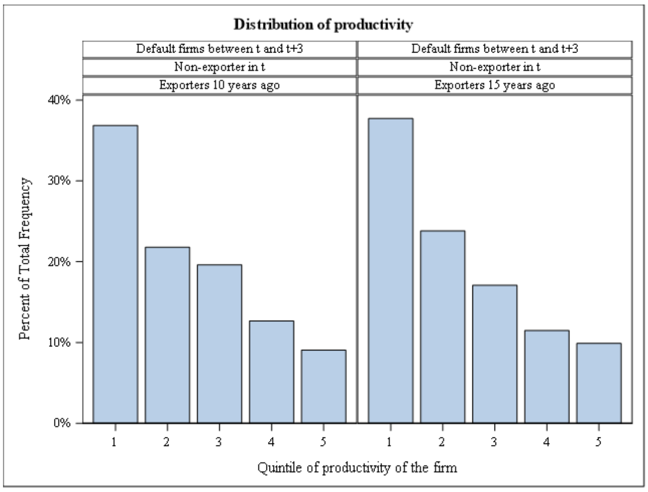


(d) Do in *t* – 10 and 15 years ago

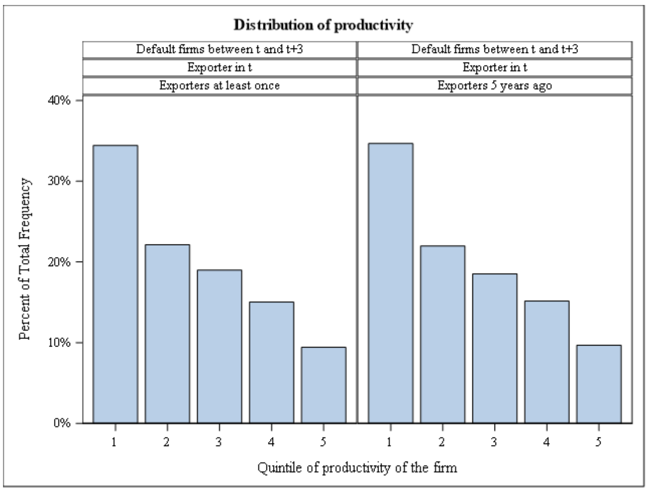
Figure 7: Distribution of productivity for non-default exporting firms, whether they export or not in *t*



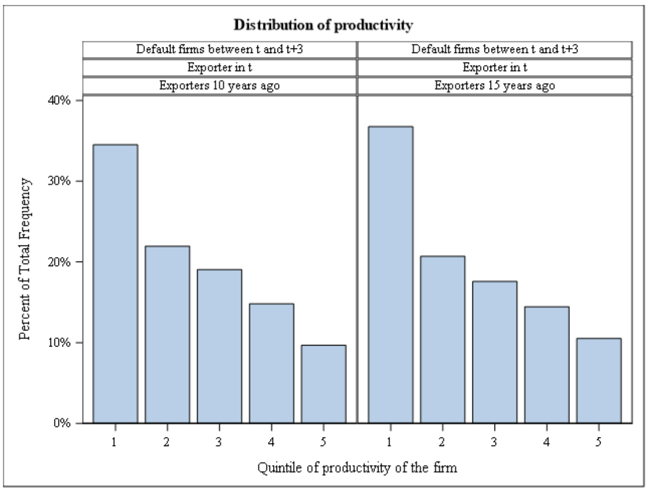
(a) Do not in *t* – at least once and 5 years ago



(b) Do not in *t* – 10 and 15 years ago



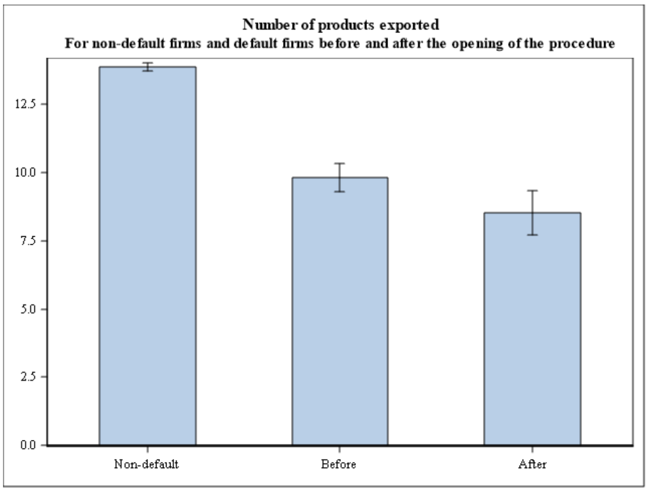
(c) Do in *t* – at least once and 5 years ago



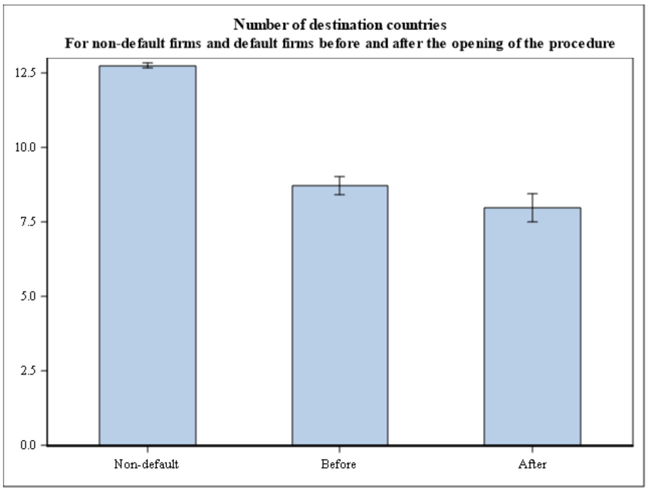
(d) Do in *t* – 10 and 15 years ago

Figure 8: Distribution of productivity for default exporting firms, whether they export or not in *t*

D Export behavior according to the firm's default status

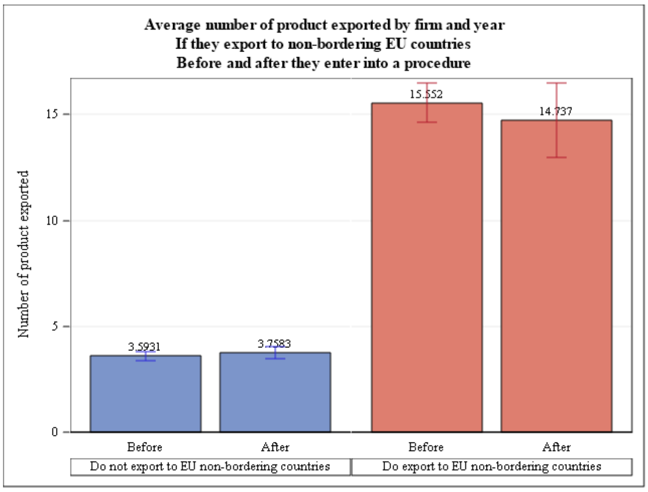


(a) Average number of products exported

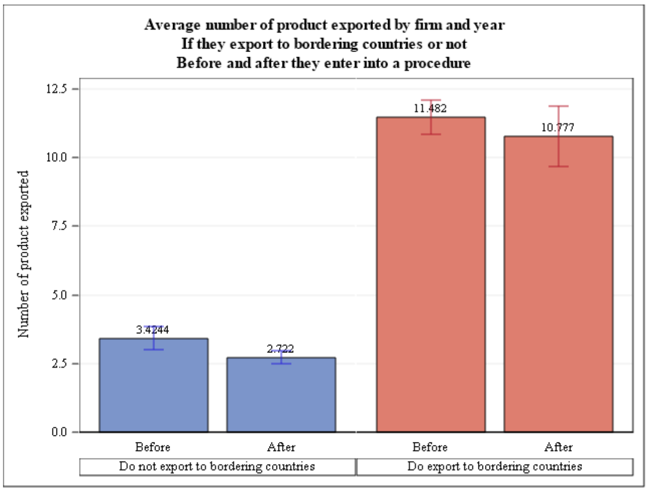


(b) Average number of destination countries

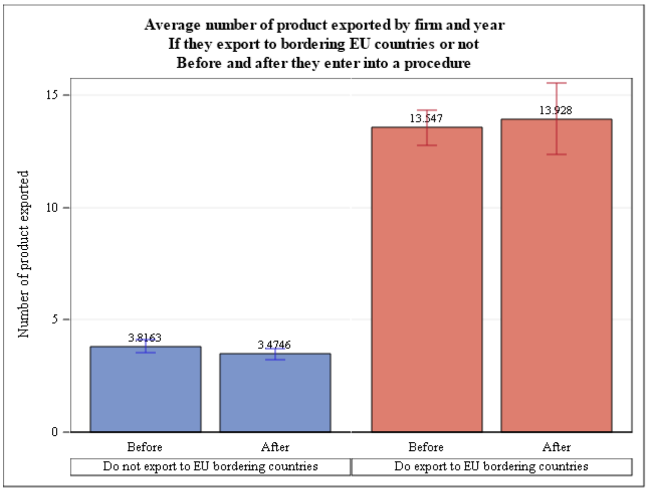
Figure 9: Non-defaulting vs. defaulting firms, before and after the start of the procedure



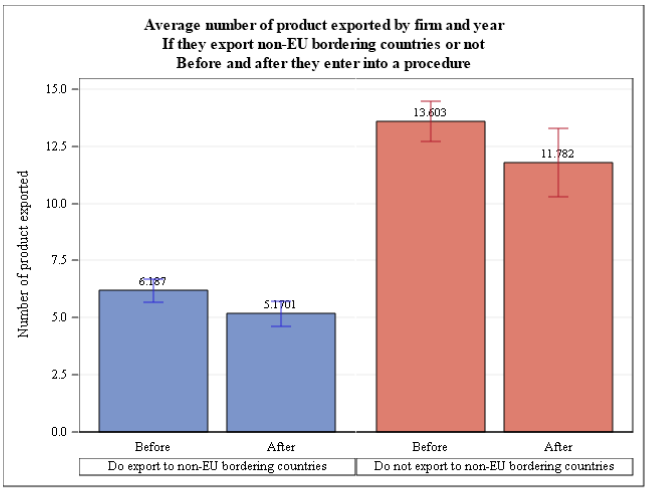
(a) Non-bordering EU countries



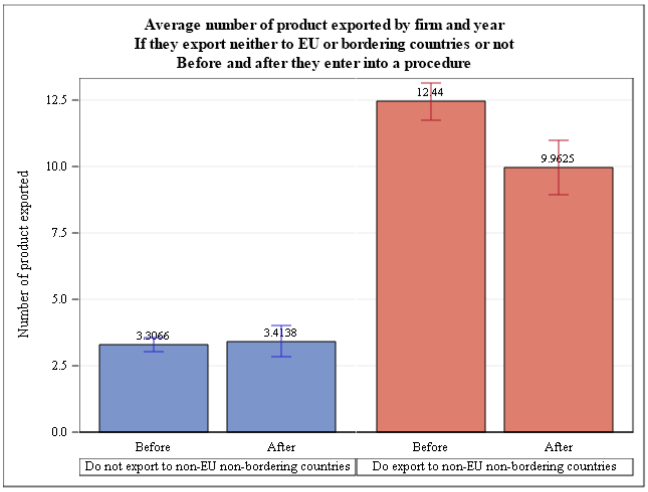
(b) All bordering countries



(c) Bordering EU countries



(d) Bordering non-EU countries



(e) Neither bordering nor EU countries

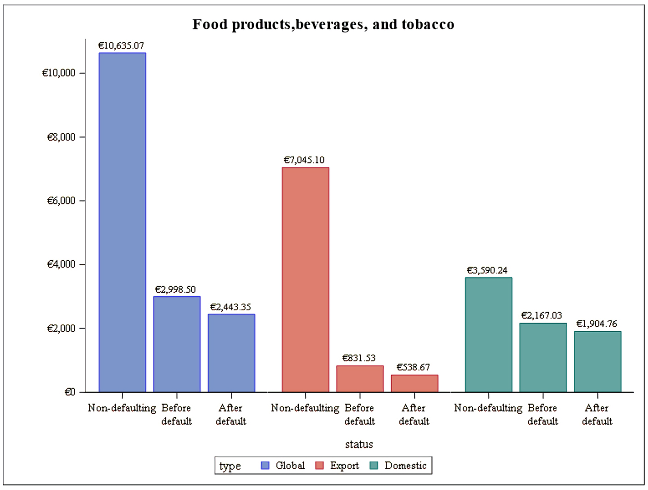
Figure 10: Number of products exported before and after the procedure's start by the type of destination country

E Sunk costs per category and industry

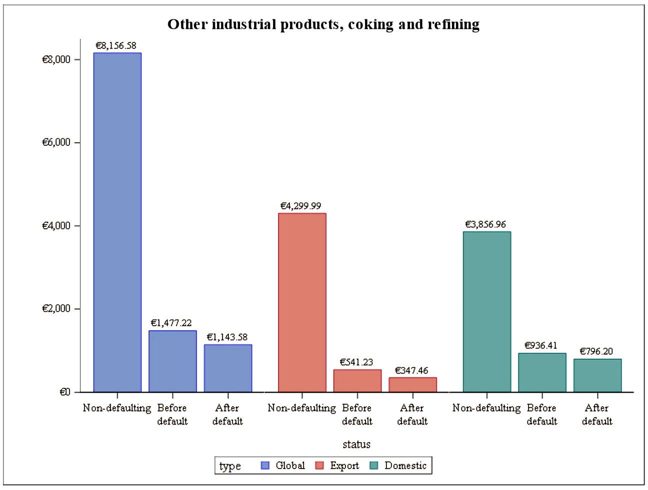
		All manufacturing industries			Food products, beverages, and tobacco			Other industrial products, coking and refining			Electrics, electronics, and informatics products		
		Incumbent	Defaulting		Incumbent	Defaulting		Incumbent	Defaulting		Incumbent	Defaulting	
			Before	After		Before	After		Before	After		Before	After
Sunk costs:													
Export	Mean	4,560.01	706.62	521.57	7,045.10	831.53	538.67	4,299.99	541.23	347.46	3,800.90	1,402.71	882.53
	SD	44,546.87	5,217.44	3,713.90	38,236.91	2,378.78	1,426.76	56,000.22	5,444.32	3,695.04	17,337.53	7,839.72	5,341.02
Domestic	Mean	2,599.05	791.05	671.95	3,590.24	2,167.03	1,904.76	3,856.96	936.41	796.20	455.98	330.36	344.67
	SD	11,508.35	5,053.29	3,802.46	5,942.35	3,326.68	2,719.91	16,025.79	6,961.63	5,250.97	381.13	330.96	357.52
Global	Mean	7,158.82	1,497.38	1,190.17	10,635.07	2,998.50	2,443.35	8,156.58	1,477.22	1,143.58	4,256.83	1,732.80	1,227.14
	SD	50,387.93	9,515.39	6,872.56	40,844.31	4,733.09	3,818.45	64,834.80	12,288.67	8,781.93	17,427.49	7,931.26	5,431.02
# of obs.		96,211	5,987	1,815	11,954	273	58	46,701	304	910	17,482	1,022	322

		Transporting materials			Clothing industries			Wood and paper industries		
		Incumbent	Defaulting		Incumbent	Defaulting		Incumbent	Defaulting	
			Before	After		Before	After		Before	After
Sunk costs:										
Export	Mean	14,793.06	615.68	784.75	1,396.74	431.03	387.31	2,425.78	648.13	800.25
	SD	71,957.64	2,280.67	3,179.62	8,027.89	2,367.78	1,015.77	12,732.35	2,025.50	3,360.13
Domestic	Mean	1,671.27	885.39	824.32	269.36	215.66	245.23	1,158.53	797.80	760.27
	SD	4,020.10	961.66	950.54	431.32	212.66	232.71	1,991.59	1,230.54	1,467.83
Global	Mean	16,464.28	1,501.02	1,609.01	1,693.01	646.62	632.48	3,534.23	1,445.87	1,531.68
	SD	72,529.43	2,746.85	3,618.52	8,086.41	2,436.48	1,155.99	13,803.45	2,790.47	4,340.78
# of obs.		3,707	194	66	709	644	252	9,277	814	207

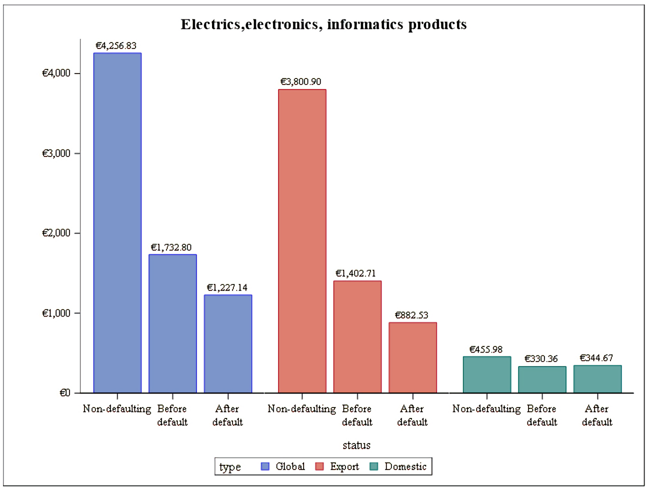
Table 5: Statistics on sunk costs, in thousand euros, depending on the default status



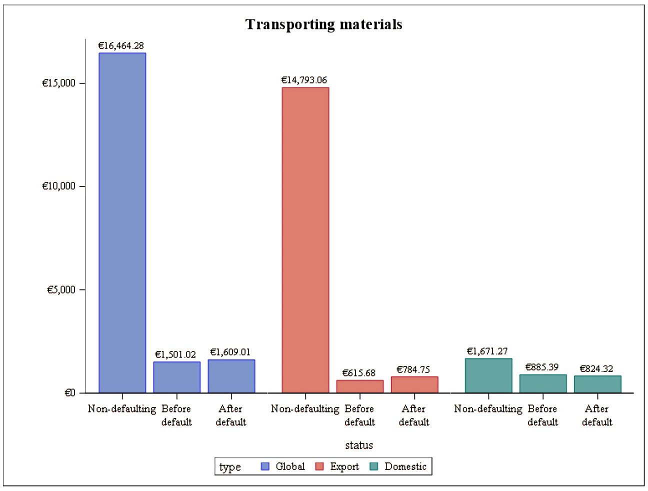
(a) Food products, beverages, and tobacco



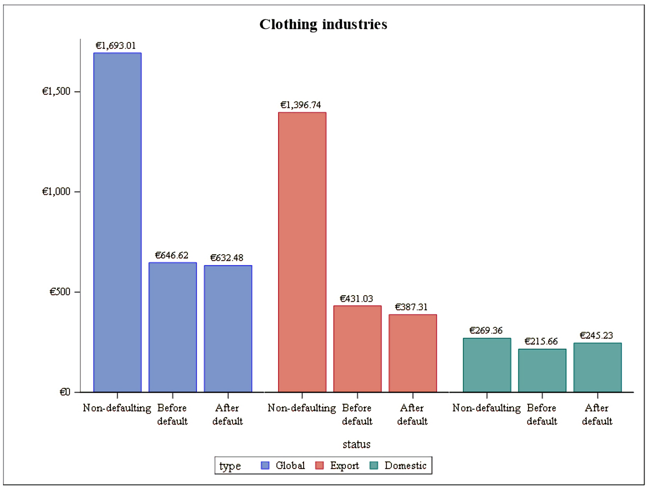
(b) Other industrial products, coking and refining



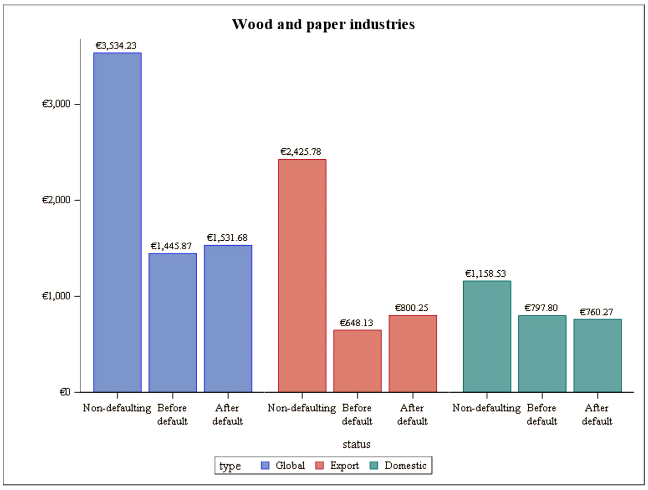
(c) Electrics, electronics, and informatics products



(d) Transporting materials



(e) Clothing industries



(f) Wood and paper industries

Figure 11: Average amount of sunk costs – Non-defaulting vs. defaulting firms

F Propensity score matching

F.1 PSM models

	(1)	(2)	(3) Excl. 1-year exporters	(4)	(5)	(6) Excl. 1-year exporters
Foreign group$_t$	0.376***	0.475***	0.498***	0.050	0.078	0.083
	(0.036)	(0.046)	(0.052)	(0.047)	(0.064)	(0.071)
Importer$_t$	1.100***	1.571***	1.686***	0.535***	0.649***	0.694***
	(0.021)	(0.030)	(0.036)	(0.021)	(0.032)	(0.035)
Log TFP$_{t-1}$	0.039***	0.080***	0.083***	0.005	0.015	0.015
	(0.009)	(0.014)	(0.015)	(0.009)	(0.013)	(0.0,15)
Log labor$_{t-1}$	0.901***	0.841***	0.947***	0.434***	0.481***	0.533***
	(0.022	(0.024)	(0.028)	(0.038)	(0.051)	(0.057)
Log liabilities$_{t-1}$	0.291***	0.292***	0.321***	0.082***	0.083***	0.086***
	(0.013)	(0.015)	(0.017)	(0.018)	(0.023)	(0.026)
Log age$_{t-1}$	0.388***	0.443***	0.464***	-0.102**	-0.123**	-0.251***
	(0.021)	(0.023)	(0.025)	(0.047)	(0.060)	(0.069)
Δ Log TFP$_{t-1}$		-0.045***	-0.235***		-0.015*	-0.032
		(0.009)	(0.047)		(0.009)	(0.055)
Δ Log labor$_{t-1}$		-0.410***	-0.691***		-0.217***	-0.179***
		(0.037)	(0.023)		(0.043)	(0.023)
Δ Log liabilities$_{t-1}$		-0.144***	-0.044***		-0.029	-0.014
		(0.020)	(0.010)		(0.022)	(0.010)
Δ Foreign group$_t$		-0.210***	-0.469***		-0.016	-0.251***
		(0.043)	(0.039)		(0.021)	(0.046)
Δ Importer$_t$		-0.634***	-0.167***		-0.158***	-0.036
		(0.021)	(0.022)		(0.022)	(0.024)
Constant	-8.258***	-8.566***	-9.278***	-9.092***	-9.324***	-10.172
	(0.098)	(0.114)	(0.130)	(0.164)	(0.179)	(0.207)
# Observations	265,310	228,939	213,187	265,310	228,939	213,187
# Firms	36,371	36,371	33,874	36,371	36,371	33,874
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Mundlak	No	No	No	Yes	Yes	Yes
AUC	0.881	0.889	0.887	0.899	0.899	0.899
Log-likelihood	-71,423.444	-62,046.032	-53,895.571	-67,771.646	-59,364.018	-51,040.456

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Probit models for propensity score matching

F.2 Post-matching tests

			Off support	On support	Total
Food products, beverages and tobacco	Continuous	Untreated		31,929	31,929
		Treated		9,005	9,005
	Non-continuous	Untreated		36,017	36,017
		Treated		3,274	3,274
Other industrial products, coking and refining	Continuous	Untreated		40,574	40,574
		Treated		35,333	35,333
	Non-continuous	Untreated		61,026	61,026
		Treated		15,341	15,341
Electrics, electronics, and informatics products	Continuous	Untreated		3,482	3,482
		Treated		15,791	15,791
	Non-continuous	Untreated		6,454	6,454
		Treated		3,066	3,066
Transporting materials	Continuous	Untreated	0	1,381	1,381
		Treated	10	3,096	3,106
	Non-continuous	Untreated		2,577	2,577
		Treated		892	892
Clothing industries	Continuous	Untreated	0	2,072	2,072
		Treated	4	6,477	6,481
	Non-continuous	Untreated		3,704	3,704
		Treated		1,529	1,529
Wood and paper industries	Continuous	Untreated		8,862	8,862
		Treated		6,045	6,045
	Non-continuous	Untreated		15,042	15,042
		Treated		4,256	4,256

Table 7: Common support

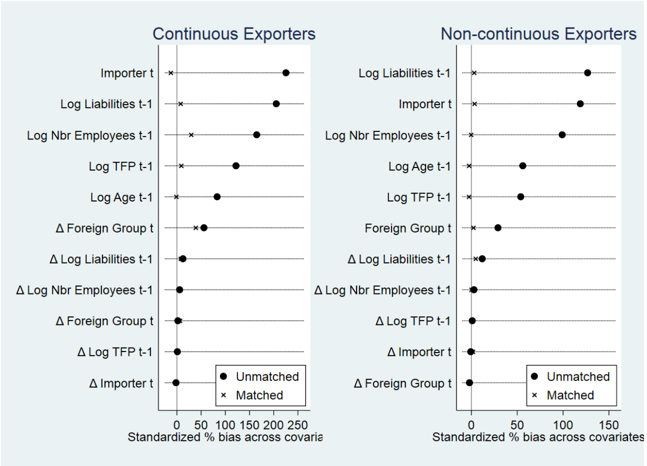
			Treated	Controls	Difference	S.E.	T-stat
All manufacturing industries	Continuous	Unmatched	8,743.40	354.28	8,389.12	189.80	44.20
		Matched	8,743.40	5,314.74	3,428.66	220.00	15.58
	Non-continuous	Unmatched	1,251.44	483.88	767.12	31.37	24.47
		Matched	1,251.44	1,130.59	120.84	56.67	2.13
Food products, beverages and tobacco	Continuous	Unmatched	12,958.28	443.95	12,514.32	259.58	48.21
		Matched	12,958.28	6,801.39	6,156.89	515.23	11.95
	Non-continuous	Unmatched	3,481.07	675.93	2,805.14	79.73	35.18
		Matched	3,481.07	2,664.36	816.71	208.08	3.93
Other industrial products, coking and refining	Continuous	Unmatched	10,398.52	333.47	10,065.06	367.58	27.38
		Matched	10,398.52	14,425.17	-4026.65	428.85	-9.39
	Non-continuous	Unmatched	1,095.64	429.15	666.50	49.68	13.42
		Matched	1,095.64	1,035.86	59.79	88.92	0.67
Electrics, electronics, and informatics products	Continuous	Unmatched	4,781.94	152.58	4,629.36	311.57	14.86
		Matched	4,781.94	656.27	4,125.66	161.42	25.56
	Non-continuous	Unmatched	400.27	221.95	178.32	25.59	6.97
		Matched	400.27	471.33	-71.06	35.07	-2.03
Transporting materials	Continuous	Unmatched	19,249.58	211.84	19,037.75	2,113.44	9.01
		Matched	19,308.99	1,955.80	17,353.19	1,418.57	12.23
	Non-continuous	Unmatched	1,862.08	524.85	1,337.23	387.30	3.45
		Matched	1,862.08	2,242.17	-380.09	595.52	-0.64
Clothing industries	Continuous	Unmatched	1,839.21	235.47	1,603.74	186.16	8.61
		Matched	1,840.22	497.79	1,342.43	194.43	6.90
	Non-continuous	Unmatched	473.23	335.54	137.69	36.26	3.80
		Matched	473.23	549.11	-75.88	47.66	-1.59
Wood and paper industries	Continuous	Unmatched	5,142.69	255.65	4,887.03	178.92	27.31
		Matched	5,142.69	2,394.87	2,747.82	225.29	12.20
	Non-continuous	Unmatched	862.60	387.95	474.65	23.66	20.06
		Matched	862.60	815.81	46.79	39.10	1.20

Table 8: Matching correction results

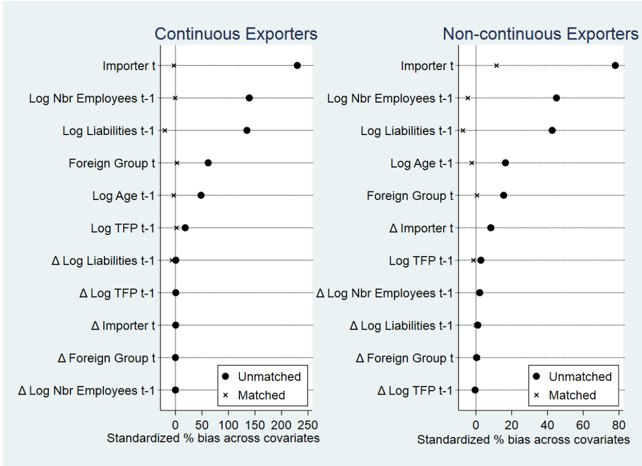
			PsR2	LRchi2	p>Chi2	Mean bias	Med bias	B	R	%Var
All manufacturing industries	Continuous	Unmatched	0.561	127,032.71	0.000	74.3	57.2	249.3*	2.05*	86
		Matched	0.036	7,586.40	0.000	7.8	3.5	45.2*	0.81	86
	Non-continuous	Unmatched	0.126	18,422.32	0.000	27.0	17.1	93.6*	1.50*	100
		Matched	0.002	173.46	0.039	2.9	2.8	11.1*	1.09	71
Food products, beverages and tobacco	Continuous	Unmatched	0.617	26,617.07	0.000	79.9	55.9	267.5*	2.43*	89
		Matched	0.038	949.71	0.000	8.6	5.9	46.7*	1.02	100
	Non-continuous	Unmatched	0.246	5,551.14	0.000	45.6	29.0	153.9*	1.43	89
		Matched	0.002	20.53	0.039	2.7	2.1	11.2	1.25	78
Other industrial products, coking and refining	Continuous	Unmatched	0.554	58,124.52	0.000	57.6	18.5	249.9*	1.88	100
		Matched	0.012	1,139.29	0.000	4.5	4.4	25.5*	0.93	100
	Non-continuous	Unmatched	0.107	8,162.19	0.000	19.3	8.3	84.6*	1.55	78
		Matched	0.002	103.69	0.000	2.8	1.5	11.6	1.04	89
Electrics, electronics, and informatics products	Continuous	Unmatched	0.581	10,578.09	0.000	63.8	27.6	264.4*	1.83	100
		Matched	0.083	3,626.94	0.000	18.2	8.3	69.5*	2.67*	100
	Non-continuous	Unmatched	0.104	1,246.50	0.000	19.7	5.4	81.0*	1.29	67
		Matched	0.002	16.08	0.138	3.0	2.6	10.2	1.09	67
Transporting materials	Continuous	Unmatched	0.675	3,737.00	0.000	76.6	28.7	298.2*	2.46*	100
		Matched	0.335	2,874.78	0.000	33.6	22.2	158.3*	1.66	89
	Non-continuous	Unmatched	0.128	505.95	0.000	23.7	7.7	91.9*	1.31	89
		Matched	0.005	12.97	0.295	5.2	5.4	17.0	0.89	56
Clothing industries	Continuous	Unmatched	0.598	5,662.93	0.000	50.4	8.0	297.3*	0.6	100
		Matched	0.066	1,190.25	0.000	8.7	3.2	58.9*	4.12*	89
	Non-continuous	Unmatched	0.144	911.97	0.000	15.5	4.7	100.1*	1.04	33
		Matched	0.009	37.36	0.000	5.3	4.9	22.1	1.03	78
Wood and paper industries	Continuous	Unmatched	0.481	9,677.76	0.000	57.0	43.1	205.9*	2.43*	89
		Matched	0.047	782.52	0.000	12.4	4.2	51.5*	0.84	89
	Non-continuous	Unmatched	0.094	1,920.87	0.000	21.9	11.3	78.7*	1.29	89
		Matched	0.002	23.20	0.017	2.7	1.9	10.4	1.01	56

* if B>25%, R outside [0.5; 2]

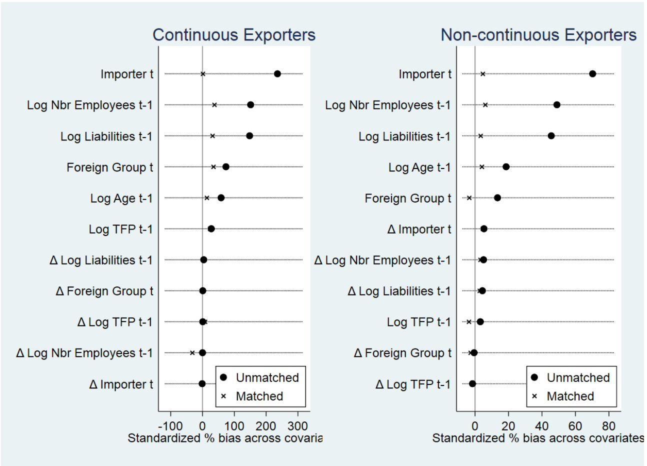
Table 9: Balance check summary



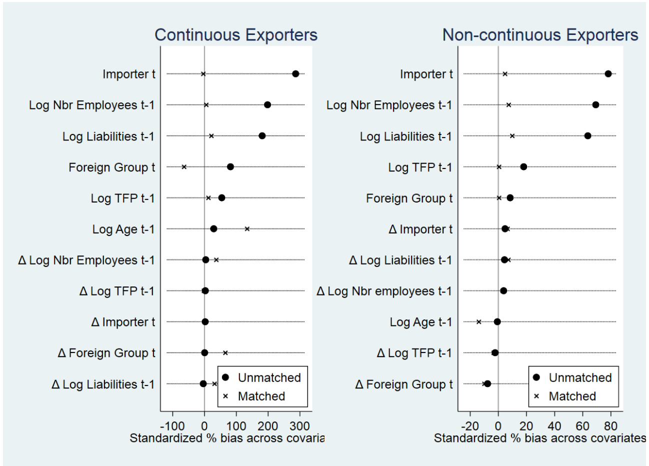
(a) Food products, beverages and tobacco



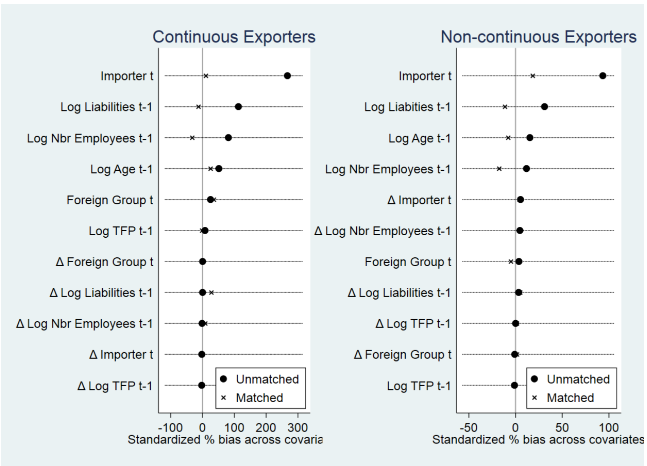
(b) Other industrial products, coking and refining



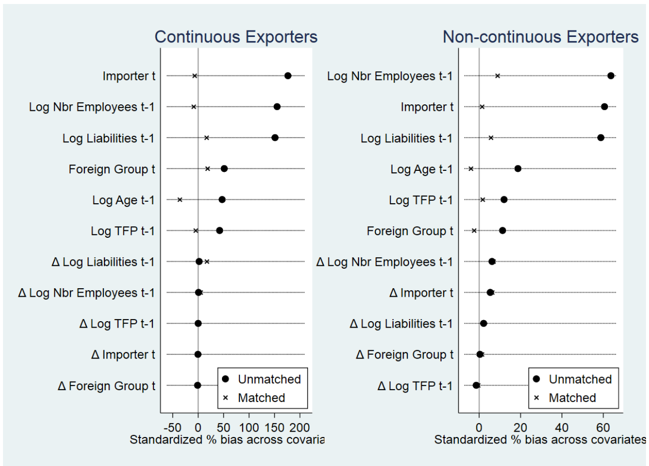
(c) Electrics, electronics, and informatics products



(d) Transporting materials



(e) Clothing industries



(f) Wood and paper industries

Figure 12: Matching standardized bias correction