Time is Money:
Cash-Flow Risk and Product Market Behavior

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Abstract

Do long payment delays in the domestic market represent a financial barrier to international trade? Introducing cash-flow risk management in a dynamic contracting environment, I analyze the role of payment delays on the decision to enter or to exit an export market and on the level of export sales. Importantly, the effects of payment delays on product market decisions should depend on the firm's level of cash holdings. To test the predictions of the model, I exploit an exogenous variation in payment delays triggered by a French reform enacted in 2009. The empirical framework relies on the disaggregated nature of export data to introduce market fixed-effects at a refined level so as to control for aggregate shocks. Moreover, I exploit the ex ante heterogeneity in sectoral exposure to the reform as an instrument to the variation in payment delays. The estimations strongly support the empirical predictions: a 100% exogenous increase in payment delays (approximately the interquartile gap) raises the probability to exit an export market by 5.8%, lowers the probability of entry by 11.8% and reduces export sales by 4.5% relative to their respective unconditional values. These effects are robust to a range of alternative specifications; estimations on sub-samples suggest that the source of identification comes from small firms operating in sectors relying on external finance.

JEL codes: *C26, C73, F14, G31.*

"Remember that Time is Money. [...] Money, more or less, is always welcome; and your Creditor had rather be at the Trouble of receiving Ten Pounds voluntarily brought him, tho' at ten different Times or Payments, than be oblig'd to go ten Times to demand it before he can receive it in a Lump."
Benjamin Franklin, "Advice to a Young Tradesman" (1748).

In the light of the recent evolutions of the factoring industry, Benjamin Franklin's advice (see above) seems more relevant than ever: according to the World Factoring Yearbook (2014), the global factoring volume (*i.e.*,

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the volume of account receivables sold in exchange of an immediate cash payments) increased by 72% between 2007 and 2013 to reach 2 230 billions euros (around 3% of global 2013 GDP). In France in which the empirical investigation takes place, the volume of credits taken over by factoring firms rose by more than 300% between 2004 and 2014 (ASF, 2014). Strikingly, while firms seem to attach growing importance on getting paid quickly, empirical evidence on the real effects of payment delays is limited. Yet, if firms do not fully hedge and if the supply of external finance is not perfectly elastic, payment delays should affect firms' decisions (Froot, Scharfstein and Stein, 1993).

The choice to serve or not an export market is perhaps the real outcome that is the most likely to be impacted by payment delays (*PD*). Since export transactions are paid in the vast majority after reception of the product (Schmidt-Eisenlohr, 2013), exporting firms are granting *de facto* an additional payment period that is equal to the transportation time. Firms's activity in international markets might therefore be affected by the prevailing payment conditions in the domestic market: firms that benefit from advantageous payment conditions in the domestic market may have in this way a competitive edge to enter international markets. As an illustration, (Atradius, 2016)[1] thus shows that payment conditions vary widely across European countries with average payment delays amounting to 32 days in Denmark but reaching 82 days in Italy. Compared to Danish firms, Italian firms might enter less easily into international trade as they encounter more difficulties to maintain a healthy cash-flow operating only in their domestic market. To use Hummels and Schaur's (2013) words, long payment delays in the domestic market may in this respect make *time act as a trade barrier*.

This article investigates the role of payment delays in the domestic market on firms' export market decisions. Using an exogenous restriction on payment delays in the French market, I am able to isolate and to identify significant evidence of a role of *PD* on the decisions to enter or to exit an export market and on the level of exports, thereby corroborating Manova's (2013) finding of a specific effect of financial frictions on international trade. Given the acknowledged role of international trade on aggregate productivity (Mélitz, 2003), this article suggests moreover that payment conditions might affect the relative performance of industries across countries.

On the theoretical side, I consider a dynamic contracting environment based on Philippon and Sannikov (2007) in which the manager of a firm (the agent) must contract with a bank (the principal) to get financed. While the volume of cash-flows is deterministic and publicly known, the timing of payment is random and follows a Poisson process. At every period, the agent has the option to pay an entry cost to enter in a new market, which raises future cash-flows but potentially lengthens the average gap between payments.

Since cash-flow payments are assumed to independent, it would be optimal to enter immediately in the absence of information asymmetry. I assume however that it is costly for the agent to get paid quickly and that effort is unobservable. In a competitive setting, offering flexible payment terms to clients may indeed be necessary to attract and keep clients (Lee and Stowe, 1993); requiring clients to pay quicker thus comes at the expense to a deterioration of the relation of the firm with its customer base, which might be costly for the manager.

Dynamic contract techniques developed in DeMarzo and Sannikov (2006) and Biais et al. (2007) show that a simple implementation of the contract makes the exercise of the firm's entry and exit options entirely conditional to the level of cash holdings. If the level of cash holdings reaches an optimally determined threshold, the firm will enter the new market; if it is too low, the contract will terminate. Importantly, in absence of cash-flow payments, cash holdings decrease continuously: hence, the manager of the firm is incentivized to always exert high effort so as to maintain payment occurrences at their optimal level. In particular, since the principal's profit function is endogenously concave, the bank acts as the creditor in Franklin's emphasized quotation and therefore prefers frequent payments of small amounts to large payments in a lump sum.

This framework yields clear-cut empirical predictions on the role of payment delays. When average *PD* in the initial market increase, two opposing effects operate. On the one hand, the probability to enter a new

[1]Atradius is a factoring firm which conducts a yearly survey on payment practices on approximately 3000 companies across Western Europe from which I report these estimations of average payment delays.

market decreases since it is more difficult for the manager to gather enough cash to reach the entry threshold ; on the other hand, the amount of cash that the bank requires to finance the entry cost decreases since exporting becomes less risky in relative terms. When cash holdings are low, the first effect dominates the second; when cash holdings approach the entry threshold, however, the model predicts that an increase in average *PD* in the initial market actually prompts firms to enter the market as the liquidity risk implications of doing so fade out. Concurrently, an increase in average *PD* or a decrease in future profitability in the new market always unequivocally lowers the probability of entry.

To test the predictions of the model, I exploit a large-scale variation in contractual payment delays following the enactment in 2009 of a French reform ("Loi de Modernisation de l'Economie" or LME) aiming at reducing excessive payment delays. This reform extended the 2006 law presented and studied by Barrot (forthcoming) by prohibiting payment contracts between *domestic* firms operating in any sectors to stipulate payment delays longer than sixty days. Although public authorities considered at the time that the reform was globally successfully applied (ODDP, 2010), a precise examination of the effects of this law is particularly challenging since *(a)* there is no natural control group to which the econometrician might refer and *(b)* the reform was voted in mid-2008 and but took only effect at the beginning in 2009, i.e. precisely during the peak of the global financial crisis.

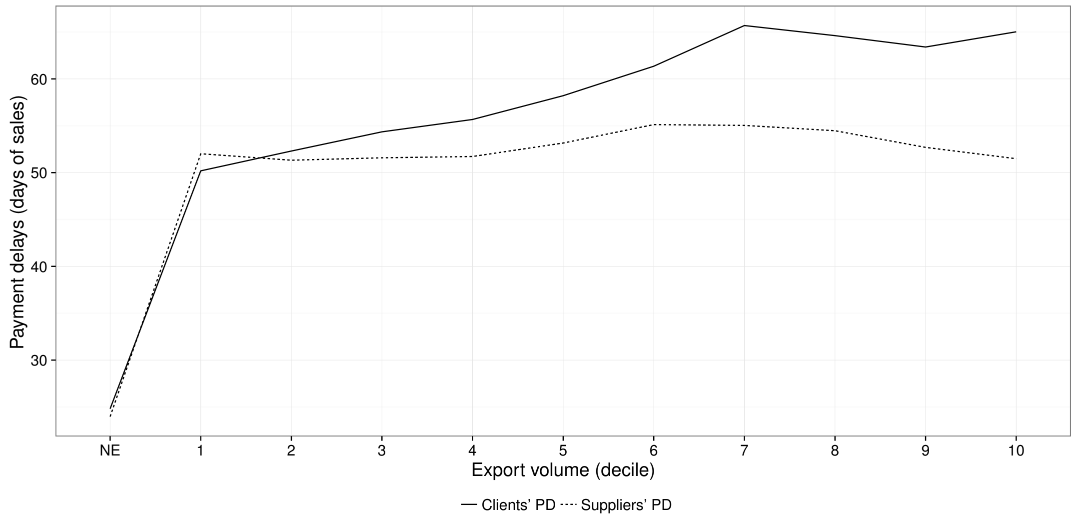
I tackle these identification issues by building an econometric framework based on three pillars. First, I exploit rich fiscal and survey data sets provided by the French statistical institute (Insee) to estimate payment delays at the firm-level. The measure is based on the observation made by Ng, Smith and Smith (1999) that since most of trade credit determinants (*e.g.,* intensity of competition, quality uncertainty) hold at the industry-level, payment delays are relatively stable within an sector. Payment delays on the clients side are therefore estimated at the industry-level (defined as a 4-digits SIC equivalent) as the mean of the accounts receivables over sales ratio. I proceed similarly to measure *PD* on the suppliers side, which allows us to quantify payment delays *in net terms, i.e.* to compare how long it takes for a firm to be paid by its clients to the amount of time that is needed for this firm to pay its suppliers. I then use information on the breakdown of firms' sales by sector to define payment delays at the firm-level as the weighted average of sectoral net payment delays (*NPD*). According to this measure, a firm that operates in sectors that exhibit high *NPD* will experience long payment delays irrespectively of the firm's own tax reports. This metric can be seen as a proxy for *contractual PD* (as opposed to *actual PD*, which might be correlated with firm's export decisions) as it reflects the payment delays that a firm operating in the same set of sectors would experience on average.

Second, I use the sixty-days-rule defined by the law to estimate the firm's *exposure to the reform prior to its enactment* as the sales-weighted average of the sectoral changes in *NPD* that would be needed for the reform to be perfectly enforced. Broadly speaking, this variable measures the distance in days to the situation in which all payment delays are inferior or equal to sixty days. This distance is then included as an instrument for the actual variation in *NPD*. This instrument strategy has two main advantages: first, it allows to overcome the absence of control group by exploiting the *ex ante* variation in exposure to the reform. Second, it enables to only capture the part of the variation in *NPD* that can be explained by the enactment of the reform, thereby leaving aside the potential effects of confounding aggregate shocks (*e.g.,* the financial crisis).

Third, I rely on the disaggregate nature of export data to introduce a whole set of market fixed effects as in Paravisini et al. (2014). The estimates are thus based on the comparison between firms differently affected by the reform of export outcomes *in a given industry and a given destination.* This procedure allows first to control for any market-level shock that might have affected exports by shifting the supply (*e.g.,* input shocks) or the demand curve (*e.g.,* real estate crisis). Moreover, the presence of market dummies removes the effects of specialization patterns: if firms that export in markets particularly hit by the crisis are also on average more exposed to the reform, an estimation without fixed effects might lead to inappropriately conclude to a causal effect of the variation in *NPD* on export outcomes.

In line of the empirical predictions, the estimates point to a significant effect of the variation in *NPD* in the French market on the decisions to enter and to exit export markets. A 100% increase in *NPD* (approximately

Figure 1: Payment delays and export activity



This figure plots clients and suppliers estimated payment delays (y-axis) as a function of export activity (x-axis): "NE" stands for "not exporting", and the numbers denote the corresponding deciles in total exports. Clients (resp. Suppliers) *PD* are estimated as the mean for a given level of export activity of the account receivables over sales (resp. account payables over sales) ratio. Average values are then multiplied by 365 to be expressed in days of sales. Accounting data is taken from tax returns (BRN-RSI) and export data from customs declarations (see sections 2.3 and 2.4). Only information on manufacturing and wholesale firms in 2013 is retained.

the interquartile gap) thus raises the probability to exit an export market by 5.8%, lowers the probability of entry by -11.8% and increases the level of exports by 4.5% relative to their unconditional values, indicating a sizeable role of payment conditions on the participation to international trade.

The results prove then robust to a battery of reliability checks. I investigate whether these effects still hold using alternative measures of payment delays. If anything, the estimates appear to be *larger* in magnitude when taking into account the effects of differences in sourcing strategy or in market power in the computation of payment delays. When restricting the estimations to sub-samples of the data set, I find that consistently with theory, the effects of the variation in *NPD* are stronger for small firms that operate in sectors that are dependent on external finance. Moreover, the export markets that are the most affected by the reform are the destinations in which small exporters are the most represented (Europe inside and outside the EU).

The emphasis on the effects of payment delays on export market decisions is justified by the particular characteristics of export transactions. As stressed by Amiti and Weinstein (2011), export transactions differ from domestic transactions as they entail *longer payment delays* and *higher customer risk*. On the basis of survey evidence, Schmidt-Eisenlohr (2013) finds that in 78% of export transactions, the importer pays after reception of the product. This means that shipping time comes in addition to the payment delays that prevail in the domestic market: Amiti and Weinstein (2011) estimate that the median transportation time can be estimated to two months. Figure 1 shows that the effects of exporting on payment delays can be observed in the data: as firms export more in volume, they have on average higher net payment delays (clients *PD* minus suppliers *PD*).

Higher customer risk then results from the difficulty to settle a dispute in an international setting and on the differences in quality of institutions between countries. Courts may in particular function more or less effectively: studying duration of legal procedures in 103 countries, Djankov et al. (2003) estimate that it takes approximately one month and a half for a court in Singapore to collect a bounced check, while more than three years are needed in Poland.

Since export transactions generate more frictions than domestic ones, Feenstra, Li and Yu (2014) argue that exporters are more likely to be financially constrained that domestic producers, a prediction that they confirm using financial data on Chinese firms. In this respect, the optimal portfolio of export markets may not only be determined by profit considerations (Mélitz, 2003), but also by whether the payment delays that hold in those markets allow the firm to maintain a cash flow that is sustainable given its financing conditions. In the presence of a variation in domestic liquidity risk such as that triggered by the 2009 French reform, firms might have to readjust their market portfolio, a prediction that the empirical results strongly support.

This work contributes to a recent strand of literature that investigates the role of working capital risk management in international trade. In an influential paper, Antràs and Foley (forthcoming) shows that the negotiation of financing terms is key in building and maintaining trade relationships, and that the way customer risk is managed shapes the impact of crises on supplier-customer links. Using data on U.S. banks' trade finance claims by country, Schmidt-Eisenlohr and Niepmann (2016) estimate that a one standard deviation negative shock to a country' trade insurance supply lowers export by U.S. firms to that country by 1.5% (see also Aubouin and Engemann (2014)). More broadly, this article relates to another group of publications (Manova (2013) ; Feenstra, Li and Yu (2014) ; Paravisini et al. (2014)) that look at the role of credit supply on exports[2]. In contrast with the theories put forward by this literature, the model provides a contractual framework in which debt plays only an indirect role in the decision to entry or exit an export market: in a dynamic framework, only the level of cash matters to ensure that the entry in a new export market is sustainable in terms of working capital management. Accordingly, I find no role of the variations in leverage on export decisions between 2008 and 2009.

This article then falls within the wide array of articles that study the interactions between structural characteristics of product markets and capital structure policies, and more specifically on the role of cash holdings in entry patterns[3]. Boutin et al. (2013) find evidence that entry is negatively correlated to the cash hoarded by incumbent affiliated groups and positively associated with the level of entrant groups' cash. Frésard (2010) then shows that large cash reserves act as a comparative advantage in product markets as they lead to systematic future market share gains at the expense of industry incumbents. In comparison, the results of this article suggest that firms operating in countries where payment delays are low benefit from a comparative advantage on their international rivals.

The closest paper to this article is presumably Barrot (forthcoming): studying an early implementation of the 2009 reform on the trucking sector, Barrot finds using differences-in-differences that corporate defaults fell following the reform and that the decrease in payment delays triggered the entry of small firms in the trucking industry. This article extends Barrot's work on three points: first, I bring a theoretical model that allows to understand precisely the effects of payment delays on product market decisions. Far from being univocal, the impacts of payment delays crucially depend on the level of the firm's cash holdings. Second, since the setting of the LME reform does not lend itself well to a differences-in-differences estimation, I deviate from Barrot's methodology by relying on the heterogeneity of the exposure to the reform to instrument the variation in payment delays. Third, thanks to the quantitative measure of payment delays, I am able to disentangle the effects of the variations of clients *PD* from suppliers *PD* by computing payment delays in net terms.

Barrot and Nanda (2016) further investigate the role of payment delays on real outcomes by exploiting a 2011 US reform that restricted payments delays of government contractors to small businesses. They estimate that at the aggregate level, each "accelerated" dollar resulted in a 10 cents increase in total payroll between 2011 and 2014, indicating a significant effect of *PD* on employment. Using information on payment delays in buyer-supplier relationships, Breza and Liberman (2016) show that long payment delays are associated with

[2] Note that Chaney (2005), which was the first article to analyse the role of financial constraints on firm-level exports, emphasized the role of *liquidity* constraints and is thus closer to an analysis in terms of working capital management than of credit constraints.

[3] A major part of this literature is devoted to the examination of the role of leverage on product market decisions. Chevalier (1995) famously shows that LBO supermarkets charge higher prices following LBO when market rivals are also highly leveraged; Khanna and Tice (2000) find evidence that highly levered supermarkets responded less aggressively to the entry of Wal-Mart in their local markets. See Parsons and Titman (2008) for a survey.

reduction in capital expenditures for the firms who bear the working capital costs; Murfin and Njoroge (2015) find with similar data that exogenous restrictions on payment delays sever supplier-buyer links.

This article eventually contributes to a burgeoning strand of theoretical papers devoted to the study of real options in presence of financing constraints. Three different lines of articles can be distinguished: a first series of studies investigate how the exercise of real options is affected by exogenous financing costs resulting from debt overhang issues or uncertainty on capital supply (Sundaresan, Wang and Yang (2015); Bolton, Wang and Yang (2014); Hugonnier, Malamud and Morellec (2014)). "Real option signalling" models then show that in presence of asymmetric information, the timing of the exercise of the real option can be used as a signal to the principal on the quality of the project or on the financial strength of the agent (Grenadier and Malenko (2011); Morellec and Schürhoff (2011); Bustamante (2011); Bouvard (2014)). A last strand of models (Philippon and Sannikov (2007); Biais et al. (2010); Gryglewicz and Hartman-Glaser (2015)) allows the agent to affect the stochastic process of the real option's underlying. This paper builds on the setting of Philippon and Sannikov (2007) by replacing Brownian motions by Poisson processes (as in Sannikov (2005)) and allowing the exercise of the real option to affect the volatility of the cash-flow process as well as its instantaneous expected value.

The remainder of the paper is organized as follows. Section 1 specifies the theoretical model and the empirical predictions that it yields. The details of the LME reform and the data sets used are described in section 2. In section 3, I present in detail the identification strategy. Empirical results are displayed in section 4; in section 5 I consider several extensions and robustness tests. Results are discussed in section 6. Section 7 concludes.

1 Theoretical framework

1.1 *Presentation of the model*

This model builds on the dynamic real option model with agency presented Philippon and Sannikov (2007): first, Brownian motions are replaced by Poisson processes (as in Sannikov (2005)) which, by their discrete nature, are naturally more suited to the study of the timing of cash-flows payments. Second, the exercise of the real option is allowed to affect the volatility of the cash-flow process since figure 1 suggests that payment delays increase with the level of exporting.

The resolution of the optimal contract is based on martingale techniques developed in a Brownian framework in DeMarzo and Sannikov (2006) and adapted to point processes in Biais et al. (2010) and Sannikov (2005). A brief sketch of the proofs initially presented in Philippon and Sannikov (2007) is recalled in appendix A ; new results using the concavity of the principal functions are derived and presented in detail in section 1.3 and appendix B.

1.1.1 General setup

A cash-constrained entrepreneur (the agent) seeks outside financing F to have her firm started. She contracts with a bank (the principal) to fund the set-up costs and to cover the losses of her project ; both the entrepreneur and the bank are risk-neutral[4] and discount future cash flows at the market interest rate r. Time is continuous.

At time $t = 0$, the project starts at the "initial" state I ; then, at every instant $t \geq 0$, the entrepreneur has the option to pay an entry cost K and to start entering in a new export market (state E)[5]. Denoting the timing of the export option exercise by τ_E, I write by a slight abuse of notation $I = [0, \tau_E]$ and $E = [\tau_E, \infty[$. The annual expected sales of the firm are given by $\Pi_{t,t\in\{I,E\}}$; the occurrence of cash-flows arrivals cash-flows is modeled

[4] Gryglewicz and Hartman-Glaser (2015) investigate the role of the agent's risk aversion in a dynamic model of real option with agency. They find that risk aversion has an ambiguous effect as it could lead to earlier as well as later exercise of the real option.

[5] Note that the firm might already be exporting in state I.

by a point process $N = \{N_t\}_{t\geq 0}$. N is assumed to follow a Poisson process of intensity $\lambda_{t,t\in\{I,E\}}$: the average time between payments at time t, the measure of the average payment delays, is therefore given by $1/\lambda_t$.

Entering a new export market is posited to simultaneously change annual sales from Π_I to Π_E and the average number of payments from λ_I to λ_E (E stands for "export"). In line with standard international trade models (Mélitz, 2003), in the absence of information asymmetries, it would be optimal to start exporting immediately as long as the option to export is profitable : $\Pi_E - \Pi_I > rK$ (1); the condition (1) is assumed to hold in the following. Moreover, figure 1 suggests to impose $\lambda_I \geq \lambda_E$ such that the average payment delays increases with export activity.

Since the focus of this paper is to investigate the effects of the volatility induced by the *uncertainty over the timing of payments*, the following analysis abstracts from the role of the *uncertainty over the amount of cash-flows* by assuming that the volume of cash-flows is deterministic (it only depends on whether the firm exports or not) and that cash-flows are evenly distributed over the year: $X_t = \Pi_t/\lambda_t$. The expected instantaneous change in cash-flows is thus given by

$$E_t[dY_t] = \lambda_t X_t = \lambda_t \Pi_t/\lambda_t = \Pi_t \tag{2}$$

Note however that for a given Π_t, the variance of X_t is decreasing in λ_t:

$$Var_t[dY_t] = \lambda_t (X_t)^2 = \lambda_t (\Pi_t/\lambda_t)^2 = \Pi_t^2/\lambda_t \tag{3}$$

Information frictions arise as it is assumed that the entrepreneur must exert an effort to maintain a high rate of cash-flow arrivals. Previous research tends to show that the collection of account receivables is a costly process: using mandatory pension contributions as an exogenous shock on cash, Bakke and Whited (2012) show that firms recover receivables when facing a liquidity shock, suggesting that firms balance out the cost of collecting commercial debt with their liquidity needs to determine the optimal level of receivables collection (a result later confirmed in another context by Amberg et al. (2016)). In presence of product risk, trade credit might be the optimal way for firms with no reputation to provide their clients with a warranty clause (Lee and Stowe, 1993): the buyer can delay the payment so as to check whether the the product meets his requirements. Collecting receivables might thus deter clients from coming back to make future purchases, which is costly for the manager.

Formally, the presence of moral hazard in this model is introduced for all $t \geq 0$ by allowing the agent to reduce the intensity of the Poisson process from λ_t to $\theta_t\lambda_t$ (with $\theta_t \in [0,1]$) in exchange for a private benefit $(1-\theta_t)\lambda_t$ per cash-flow unit[6] ; the effort process $\theta = \{\theta_t\}_{t\geq 0}$ is unobservable by the principal. Importantly, shirking reduces the rate of cash-flows but does not modify their volume, thereby reducing the expected instantaneous profitability of the firm. For all $t \geq 0$, the instantaneous flows of private benefits dY_t^B and realized profits dY_t^R are then equal to $dY_t^B = (1-\theta_t)\lambda_t X_t$ and $dY_t^R = dY_t - dY_t^B$.

The agent is not allowed to save money [7] so that her consumption process is defined by:

$$dc_t = dY_t^B + di_t \tag{4}$$

where $dc_t \geq 0$ is her increase in consumption and $di_t \geq 0$ is her increase in income paid by the principal. $c = \{c_t\}_{t\geq 0}$ and $i = \{i_t\}_{t\geq 0}$ are assumed to be right continuous with left limits. The principal has complete control over the agent's retribution i, over the timing of the export option exercise τ_E and over the termination date τ_L of the contract. The present value of future payment to the agent is in particular assumed to be finite: $\int_0^{\tau_E \wedge \tau_L} e^{-rt} i_t dt < \infty$ (5). The principal's set of admissible controls is denoted by P. On her side, the agent

[6] The intensity of the moral hazard problem could be modulated through an additional parameter $\kappa > 0$ such that the private benefits equal $\kappa(1-\theta_t)\lambda_t$. Setting $\kappa = 1$ does not change the main properties of the model but simplifies significantly the proofs.

[7] DeMarzo and Sannikov (2006) shows that if the private saving rate of the agent is strictly inferior to the market interest rate, it is optimal for the agent never to save money.

determines the effort intensity $\theta = \{\theta_t\}_{t\geq 0}$. Given i, τ_E and τ_L, the agent's admissible set is given by $A(i, \tau_E, \tau_L)$.

In case of termination of the contract, the principal gets his state-dependent liquidation value $L_{t,t\in\{I,E\}}$ and the agent gets her state-dependent outside option value $R_{t,t\in\{I,E\}}$. In the line of DeMarzo and Sannikov (2006), these values are later made endogenous. Termination of the contract is assumed to be socially inefficient, which imposes the inequalities $L_t + R_t < \Pi_t / r$ for $t \in \{I, E\}$ (6).

Two additional conditions are necessary: first,

$$\lambda_I > \lambda_E > r \tag{7}$$

is assumed. This assumption is very likely to hold: remember that λ can be interpreted as the average number of payments received by the firm during the year. The second constraint imposes that the outside option of the entrepreneur is strictly superior to the value of an additional cash-flow:

$$R_t > X_t \text{ for } t \in \{I, E\} \tag{8}$$

This inequality is quite reasonable for most of the firms: when annual cash-flows do not depend on a particular customer, an additional cash-flow payment is generally inferior to the liquidation value of the firm. However, for firms with a very high operational leverage (e.g., in the aircraft or boat industry), this assumption might be violated. Section 1.3 discusses the consequences of this constraint.

1.1.2 *Maximization problems*

The agent's problem is to maximize her expected discounted utility W_0 :

$$W_0 = \max_{\theta\in A(i,\tau_E,\tau_L)} E^\theta \left[\int_0^{\tau_L} e^{-rt} dc_t + R_{\tau_L\wedge\tau_E} e^{-r(\tau_L\wedge\tau_E)} \right] \tag{9}$$

where E^θ denotes the expectation operator under the probability $\mathbf{P}^\theta$ given by θ. It is also assumed that for every strategy θ, her continuation utility W_t^θ must exceed the value of her outside option at every time t:

$$W_t^\theta = E^\theta \left[\int_t^{\tau_L} e^{-r(s-t)} dc_s + R_{\tau_L\wedge\tau_E} e^{-r(\tau_L\wedge\tau_E)} | \mathscr{F}_t^N \right] \geq R_t. \tag{10}$$

where $\mathscr{F}^N = \{\mathscr{F}_t^N\}_{t\geq 0}$ is the filtration generated by N. The principal's problem is to maximize its expected discounted profit; using the continuation utility of the agent as a state variable (see for instance Spear and Srivastava (1987)), the principal's profit $b^I(W_0)$ for a given starting value W_0 can be expressed as:

$$b^I(W_0) = \max_{(i,\tau_E,\tau_L)\in P} \max_{\theta\in A(i,\tau_E,\tau_L)} E^\theta \left[\int_0^{\tau_L\wedge\tau_E} e^{-rt}(dY_t^R - di_t) - 1_{\tau_E<\tau_L} K + L_{\tau_L\wedge\tau_E} e^{-r(\tau_L\wedge\tau_E)} \right] \tag{11}$$

subject to (10) and to make the contract incentive-compatible for the agent. Similarly to (11), consider eventually for a given starting value W_0 the function $b^E(W_0)$ giving the profit of principal if the firm is already exporting:

$$b^E(W_0) = \max_{(i,\tau_L)\in P} \max_{\theta\in A(i,\tau_L)} E^\theta \left[\int_0^{\tau_L} e^{-rt}(dY_t^R - di_t) + L_E e^{-r\tau_L} \right] \tag{12}$$

1.1.3 *Endogenous termination values*

Before tackling the resolution of the model, it is worth taking a closer look at the termination decision in stages I and E. In both cases, it is legitimate to think that neither the bank nor the entrepreneur would find optimal to liquidate the firm if another option was available. Bricongne et al. (2012) find indeed that the effects of the crisis on French exports were nearly twice as big at the intensive margin than at the extensive margin:

if entry or exit entail fixed costs, it might be optimal in face of an adverse shock to reduce the scale of the operations in a market than leaving it altogether.

The intensive margin can be introduced in this model by making the termination values endogenous: suppose that in addition to the liquidation of the firm, the principal has the option to wait during an interval of time Δ_t and to reset the contract at $W_t = W_0$. In this case, the liquidation value becomes $L_I^* = \max(L_I, e^{-\Delta_t} b_I(W_0))$ and $R_I^* = R_I$ if the contract is terminated or $R_I^* = e^{-\Delta_t} b_I(W_0)$ if the contract is relaunched.

Similarly, instead of terminating the contract when W_t reaches R_E in state E, the exporter might prefer to reduce its sales in the new export market or simply come back to state I. In this setting, the liquidation value is given by $L_E^* = \max(b_I(W_0), e^{-\Delta_t} b_E(W_E))$ and $R_E^* = W_0$ if the exporter reduces her export sales at the extensive margin or $R_E^* = e^{-\Delta_t} b_E(W_E)$ if export sales are reduced at the intensive margin.

Though difficult to handle in general, this modelization is useful when trying to understand the effects of the reform on the extensive and intensive margins. As will be seen in proposition 6, reducing export sales at the intensive margin when *PD* increase is optimal in particular when entry in new export markets is costly.

1.2 Resolution of the optimal contract

Martingale techniques show that incentive compatibility impose to make the continuation utility of the agent W_t evolve according to

$$dW_t = rW_t dt + X_t(dN_t - \lambda_t dt) - di_t \tag{13}$$

Intuitively, by setting the sensibility of the agent's continuation utility to the cash-flow process equal to 1, the principal makes the agent indifferent between shirking ($\theta_t < 1$) and exerting high effort ($\theta_t = 1$). In the regions where $di_t = 0$, the principal's profit functions follow the following differential equation:

$$rb(W_t) = \Pi_t + (rW_t - \Pi_t)b'(W_t) + \lambda_t(b(W_t + X_t) - b(W_t)) \tag{14}$$

Proceeding by backward induction as in Philippon and Sannikov (2007), the optimal contract can be fully characterized after exporting and before exporting by the equation (14) with the appropriate border conditions.

1.2.1 Optimal contract after exporting

After paying the entry cost K, the cash-flows process of the firm is characterized by $X_t = X_E$, $\lambda_t = \lambda_E$ and $\Pi_t = \Pi_E$. The optimal contract is given by the following proposition:

Proposition 1. *(Sannikov 2005) In the optimal contract, the continuation value W_t evolves according to (13) starting with value W_0. When $W_t \in [R_E, R^*[$, with $R^* = \Pi_E / r$ the agent receives no payment: $di_t = 0$. When W_t reaches R^*, payments di_t cause W_t to reflect at R^*. The profit function b^E follows (14) on the interval $[R_E, R^*]$ with the boundary conditions $b^E(R_E) = L_E$ and $b^E(R^* + \omega) = -\omega$ for all $\omega \geq 0$. The contract is restarted after a delay Δ_t (or switches back to state I) at time τ_L when W_t reaches R_E.*

The upper threshold R^* corresponds to the private benefit the agent would get if she chooses to shirk forever: $\theta_t = 0$ for all $t \geq 0$. When $W_t \geq R^*$, the moral hazard problem disappears: the agent gets all the proceeds of the cash-flows as if she was the sole owner of the project.

1.2.2 Optimal contract before exporting

In the initial stage of the game, the cash-flows process of the firm is characterized by $X_t = X_I$, $\lambda_t = \lambda_I$ and $\Pi_t = \Pi_I$.

Proposition 2. *(Philippon and Sannikov 2007) In the optimal contract, the continuation value $W_t \in [R_I, W_E[$ evolves according to (13) starting with value W_0 with $di_t = 0$ for all $t \geq 0$. The profit function b_I follows (14) on the interval $[R_I, W_E]$ with the boundary conditions $b^I(R_I) = L_I$ and $b^I(W_E + \omega) = b^E(W_E + \omega) - K$ for all $\omega \geq 0$. If*

W_t reaches W_E before R_I at time τ_E, the firm starts exporting and the optimal contract is given by Proposition 1. If W_t reaches R_I first at time τ_L, the contract is restarted after a delay Δ_t (or terminated).

In contrast with the perfect information case, it is optimal for the agent and the principal to wait that W_t reaches the threshold W_E to start exporting. Note that in contrast with standard real option models (e.g. McDonald and Siegel (1986)), waiting does not provide any additional information on the profitability of the firm: by assumption, cash-flows are *iid*. The value of waiting in this model stems from the moral hazard problem: by making entry conditional on the continuation value of the agent passing a given threshold, the contract gives incentives to the agent to maintain a high rate of cash-flow arrival and thus allows to decrease the risk of liquidating the firm, which is costly for the principal.

1.2.3 Implementation of the optimal contract

The optimal contract has a natural implementation with cash reserves and debt (see Biais et al. (2007)). Defining the stock of cash C_t by $C_t = W_t - R_I$, the optimal contract can be defined as following in the case of exogenous termination values:

- The entrepreneur begins with a reserve of cash $C_0 = W_0 - R_I$. At every instant, she pays back a coupon $\lambda_I dt$ to the bank; new payments are immediately deposited on her bank accounts. Cash holdings therefore evolves according to $dC_t = rC_t dt + X_t(dN_t - \lambda_I dt)$. Note that cash reserves decrease in absence of cash-flows arrival.
- If her cash reserves reach $C_E = W_E - R_I$, the agent enters in a new export market. If she runs out of cash first, the contract is terminated.
- After starting to export, the agent is paid every time the level of cash goes above $C^* = R^* - R_I$. The contract is terminated as soon as C_t goes below $R_E - R_I$.

The initial level of cash reserves C_0 is determined by the respective bargaining powers of the agent and the principal. In particular, if the bank is a monopoly, $W_0 = C_0 + R_I$ is defined by the condition $b_I'(W_0) = 0$. On the opposite, if the agent has all the bargaining power, W_0 is pinned down by the conditions $b_I(W_0) = I$ and $b_I'(W_0) < 0$. The face value of the debt with coupon payments λ_k and coupon rate r is equal to $D_k = \lambda_k / r$ for $k \in \{I, E\}$.

1.3 Empirical predictions

This implementation allows us to make predictions about observable outcomes. The first result shows that in the two polar cases of bargaining process between the agent and the principal described above, initial financing decreases with the average payment delays and increases with profitability.

Proposition 3. *If there is perfect competition among banks or if the bank acts like a monopoly, the initial cash financing C_0 decreases with $1/\lambda_I$ (the average PD before exporting) and increases with Π_I (the profitability before exporting).*

The intuition behind proposition 3 is clear: when the agent has all the bargaining power, she gets all the net benefits from running the project. Since a higher profitability and lower *PD* increases the expected value of the firm (by raising profits and lowering the probability of liquidation), the initial utility and therefore the initial financing that the agent secures increases. If the bank is a monopoly, then in face of better firm's fundamentals the bank has interests in diminishing the probability of liquidation by increasing the amount of initial financing so as to extract more of the firm's future value.

The following result is more counterintuitive: the amount of cash C_E required to enter in a new export market *increases* as initial conditions of the firm improve.

Proposition 4. *When termination values are taken as exogenous, the amount of cash required to enter in a new export market* C_E *decreases with* $1/\lambda_I$ *(the average PD before exporting) and* Π_E *(the profitability after exporting) and increases with* $1/\lambda_E$ *(the average PD after exporting),* Π_I *(the profitability before exporting) and* K *(the cost of entry).*

The threshold C_E is the result from an arbitrage for the bank between the value of exercising the entry option and the value of waiting that the agent builds cash reserves (which lowers the chances of a costly liquidation). All other things equal, if the initial conditions of the firm improve, exporting becomes more risky in relative terms, which induces it to raise the required amount of cash. Proposition 4 leads therefore to seemingly paradoxical conclusions: a deterioration of the payment conditions might lead firms with high levels of cash to enter the export market as differences in *PD* between exporting and not exporting fade out.

The following proposition shows however that conditionally on a level of cash holdings, decreasing average *PD* has a positive effect on the probability of exporting:

Proposition 5. *When termination values are taken as exogenous, the probability to enter in a new export market (resp being liquidated) conditionally on* $C_t = C < C_E$ *decreases (increases) with the average PD before exporting* $1/\lambda_I$ *and increases (decreases) with the profitability* Π_I.

A decrease in average *PD* has two opposite effects: it increases the threshold C_E and it increases the future prospects of the firm by lowering the probability of liquidation. Proposition 5 shows that all other things equal, the first effect is always dominated by the second one.

This result might not hold in general if I relax condition 8: for low levels of cash $C \in [0, X_I - R_I]$, the probability of entry might increase with average *PD*. The intuition is that for a firm that is liquidity-distressed, an increase in average payment delays makes the principal expect longer intervals between cash-flow arrivals and thus tempers the stringency of the requirement of an immediate important payment, which reduces the probability of an immediate liquidation and thus increases the probability of exporting.

Proposition 6. *When termination values are endogenous, it becomes optimal to reduce export sales at the intensive margin rather than at the extensive margin as the cost of entry* K *increases.*

The last proposition is very intuitive: as the cost of entry increases, reducing export sales at the extensive margin becomes more costly: firms should therefore prefer to reduce sales at the intensive margin when markets are more difficult to access.

I test these assertions in the following sections.

2 Background and data description

2.1 Payment delays reform

The 2009 payment delays reform is the outcome of a long-term process of reflections and negotiations on the regulation of payment delays in France. Since 2000, the regulation of late payment practices has been on the European agenda (Barrot, forthcoming): based on the notion that *"heavy administrative and financial burdens are placed on businesses, particularly small and medium-sized ones, as a result of excessive payment periods and late payment"*, the directive 2000/35/EC allowed firms to demand interest payments to their debtors in case of excessive payment delays (30 days). In France where *PD* were in average higher than in the other members of the European Union (ODDP, 2007), the government took up this issue by fostering negotiations between professional organisations representing clients and suppliers of a given sector. This resulted in 2006 in a reform limiting contractual payment delays to thirty days in the trucking sector, and in 2007 in a agreement to limit contactual *PD* to ninety days in the automobile sector.

The 2009 reform extended these reforms by generalizing as of January, 1. 2009 the limit of contractual payment delays to sixty days in any transactions involving French firms, regardless of the sectors they are operating in. More precisely, the limit was set to sixty days after sending the invoice or forty-five days after the end of the month in which the invoice has been sent. Excess payment delays are to be reported to public authorities by firms' accounting auditors: sanctions resulting from a violation of the contractual limits can reach a maximum of 2 millions euros. These rules appear to be enforced in practice: in 2015, a major telecom group had to settle a fine of 750 000 euros (around 845 000 $) following several complaints of excessive payment delays[8].

The 2009 law featured several major exceptions to the sixty-days-rule. First, in some sectors of activity involving the production or the sale of perishable products contractual payment delays were restricted to be shorter (e.g. thirty days for transactions involving frozen food products). Second, some sectors whose activity is highly seasonal (e.g. the toy industry) or where the immediate enforcement of the sixty-day-rules appeared to be problematic could benefit from longer contractual payment delays; however, these derogations scheduled a progressive normalization of the contractual payment delays limit to the general sixty-days-rule before 2012 at the latest. The list of derogations is displayed in appendix D. Third, the reform put only a ceiling on *contractual PD* and not on *actual PD*, which might differ in practice. Eventually, the scope of the 2009 reform included only *domestic* transactions, thereby leaving aside import and export transactions: this point is important as it allows us to investigate the effect of payment delays in the domestic market on decisions made in foreign product markets.

Overall, several specificities of this reform that makes it particularly challenging to use for causal inference have motivated the empirical strategy described in section 3:

(a): Absence of a natural control group Unlike Barrot (forthcoming) or Barrot and Nanda (2016), no natural control group emerges as this reform affects all sectors[9]. Discontinuities induced by the derogations to the reform cannot be exploited as they are clearly endogeneous (derogations would be granted to some professional organisations representing a given sector provided they could justify that the sixty-days-rule would affect them more than other sectors).

(b): 2008-09 financial crisis The 2009 reform was voted on August 4. 2008, that is only a few weeks before the Lehman Brothers collapse. French export transactions were greatly affected by the ensuing global financial crisis: Bricongne et al. (2012) find that exports dropped by -16.2% between September 2008 and April 2009, the contribution of the intensive margin being four times higher in magnitude than the extensive margin one. Should this effect not be properly accounted for, any inference in this period would be subject to the risk of being contaminated by the confounding presence of the 2008 financial crisis.

(c): Presence of derogations The 2009 law allowed some sectors to deviate from the sixty-days-rule because of particular difficulties (seasonal activity, particular payment usages...) to implement it as of 2009. If those difficulties are correlated to firms' export market behavior, the measured variation in payment delays might be endogenous.

(d): Anticipation Eventually, since the law was voted in mid-2008, firms might have been anticipating the enactment of the law and begun to adjust their payment contracts as of 2008. This possibility has been studied by the public instance responsible for the follow-up of the enactment of the reform (ODDP, 2008). It found that out of of a sample of nearly 200 credit managers of large industrial firms, 47% tried to renegotiate their payment contracts as of 2008; however, some credit managers report that these negotiations proved difficult to succeed, since the different firms involved would wait for all their main

[8] See a press article here (in English).

[9] Unfortunately, if the 2006 reform proved well-suited for a difference-in-difference setting, firms in the trucking sector do virtually no exporting (which makes it likewise impossible to use the trucking sector as a control group for this reform). Similarly, the 2007 agreement may seem promising at first glance since the automobile sector is one the main French exporting industries; however, the non-binding nature of the agreement casts some doubt on the actual enforcement of the payment delays limits (ODDP, 2008). In fact, this report suggests that it is because of the very difficulties faced by the government to enforce the 2007 agreement that public authorities decided to move from an approach based on interprofessional negotiations to a general law that incorporated all sectors.

clients and customers to agree to modify their delays as well so as not to bear alone the working capital costs.

2.2 Firm data

Balance sheet data comes from tax returns collected by the French fiscal administration[10]. This data set gives accounting information for the whole universe of French firms in the private sector, excluding the financial and agricultural sectors between 2006 and 2011. In addition of balance sheet information, a common identifier among all French firm data (SIREN number) and a 4-digits sector classification are provided. Since the focus is on the effects of *PD* on the export markets behaviour, only firms belonging to the manufacturing and wholesale sectors (the two main French exporting sectors) are retained.

To identify precisely in which sectors firms are operating, I then rely on an extensive yearly survey conducted by the Ministry of Industry (Enquête Annuelle des Entreprises, "EAE"). The survey is exhaustive for French firms with more than 20 workers or whose sales exceed 5 millions euros (smaller firms are surveyed according to a stratified sample design) and contains the amounts of sales realized by each surveyed firms in each 4-digits sector. 36 231 manufacturing firms and 22 602 wholesale firms thus appear in 2009 in the data set obtained by merging balance sheet data and the EAE data set.

Information on group ownership is eventually added using the LIFI ("Liaisons financières") survey; exhaustive on the set of firms that employ more than 500 employees, that generate more than 60 millions euros in revenues or that hold more than 1.2 million euros of traded shares, the LIFI survey is completed by data coming from Bureau Van Dijk (Diane-Amadeus data set) so as to cover the whole universe of French corporate groups. This data set allows us to identify the set of business units that belong to the same corporate group and to determine whether a given business unit can be classified as a SME according to the French legislation[11].

2.3 Measurement of payment delays

Traditional firm-level data sets such as tax returns databases do not feature information on contractual payment delays[12]. However, a natural measure of the actual client payment delays (used for instance in ODDP (2010) or Barrot and Sauvagnat (2015)) might be derived from standard balance sheet data by defining for a firm f

$$Client_f = \frac{Account\ receivables_f}{Sales_f} * 365$$

The ratio is multiplied by 365 so as to be readily interpretable in terms of days; $Client_f$ can be thought as the average payment delays between firm f and its client for a given fiscal year. This measure corresponds to $1/\lambda$ in the model, i.e. the average gap between cash-flow payments.

Since the reform affected suppliers as well as clients payment delays, it is necessary to find an estimation of the variation in payment delays that takes both sides of trade credit into account. Suppliers' *PD* are therefore symmetrically computed as

$$Supplier_f = \frac{Account\ payables_f}{Sales_f} * 365$$

which leads to define "net" payment delays NPD_f as $Client_f - Supplier_f$. Positive NPD_f mean that firm f is paid slower by its clients than it pays its suppliers.

Notwithstanding their simplicity and ease of interpretation, there are several reasons to believe that these direct measures of *PD* might not be appropriate for the analysis. First, as noted by Barrot (forthcoming), these

[10] See Bertrand, Schoar and Thesmar (2007), Garicano, Lelarge and Van Reenen (2013) or Boutin et al. (2013) for other uses of this data set.

[11] According to a 2008 law, a firm (which can be composed of several business units) is considered as a SME if (1) it employs less than 250 workers and (2) it generates less than 60 millions euros in revenues or possesses less than 43 millions euros in total assets.

[12] See Antràs and Foley (forthcoming) for a recent example of a data set including such information.

estimations are subject to measurement error as they compare the amount of sales generated in the whole fiscal year to the amount of trade credit recorded at the time of the tax report. If firm f's sales fall at the time of the tax report, clients trade credit will fall and thus $Client_f$ will be underestimated. Similarly, if firm f sells all its account receivables to a factoring firm, estimated *PD* will be zero while effective *PD* will stay strictly positive.

Second, and perhaps more importantly, these estimations measures *actual PD*, which may differ from *contractual PD*. Yet, contractual *PD* may be more determinant in the choice of export strategies than actual *PD*: take for instance the case of a firm that have actual suppliers *PD* of 50 days. If contractual *PD* are actually of 60 days, then the firm knows that it can benefit of a margin of 10 days to pay its suppliers if its foreign clients pay late ; in the opposite case, if contractual payments are equal to 50 days (or even lower), then the firm knows that it has no flexibility on its payment delays, which may make it give up entering a new export market.

This measurement problem can be overcome by noting that if contractual payment delays widely vary across industries, they are quite stable within a given sector (Ng, Smith and Smith (1999) and Costello (2013)). This finding is consistent with the fact most of the trade credit determinants emphasized in existing trade credit theories[13] are homogeneous at the sector-level.

Better estimations of contractual *PD* can therefore be obtained by taking the sectoral means[14][15] of $Client_f$ and $Supplier_f$: we denote the averages in a sector s by $\overline{Client_s}$ and $\overline{Supplier_s}$. Taking the mean should remove measurement errors provided that they are not too correlated in a given sector. Moreover, the average *PD* give an estimation of the *PD* that are generally settled in a given sector, which can be considered as a reasonable proxy for contractual *PD*.

Table 1: Top and bottom 5 sectors for $\overline{Client_s}$ and $\overline{Supplier_s}$ (2007)

$\overline{Client_s}$ (DoS)		$\overline{Supplier_s}$ (DoS)	
Construction of military vehicles	158.24	Construction of military vehicles	97.20
Manufacture of fibre-optic cables	122.65	Manufacture of fibreglass	79.98
Manufacture of steam generators	110.39	Manufacture of batteries and accumulators	77.97
Manufacture of other transport equipments	109.24	Manufacture of other non-metallic products	73.52
Nuclear materials processing	107.54	Manufacture of rubber or plastics machinery	70.90
Ice cream production	22.43	Bindery and related activities	27.89
Processing and conservation of potatoes	16.17	Production of precious metals	27.71
Sale and repair of motorcycles	13.35	Manufacture of musical instruments	27.11
Preparation of meat products	10.75	Wholesale trade services of live animals	25.62
Manufacture of bread and fresh pastry goods	7.00	Manufacture of medical instruments	22.60

This table displays the NAF-4 digits sectors in the manufacturing or retail sectors with the highest and lowest values of average actual clients *PD* ($\overline{Client_s}$) and suppliers *PD* ($\overline{Supplier_s}$). The values are given in days of sales (DoS). A value of 100 for $\overline{Client_s}$ means that the average gap between cash-flow payments for firms in sector s is 100 days.

Table 1 displays the sectors with the highest and lowest values of $\overline{Client_s}$ and $\overline{Supplier_s}$. Several patterns emerge from table 1. First, highest $\overline{Client_s}$ and $\overline{Supplier_s}$ appear mostly in heavy industry, while lowest $\overline{Client_s}$ and $\overline{Supplier_s}$ are mostly to be seen in the agri-food sector. This is consistent with the theoretical prediction of Long, Malitz and Ravid (1993) that the durability of the product should be positively correlated to payment

[13]Among them one can mention the degree of product market competition (Brennan, Maksimovic and Zechner, 1988), the degree of uncertainty on the quality of the product (Long, Malitz and Ravid (1993) and Lee and Stowe (1993)) and the information advantage of suppliers over banks to observe product quality or to enforce high effort (Smith (1987), Biais and Gollier (1997), Burkart and Ellingsen (2004) or Cunat (2007)).

[14]For each sector, observations that are superior to the median plus five times the interquartile gap or inferior to the median minus five times the interquartile gap are removed in the computation of the mean so as to limit the effects of outliers. Moreover, we discard sectors with less than 10 observations.

[15]Since the reform affected only transactions made between French firms, a better proxy for the payment delays might be obtained by taking the mean of $Client_f$ and $Supplier_f$ only on the set of firms that do not export. However, this makes me lose an important share of industries (in particular in the manufacturing sector) as I am left with too few firms to take the sectoral mean.

delays. However, there is no direct mapping between the sectoral rank of $\overline{Client_s}$ and of $\overline{Supplier_s}$: in 2007, the correlation between the two is only of 61.3%. For instance, firms in the "homogenised food and dietary preparations" sector have on average high clients *PD* and low suppliers *PD* compared to other sectors (the industry is in the first tercile of the sectoral distribution of $\overline{Client_s}$ and the last tercile of the distribution of $\overline{Supplier_s}$) which can in this particular example be understood by the fact that the products that they sold have higher durability than the inputs that they use.

Once $\overline{Client_s}$ and $\overline{Supplier_s}$ are estimated, I use the information of the sales by sector given in the EAE dataset; denoting by $\omega_{f,s} = Sales_{s,f}/Sales_f$ the weight of firm f's sales in sector s $Sales_{s,f}$ in its total sales, contractual clients and suppliers *PD* are computed as

$$\overline{Client_f} = \sum_s \omega_{f,s}\overline{Client_s} \text{ and } \overline{Supplier_f} = \sum_s \omega_{f,s}\overline{Supplier_s}$$

and similarly net contractual payment delays $\overline{NPD_f}$ are defined as $\overline{NPD_f} = \overline{Client_f} - \overline{Supplier_f}$. The measure of contractual *PD* is therefore a sales-weighted sum of the *PD* might have to agree to through its presence in an industry.

The main variable of interest is the change in net payment delays between 2008 and 2009; decomposing this variation, one can see that

$$\begin{aligned}
\Delta\overline{NPD}_{ft} &= \sum_s \omega_{f,t}\overline{NPD}_{s,t} - \sum_s \omega_{f,t-1}\overline{NPD}_{s,t\text{-}1} \\
&= \sum_s \omega_{f,t-1}(\overline{NPD}_{s,t} - \overline{NPD}_{s,t\text{-}1}) + \sum_s (\omega_{f,t} - \omega_{f,t\text{-}1})\overline{NPD}_{s,t} \\
&= \Delta_T\overline{NPD}_{ft} + \Delta_\omega\overline{NPD}_{ft}
\end{aligned}$$

where $\Delta_T\overline{NPD}_{ft}$ is the variation in net *PD* holding the market shares constant and $\Delta_\omega\overline{NPD}_{ft}$ reflects the change in sectors of activity. Since $\Delta_\omega NPD_{ft}$ results from product market decisions and might be correlated to the firm's export behavior, I only keep $\Delta_T\overline{NPD}_{ft}$ and define

$$Var\,\overline{NPD}_{ft} = \frac{\Delta_T\overline{NPD}_{ft}}{|\overline{NPD}_{f,t-1}|}$$

as the explanatory variable of interest. $Var\,\overline{NPD}_{ft}$ therefore measures the variation (in percentage) in payment delays holding market shares constant.

2.4 International trade data

International trade data comes from the French customs (DGDDI). For each firm identified by its SIREN number, this data set gives the (free on board) value of exports and imports by country and by product ; products are identified by a 6-digit number (CPF6) easily comparable to the French activity nomenclature. A firm operating in the French metropolitan territory must report detailed information to French customs if it exports more than 1 000 euros outside the European Union. To facilitate intra-EU trade, however, firms are not required to provide information at the product-level if its total exports to the European Union for a given year are inferior to 150 000 euros and therefore do not appear in the data.

A lot of observations are excluded as export information is added since a firm must export at least once between 2007 and 2011 to appear in the resulting data set: from 58 833, the number of firms present in 2009 falls to 33 009. Exports are then clustered at the firm-country-industry level by summing all export flows from the same firm f to the same country c in the same 2-digits product classification i ("industry").

The export behavior at the *intensive margin* can then be observed by defining $\Delta Y_{fcit} = \Delta\log(Exports_{fcit})$ if firm f is present in the market *(c,i)* in t and $t-1$. To have a sharp distinction between the intensive and extensive margins, a firm is considered to be present in a market if $Exports_{fcit}$ is at least equal to 5 000 euros.

As in Paravisini et al. (2014), the export behavior at the *extensive margin* is treated differently depending if the firm enters or exits a given market. If firm f is present in market *(c,i)* at time $t-1$, I set $Exit_{fcit} = 1$ if f is not present at time t and 0 otherwise. Entries are more tricky as one must define the set of potential markets $\Omega(f)$ in which firm f might enter[16]. Building on Paravisini et al. (2014) and denoting by C^{TOP} the set of the top 50 countries of exports for French firms in 2007, $\Omega(f)$ is defined as follows:

- If firm f exports at time $t-1$, then $\Omega(f) = \left\{C^{TOP} \times I^{Exp}_{t-1}\right\}$ in which I^{Exp}_{t-1} denotes the set of industries in which f exports at $t-1$
- If firm f does not export at time $t-1$, then $\Omega(f) = \{C^{TOP} \times I^{Dom}_{t-1}\}$ in which I^{Dom}_{t-1} denotes the set of domestic industries in which f sells its products at $t-1$ (this information being given by the EAE)

If firm f is not present in market *(c,i)* $\in \Omega(f)$ at time $t-1$, I set $Entry_{fcit} = 1$ if f is present at time t and 0 otherwise.

3 Empirical strategy

3.1 PT variation and export market behavior

This section describes the approach to identifying the causal effects of payment delays on export market decisions. In order to disentangle the effects of the 2009 reform from the presence of the financial crisis (point (b) in section 2.1), I first rely on the disaggregated nature of export data by bringing the analysis to the market level and introducing industry-country fixed effects (Paravisini et al., 2014). By comparing export outcomes within an industry-country pair, I am able to remove any market-level shock that hit demand (*e.g.*, household over-indebtness) or supply (*e.g.*, variation in input prices) between 2008 and 2009 in a given market. Instead of comparing total export variations, the estimations will therefore be based on the comparison of export outcomes in a industry-country pair between firms that were differently affected by the reform.

Market fixed effects additionally allow to take into account a possible correlation between the exposure to the reform and the presence in certain markets. Suppose for instance that because of their position in the input-output network, firms that were exporting plastics and rubber products to the US experienced a strong fall in *NPD* following the reform. A "naive" estimation might erroneously conclude to a significant positive effect of the variation in payment delays to the drop in exports to that market even in the absence of actual causation. Removing average trends at the market level ensures that the estimations are not prone to such potential bias.

The introduction of fixed effects will however not yield unbiased estimates if the impact of the crisis is heterogeneous among firms exporting in the same market. I first rely on accounting data to assess the impact of the crisis at the firm-level; I use in particular the firm-level variation of the operational margin $\Delta OperMarg_{f,t}$ to control for changes in profitability and the variation in the cash-to-assets ratio $\Delta CashTA_{f\,t}$ to control for the evolution of the level of liquidity of the firm (a description of the construction of these variables is given in Table 2). Note that the introduction of $\Delta CashTA_{f,t}$ is all the more necessary to test the empirical predictions presented in section 1.3 than proposition 5 predicts that a change in *PD* should affect export decisions *holding constant the level of cash*. I eventually include the variation in leverage $\Delta DebtTA_{f,t}$ in the set of variables of control.

Since Bricongne et al. (2012) find that French exporters' reaction to the crisis varied a lot with firm's size[17],

[16]In the absence of such restrictions, the set $\Omega(f)$ is composed of approximately 25 industries * 200 countries = 5000 markets, which generates very low entry probabilities. To facilitate the estimation of linear probability models, I focus here on the "most reasonable" entry markets which I define as the product of the industries in which firms are already present and the top 50 export destinations for French firms.

[17]Bricongne et al. (2012) find that while all firms have been evenly affected by the crisis, large firms did mainly adjust through the intensive margin and by reducing the portfolio of products offered in each destination served while smaller exporters have been instead forced to reduce the range of destinations served or to stop exporting altogether.

I also add the lag of the logarithm of total assets $Size_{f,t-1}$; similarly, a dummy $Group_{f,t-1}$ is included to control for heterogeneity in financing conditions due to the affiliation to a business group.

Another potential concern with this approach is that the methodology designed to compute $Var\,\overline{NPD}_{ft}$ might make it inappropriately capture sectoral variations of factors correlated to payment delays. In order to control for such correlations, I use the same methodology to build $Var\,\overline{Sales}_{ft}$ and $Var\,Inv_{ft}$ (see table 2 for the details of the computation): this allows us to take explicitly into account the effects of the crisis as experimented by firm f through the sales-weighted mean of the variation in sectoral sales (which I interpret as a measure of the impact of the crisis on the supply-demand equilibrium at the sectoral level) and investment (which captures the changes in expectations on future profitability and possibly the effects of the tightening of credit conditions). $Var\,\overline{NPD}_{ft}$ might also simply reflect firm f's exposure to financial constraints through its presence on sectors with varying dependence on external finance (Rajan and Zingales, 1998): I take this eventuality into account by introducing the sales-weighted average of sectoral financial dependence, $\overline{ExtFin}_{f,t-2}$, where financial dependence is defined as the average share of capital expenditures that is not financed by operating cash-flows[18]. This measure has been in particular previously used in previous work on the links between finance and international trade such as Manova (2013) or Paravisini et al. (2014).

For $Z_{fcit} \in \{\Delta Y_{fcit}, Exit_{fcit}, Entry_{fcit}\}$, the baseline regression is therefore specified as

$$Z_{fcit} = \alpha_{ci} + \beta Var\,\overline{NPD}_{ft} + \gamma X_{ft} + \epsilon_{fcit} \text{ for } t = 2009 \tag{15}$$

where α_{ci} is the industry-country fixed effects and X_{ft} the set of firm-level control variables. Several features in equation 15 are worth emphasizing: first, since the left-hand variable is observed at the firm-country-industry-level and right-hand sides variables only at the firm-level, error delays ϵ_{fcit} will be correlated for a given firm f. Bertrand, Duflo and Mullainathan (2004) and Petersen (2009) show with Monte-Carlo simulations that this will lead to underestimate standard errors and thus to under-reject the null hypothesis of non significance. I follow the econometric literature on that subject and cluster standard errors by firm to allow for arbitrary patterns of cross-correlation. Second, for $Z_{fcit} \in \{Exit_{fcit}, Entry_{fcit}\}$, equation 15 boils down to a linear probability model. The choice of a linear estimator over nonlinear ones can be understood by the necessity for the estimator to handle a large number of fixed effects, which the probit estimator appears to struggle with (see Greene (2004)). This suggests the use of logit models ; however, this strand of nonlinear econometric models does not easily deal with endogeneity issues[19], a problem I now turn to.

3.2 *Description of the IV strategy*

There are indeed several reasons to believe that $Var\,\overline{NPD}_{ft}$ might be endogenous. As previously noted in point (c), derogations to the 2009 might cause the variation in PD to be driven by export-related factors and thus create a form of simultaneity in equation 15. More importantly, if there are omitted variables (such as aggregate factors) that drive $Var\,\overline{NPD}_{ft}$ even in the presence of control variables, the estimated coefficient $\hat{\beta}$ will be biased. Ideally, $Var\,\overline{NPD}_{ft}$ should only reflect the effect of the reform. A natural way to isolate the effect of the reform is to rely on the sixty-day-rule: since the reform gave a clear ceiling to contractual payment delays, it is possible to determine to which extent sectors were likely to be affected by the reform. For a given

[18] Rajan and Zingales (1998) recommend to use the average values taken for the US economy, as they advocate that the US financial system is the most developed one and that the values of *ExtFin* computed for the US economy would therefore capture variation in financial dependence due only to industrial factors (degree of uncertainty, of redeployability of the assets...) and not to variation in development of the financial system. I use here the values taken for the French economy since (1) the identification does not depend on cross-country variations (2) the French financial system is arguably developed enough for *ExtFin* to mostly capture variation in demand-originated variation in financial dependence.

[19] Recent developments (Wooldridge, 2014) suggest that quasi-maximum likelihood techniques can be developed to get consistent estimators in logit models with a continuous endogenous regressor.

sector s, I define to that end excessive net payments delays $\overline{ENPD}_s$ as the mean for all firms f in s of

$$\max(0, Client_f - 60) - \max(0, Supplier_f - 60)$$

$\overline{ENPD}_s$ can be interpreted as a measures of the net change in PD needed to reach the setting where the reform is perfectly enforced: if $Client_f$ and $Supplier_f$ were always inferior to sixty days in sector s, then $\overline{ENPD}_s$ would equal zero. Similarly, if suppliers excessive PD were about as high than clients excessive PD, the needed change in PD would be zero in net terms. In general, a high value of $\overline{ENPD}_s$ means that clients PD are on average higher than sixty days and that suppliers PD are relatively low. The firm-level variable $\overline{ENPD}_{f,t\text{-}2}$ is then computed as

$$\overline{ENPD}_{f,t\text{-}2} = \sum_s \omega_{f,s,t\text{-}1} \overline{ENPD}_{s,t\text{-}2}$$

For $t = 2009$, the variable $\overline{ENPD}_{f,t\text{-}2}$ is thus the mean of the sectoral excessive net payments computed in 2007 weighted by the sectoral sales of firm f in 2008. This variable is used as in instrument for $Var\,\overline{NPD}_{ft}$:

$$Var\,\overline{NPD}_{ft} = \eta_{ci} + \xi \overline{ENPD}_{f,t\text{-}2} + \rho X_{ft} + \nu_{fcit} \;\text{ for } t = 2009 \tag{16}$$

I expect a negative significant coefficient ξ: the variation in net payment delays subsequent to the reform should correct for previous excessive PD.

The identification assumption behind the IV strategy is that factors other than payment delays that affect export outcomes of firms present *in a given market* are not correlated to the exposure to the reform. This assumption might be violated if firms with more market power were more likely to be affected by the reform than other. Since one of the main goal of the reform was to put an end to abusive practices resulting (in particular) from dominant positions in supplier-customer relationships, this might create some bias in the estimations since export decisions are presumably correlated with market power. I turn to these issues in section 5.

This instrumentation strategy has several advantages in this context: first, in the absence of a control group (point (a)), it allows to turn a *qualitative* assignment (treatment versus control group) into a *quantitative* one (to what extent is firm f exposed to the reform?). Second, the instrument is designed so as not to take into account derogations (point (c)). The first-stage estimation thus only captures the variation of net PD that can be explained by the sixty-days-rule and should leave aside the effects of derogations; in the end, derogations should only bring down the coefficient $\hat{\xi}$ but should leave $\hat{\beta}$ unaffected. In other terms, the IV estimator captures the *local average treatment effect* (LATE) by relying on the effects of the reform only in the sectors that applied the sixty-days rule (*compliers*). Equation 16 eventually gives a convenient way to test point (d); if $\hat{\xi}$ is significantly different from zero for $t = 2008$, one might conclude that firms have indeed anticipated the reform by modifying their PD as of 2008.

3.3 Descriptive statistics

To obtain the final data set, I eventually remove outliers by dropping observations that are superior (resp. inferior) to the median plus (resp. minus) five times the gap between the 95^{th} and 5^{th} percentile. Since the estimations requires to observe export and accounting data for $t = 2008$ and 2009, the main data set is restricted to 14 888 firms present in the EAE in both years and with non-missing values for all variables. Most of the firms are SMEs (73.3 %) and belong to the manufacturing sector (73.1 %); they are moreover relatively mature (the median age is 27 years). Panel B of table 2 shows that average total assets is around 5 millions euros, and that 49 % of the firms in the data set belong to a business group, which is in line with the importance of business groups in the French economy (Boutin et al., 2013).

The effects of the crisis are clearly visible in the summary statistics. The operating margin dropped on average by -3%, while sectoral sales (as measured by $Var\,\overline{Sales}_{ft}$) decreased by -15%. On the export side, I

Table 2: Descriptive statistics

This table summarizes the main variables used (Panel A) and presents summary statistics (Panel B).

Panel A: Data Definitions

Dependent variables	
ΔY_{fcit}	$\Delta \log(Exports_{fcit})$ if firm f is present in the market *(c,i)* at time t and $t-1$. *Source: Customs.*
$Exit_{fcit}$	$Exit_{fcit}=1$ if firm f is present in market *(c,i)* at time $t-1$ and f exits at time t (0 otherwise). *Source: Customs.*
$Entry_{fcit}$	$Entry_{fcit}=1$ if firm f is not present in market *(c,i)* at time $t-1$ and f enters at time t (0 otherwise). *Source: Customs.*
Independent variables	
$Var\,\overline{NPD}_{ft}$	Variation in the sales-weighted average of sectoral net payment delays (see section 2.3), standardized by the absolute value of $NPD_{f,t\text{-}1}$. *Source: EAE, BRN-RSI.*
$Var\,\overline{Sales}_{ft}$	Variation in the logarithm of sales-weighted average of sectoral total sales. *Source: EAE, BRN-RSI.*
$Var\,\overline{Inv}_{ft}$	Variation in the logarithm of sales-weighted average of sectoral total investment. *Source: EAE, BRN-RSI.*
$\Delta OperMarg_{f,t}$	Variation in the EBIT over sales ratio, standardized by $OperMarg_{f,t\text{-}1}$. *Source: BRN-RSI.*
$\Delta CashTA_{f,t}$	Variation in the (net) cash to assets ratio, standardized by $CashTA_{f,t\text{-}1}$. Cash holdings are computed in "net" delays, that is by removing bank overdrafts. *Source: BRN-RSI.*
$\Delta DebtTA_{f,t}$	Variation in the long-term debt to assets ratio, standardized by $DebtTA_{f,t\text{-}1}$. *Source: BRN-RSI.*
$Group_{f,t}$	Dummy indicating the affiliation to a business group. *Source: LIFI.*
$Size_{f,t\text{-}1}$	Lag of the logarithm of total assets. *Source: BRN-RSI.*
$\overline{ExtFin}_{f,t\text{-}2}$	Lag of the logarithm of the sales-weighted average of the sectoral mean of the share of capital expenditures that is not financed by operating cash-flows (computed in 2007). *Source: EAE, BRN-RSI.*
Instrument	
$\overline{ENPD}_{f,t\text{-}2}$	Sales-weighted average of sectoral excessive net payment delays computed in 2007 (see section 3.2). *Source: EAE, BRN-RSI.*

Panel B: Summary Statistics

Name	# Obs.	Mean	Std. Dev.	Percentiles 5th	25th	50th	75th	95th
ΔY_{fcit}	101 132	-0.49	1.35	-2.89	-1.06	-0.33	0.18	1.42
$Exit_{fcit}$	130 531	0.22	0.42	0.00	0.00	0.00	0.00	1.00
$Entry_{fcit}$	664 700	0.02	0.13	0.00	0.00	0.00	0.00	0.00
$Var\,\overline{NPD}_{ft}$	14 888	-0.56	3.91	-5.38	-0.45	-0.06	0.58	1.50
$\overline{ENPD}_{f,t\text{-}2}$	14 888	-35.30	133.80	-150.03	-30.29	-6.32	12.02	27.95
$Var\,\overline{Sales}_{ft}$	14 888	-0.15	0.10	-0.34	-0.19	-0.13	-0.08	-0.02
$Var\,\overline{Inv}_{ft}$	14 888	-0.27	0.28	-0.70	-0.42	-0.25	-0.13	0.15
$\Delta OperMarg_{f,t}$	14 888	-0.03	0.12	-0.19	-0.05	-0.01	0.01	0.08
$\Delta CashTA_{f,t}$	14 888	-0.86	4.89	-4.68	-0.34	0.10	0.51	0.96
$\Delta DebtTA_{f,t}$	14 888	0.00	0.05	-0.05	-0.01	0.00	0.00	0.09
$Group_{f,t}$	14 888	0.49	0.00	0.00	1.00	1.00	1.00	
$Size_{f,t\text{-}1}$	14 888	8.52	1.57	6.03	7.52	8.45	9.44	11.25
$\overline{ExtFin}_{f,t\text{-}2}$	14 888	-11.15	10.26	-23.30	-13.64	-9.55	-7.13	-2.93

observe an exit probability of a market (c,i) between 2008 and 2009 of 22%; when firms maintained their presence in a market, they decreased the volume of exports by 49% on average. The probability of entry in a new export market is on the other hand about 2%. Net payment delays decreased by -56% on average, but a closer look to the distribution shows that they increased for half of firms, which makes explicitly appear that the renegotiation of *PD* produced both winners and losers.

Median excessive payment delays were about -6.3 days prior to the reform, which means that the majority of firms were located in sectors where most of the excessive payment delays were to be found on the suppliers side. This is mainly due to the presence of wholesale firms in the data set; the wholesale sector was indeed perceived as one of the sectors who benefitted the most from important suppliers *PD* (ODDP, 2010). When I restrict the data set to manufacturing firms, median $\overline{ENPD}_{f,t\text{-}2}$ increases to 6.1 days, indicating that a strict application of the reform should normally impact more clients *PD* in the manufacturing sector.

4 Results

4.1 Variation in net payment delays

Table 3: Variation in net payment delays

	OLS (1)	OLS (2)	OLS (3)	OLS (4)	OLS (5)	OLS (6)
		$Var\,\overline{NPD}_{f,08\text{-}09}$			$Var\,\overline{NPD}_{f,07\text{-}08}$	$Var\,\overline{NPD}_{f,09\text{-}10}$
$\overline{ENPD}_{f,t\text{-}2}$	-0.002^{***}	-0.002^{***}	-0.002^{***}	-0.002^{***}	-0.017	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.010)	(0.000)
$\Delta OperMarg_{ft}$		-0.392	-0.328	-0.316	1.739	-0.263
		(0.351)	(0.368)	(0.389)	(1.499)	(0.204)
$Size_{f,t\text{-}1}$		-0.091	-0.120^{**}	-0.117^{*}	-0.179	-0.014
		(0.063)	(0.058)	(0.062)	(0.151)	(0.045)
$\Delta CashTA_{ft}$		0.016^{*}	0.017^{*}	0.017^{*}	0.038^{**}	0.000
		(0.008)	(0.008)	(0.008)	(0.015)	(0.003)
$\Delta DebtTA_{ft}$		-0.156	-0.164	-0.163	-1.016	0.151
		(0.639)	(0.572)	(0.560)	(1.792)	(0.463)
$Group_{ft}$			0.185	0.184	0.082	0.056
			(0.171)	(0.167)	(0.233)	(0.064)
$Var\,\overline{Sales}_{ft}$			-0.394	-0.341	9.782^{*}	-1.161
			(1.668)	(1.762)	(4.860)	(1.297)
$Var\,\overline{Inv}_{ft}$				-0.099		
				(0.518)		
$\overline{ExtFin}_{f,t\text{-}2}$				0.003		
				(0.017)		
Observations	14 888	14 888	14 888	14 888	11 004	11 195
Fixed effects	No	No	No	No	No	No
R^2	0.0038	0.0055	0.0058	0.0058	0.0310	0.0012

All standard errors are clustered at the sector (NAF 2-digits) level. *, **, and *** denote statistical significance at 10, 5 and 1%. Standard errors are given in parentheses.

In column 1 to 6, equation 16 is tested for $t = 2009$ at the firm-level; standard errors are here clustered by industry (2 digits). This exercise allows to understand as a first step the impacts of the sixty-days-rule on net payment delays. The effect of $\overline{ENPD}_{f,t\text{-}2}$ is negative and significant, which is line with the idea of the reform as correcting past excessive payment delays. On average, estimations indicate that an increase of $\overline{ENPD}_{f,t\text{-}2}$ by one day decreases $Var\,\overline{Sales}_{ft}$ by -0.2%. This effects is robust to the addition of control variables; in particular, the effects of $Var\,\overline{Sales}_{ft}$ and $Var\,\overline{Inv}_{ft}$ is found to be non-significant, which alleviates the concern that the significance of the $Var\,\overline{NPD}_{ft}$ coefficient might be driven by aggregate shocks due to the crisis. Similarly, $Var\,\overline{NPD}_{ft}$ does not seem to be correlated with the sales-weighted average of sectoral financial dependence $\overline{ExtFin}_{f,t\text{-}2}$. Interestingly, I find a negative (though imprecisely estimated) effect of $Size_{f,t\text{-}1}$ on the variation in net *PD*, which suggests that in addition to the sectors in which the firm was operating, the effect of the reform also depended also on its size. The estimations also point to a robust and significant correlation between

$\Delta CashTA_{f,t}$ and $Var\,\overline{NPD}_{ft}$.

I then test for the hypothesis that firms anticipated the reform by testing equation 16 for $t = 2008$. I find no evidence of such effects (column 7). As suggested by ODDP (2010), the application of the reform prior to 2009 was difficult since it involved convincing all the actors implied in the customer-supplier relationship to renegotiate their payment delays so as not to impose the financial burden on a single firm. Similarly, I perform a placebo equation by testing equation 16 for $t = 2010$ and find once again no effect of a correction of excessive net payment delays.

4.2 Extensive margin

Table 4 shows the results of the estimations of equation 15 for $Z_{fcit} = Exit_{fcit}$ (panel A) and $Z_{fcit} = Entry_{fcit}$ (panel B). Column 1 of panel A find a weak but significant positive association between the probability of exit and $Var\,\overline{NPD}_{ft}$; however, the coefficient becomes almost non significant as soon as I include control variables. In particular, it can be observed that larger firms with better operating margins had lower probability of exit between 2008 and 2009. Similarly, an increase in the cash-to-assets ratio $CashTA_{f,t}$ is associated with a higher survival rate in export markets.

Consistently with the results from the first-stage estimations, the Kleibergen-Paap statistics go in favour of a rejection the hypothesis of a weak instrumentation; moreover, when $Var\,\overline{NPD}_{ft}$ is instrumented with $\overline{ENPD}_{f,t\text{-}2}$, the coefficient on $Var\,\overline{NPD}_{ft}$ becomes positive and highly significant. This result is very intuitive: columns 3-6 indicate that longer payment delays had a positive effect on the probability of exit. The magnitude of the effect is sizeable: according to the estimations, a 100% increase in net payment delays (approximately the interquartile gap) would increase the probability of exit by 1.2%.

The fact that simple OLS do not allow to pin down this effect suggests the presence of confounding aggregate factors leading direct estimations to yield biased estimates. By capturing the part of the variation in net payment delays that can be explained by the exposure to the reform, I am able to isolate the causal effect of $Var\,\overline{NPD}_{ft}$ on firms' exit decisions.

Panel B displays the results of the regressions on the probability of entry for the subpopulation of firms that already export in 2008. The estimates do not substantially change if I also include non-exporters (last column in appendix C). However, since in the data set the probability of entry for non-exporters is very low (0.2 %), equation 15 is imprecisely estimated on this sub-sample (see appendix C), which explains why I exclude it from the main estimations.

In a very coherent way, the results shows that $Var\,\overline{NPD}_{ft}$ had a positive and highly significant effect on $Entry_{fcit}$. On average, a 100% increase in $NPD_{f,t}$ would lead to a 0.2% increase of the probability of entry. When compared to the unconditional probability of entry (2%), an interquartile gap increase of payment delays leads to 11.8% rise in the probability of entry. Modifying the restrictions made on the set of potential entry market might however yield different magnitudes of this effect. Furthermore, it appears that size has a significant and positive effect on the entry decision. I find eventually no effect of the variation in long-term debt on the exit/entry decisions, which seems to suggest that financial frictions rather affect export decisions in the form of liquidity constraints (through $CashTA_{f,t}$ and $Var\,\overline{NPD}_{ft}$) than of credit constraints.

4.3 Intensive margin

Table 6 shows the result of the estimations of equation 15 for $Z_{fcit} = \Delta Y_{fcit}$. I find a positive correlation between ΔY_{fcit} and the variation in operating margin $\Delta OperMarg_{ft}$. Consistently with Bricongne et al. (2012), I find that larger firms reduced more their exports at the intensive margin.

The coefficient $Var\,\overline{NPD}_{ft}$ appears to be negative in all specifications; it is significant at the 10% level in the IV estimations. The magnitude of the coefficients indicate that a 100% increase in $Var\,\overline{NPD}_{ft}$ caused on average a drop in exports by 2.2%.

Table 4: Effects of $Var\,\overline{NPD}_{ft}$ at the extensive margin

Panel A: Exit

	First stage	OLS (1)	OLS (2)	IV 2SLS (1)	IV 2SLS(2)	IV 2SLS (3)
	$Var\ \overline{NPD}_{ft}$			$Exit_{fcit}$		
$Var\,\overline{NPD}_{ft}$		-0.001^{**}	-0.001^{*}	0.013^{**}	0.012^{**}	0.012^{**}
		(0.001)	(0.001)	(0.005)	(0.005)	(0.005)
$\Delta OperMarg_{ft}$	-0.664^{*}		-0.070^{***}		-0.061^{**}	-0.061^{**}
	(0.394)		(0.026)		(0.027)	(0.027)
$Size_{f,t\text{-}1}$	0.069		-0.021^{***}		-0.022^{***}	-0.022^{***}
	(0.051)		(0.002)		(0.002)	(0.002)
$\Delta CashTA_{ft}$	0.036^{**}		-0.002^{***}		-0.002^{***}	-0.002^{***}
	(0.018)		(0.001)		(0.001)	(0.001)
$Group_{ft}$	-0.082		0.000			0.001
	(0.151)		(0.006)			(0.007)
$Var\,\overline{Sales}_{ft}$	0.474		0.027			0.020
	(0.624)		(0.023)			(0.024)
$\Delta DebtTA_{ft}$	-0.174		0.028			0.029
	(1.252)		(0.042)			(0.043)
$\overline{ENPD}_{f,t\text{-}2}$	-0.003^{***}					
	(0.000)					
Observations	130 531	130 531	130 531	130 531	130 531	130 531
Product-Destination FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.086	0.074	0.081	-	-	-
Weak identification (KP stat)	-	-	-	186.39	188.08	186.62

Panel B: Entry (exporters)

	First stage	OLS (1)	OLS (2)	IV 2SLS (1)	IV 2SLS(2)	IV 2SLS (3)
	$Var\ \overline{NPD}_{ft}$			$Entry_{fcit}$		
$Var\,\overline{NPD}_{ft}$		-0.000	-0.000	-0.002^{**}	-0.002^{**}	-0.002^{**}
		(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
$\Delta OperMarg_{ft}$	0.806		0.004		0.006	0.006
	(0.614)		(0.004)		(0.004)	(0.004)
$Size_{f,t\text{-}1}$	0.045		0.003^{***}		0.003^{***}	0.003^{***}
	(0.064)		(0.000)		(0.000)	(0.000)
$\Delta CashTA_{ft}$	-0.011		-0.000		-0.000	-0.000
	(0.008)		(0.000)		(0.000)	(0.000)
$Group_{ft}$	0.044					-0.000
	(0.126)					(0.001)
$Var\,\overline{Sales}_{ft}$	-0.288					-0.013^{**}
	(0.520)					(0.006)
$\Delta DebtTA_{ft}$	0.752					-0.008
	(1.218)					(0.007)
$\overline{ENPD}_{f,t\text{-}2}$	-0.002^{***}					
	(0.000)					
Observations	664 700	664 700	664 700	664 700	664 700	664 700
Product-Destination FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.038	0.006	0.007	-	-	-
Weak identification (KP stat)	-	-	-	253.590	255.654	250.187

All standard errors are clustered at the firm level. *, **, and *** denote statistical significance at 10, 5 and 1%. Standard errors are given in parentheses. The Kleibergen-Paap statistic (KP stat) tests for the presence of a weak instrument in presence of heteroscedasticity (high values suggest to reject the null hypothesis of weak identification).

5 Robustness tests

5.1 *Alternative specifications*

The methodology of construction of $Var\,\overline{NPD}_{ft}$ is based on a set of assumptions that, if proved wrong, might render the estimations invalid. First, the measures do not take into account differences in sourcing strategy: a firm that products most of its inputs should be less affected by a variation of its suppliers *PD* than a

Table 5: Effects of $Var\,\overline{NPD}_{ft}$ at the intensive margin.

	First stage	OLS (1)	OLS (2)	IV 2SLS (1)	IV 2SLS(2)	IV 2SLS (3)
	$Var\ \overline{NPD}_{ft}$			ΔY_{fcit}		
$Var\,\overline{NPD}_{ft}$		-0.001	-0.001	-0.022^{*}	-0.023^{*}	-0.023^{*}
		(0.001)	(0.001)	(0.013)	(0.012)	(0.012)
$\Delta OperMarg_{ft}$	-0.710		0.348^{***}		0.333^{***}	0.326^{***}
	(0.444)		(0.059)		(0.060)	(0.060)
$Size_{f,t\text{-}1}$	0.083		-0.014^{***}		-0.013^{***}	-0.010^{**}
	(0.052)		(0.004)		(0.004)	(0.004)
$\Delta CashTA_{ft}$	0.037^{*}		0.002		0.003^{**}	0.003^{*}
	(0.019)		(0.001)		(0.002)	(0.002)
$Group_{ft}$	-0.120					-0.020
	(0.160)					(0.015)
$Var\,\overline{Sales}_{ft}$	0.460					0.098
	(0.683)					(0.062)
$\Delta DebtTA_{ft}$	-0.476					-0.006
	(1.352)					(0.131)
$\overline{ENPD}_{f,t\text{-}2}$	-0.003^{***}					
	(0.000)					
Observations	101 132	101 132	101 132	101 132	101 132	101 132
Industry-Country FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.090	0.013	0.014	-	-	-
Weak identification (KP stat)	-	-	-	164.089	165.214	164.192

All standard errors are clustered at the firm level. *, **, and *** denote statistical significance at 10, 5 and 1%. Standard errors are given in parentheses. The Kleibergen-Paap statistic (KP stat) tests for the presence of a weak instrument in presence of heteroscedasticity (high values suggest to reject the null hypothesis of weak identification).

Table 6: Alternative specifications.

	IV 2SLS (5) - ΔY_{fcit}		IV 2SLS (5) - $Exit_{fcit}$		IV 2SLS (5) - $Entry_{fcit}$	
	Coef./SD	KP/Obs.	Coef./SD	KP/Obs.	Coef./SD	KP/Obs.
Baseline	-0.023^{*}	164.192	0.012^{**}	186.621	-0.002^{***}	250.187
	(0.012)	101 132	(0.005)	130 531	(0.001)	664 700
Sourcing	-0.134^{***}	16.019	0.042^{**}	15.123	-0.007^{***}	30.646
	(0.049)	98 958	(0.017)	127 748	(0.002)	647 700
Size	0.006	7.489	0.048^{**}	8.139	-0.003^{***}	34.656
	(0.027)	99 397	(0.024)	128 315	(0.001)	652 690
Derogations	-0.023^{*}	170.759	0.015^{**}	193.474	-0.002^{**}	250.153
	(0.012)	101 132	(0.005)	130 531	$(0.8\cdot10^{-3})$	664 700
Days-days	$-1.0\cdot10^{-4*}$	1730.078	$0.5\cdot10^{-4**}$	1754.808	$-0.6\cdot10^{-5***}$	2761.168
	$(0.5\cdot10^{-4})$	101 119	$(0.2\cdot10^{-4})$	130 516	$(0.3\cdot10^{-5})$	664 200

All standard errors are clustered at the firm level. *, **, and *** denote statistical significance at 10, 5 and 1%. Standard errors are given in parentheses. The Kleibergen-Paap statistic (KP stat) tests for the presence of a weak instrument in presence of heteroscedasticity (high values suggest to reject the null hypothesis of weak identification). All estimations are made according to the IV 2SLS (5) model (see tables 4 and 6). *Baseline* denotes the estimations with the standard specification of $Var\,\overline{NPD}_{ft}$; *Sourcing* is designed so as to take into account differences in sourcing strategies; *Size* incorporates the size as a proxy for market power in $Var\,\overline{NPD}_{ft}$; *Derogations* include the role of derogations in the computation of the instrument and *Days-days* uses $\Delta_T NPD_{f,t}$ instead of $Var\,\overline{NPD}_{ft}$.

firm that heavily relies on outsourcing. I build therefore an alternative measure of *PD* by defining

$$Supplier_f^{alt} = \frac{Account\ payables_f}{Purchases_f} * 365$$

so that

$$NPD_f^{alt} = Client_f - \frac{Purchases_f}{Sales_f} Supplier_f^{alt}$$

and I compute $Var\,\overline{NPD}_{ft}^{alt}$ accordingly[20].

I reestimate the equations using $Var\,\overline{NPD}_{f,t}^{alt}$ and $\overline{ENPD}_{f,t\text{-}2}^{alt}$ as instrument (*Sourcing* line). The negative effect of $Var\,\overline{NPD}_{ft}^{alt}$ at the intensive margin becomes more significant. The sign of the other coefficients is unchanged; the magnitude of the effects appear however to be much stronger (there is approximately a factor 4 compared to the baseline model), at least in part as a result of a tighter distribution of $Var\,\overline{NPD}_{f,t}^{alt}$ (its estimated standard deviation is about two times lower than for $Var\,\overline{NPD}_{ft}$).

The construction of $Var\,\overline{NPD}_{ft}$ then relies on the notion that most of the determinants of payment delays are sectoral. There is however empirical evidence (Giannetti, Burkart and Ellingsen, 2011) that payment delays depend on market power. Not taking into account this factor might invalidate the instrumentation strategy: if firms with more market power were more likely to be affected by the reform, then the identification assumption might be violated. A simple way to tackle this issue is to construct a measure of net payment delays that incorporates the effects of market power so as to remove the potential correlation between the instrument and the error term in equation 15.

Since ODDP (2010) display anecdotal and empirical evidence that excessive payment delays are more common in intermediate and large firms, I use the size of the firm as a proxy of its market power. Precisely, I define

$$\overline{NPD}_f^{size} = \sum_s \omega_{f,s} \overline{NPD}_{s,z}$$

with $\overline{NPD}_{s,z}$ the average net payment delays in sector s for small firms ($z = SME$) or large firms ($z = Not\ SME$). $\overline{ENPD}_{f,t-2}^{size}$ is defined accordingly. The effects (*Size*) are quite similar to the baseline estimations (albeit a bit larger in magnitude), which suggests that a limited role of market power in the exposure to the reform.

I then look the effects of integrating the derogations in the computation of the instrument on the export coefficients; the results are barely unchanged (*Derogations*). Eventually, I replace $Var\,\overline{NPD}_{ft}$ by $\Delta_T \overline{NPD}_{f,t}$ in equation 15 so as to directly get the effects of a change in NPD in days on export decisions (*Days-days*). According to this estimation, an increase in NPD of ten days raises the exit probability by 0.05%, lowers the entry probability by 0.006% and the volume of exportations by 0.1%.

5.2 *Unobserved heterogeneity*

A last issue of concern is the role of uncontrolled heterogeneity in the results. Systematic unobserved variations between groups differently affected by the reform might lead us to erroneously conclude to a causal effects of $Var\,\overline{NPD}_{ft}$ on export outcomes (Bakke and Whited, 2012). I therefore re-estimate the regressions on different sub-samples of firms and export markets: in addition to highlight the source of identification of the estimations, this exercise allows us to assess whether the results still hold for groups of firms that are supposedly more homogeneous.

I first rerun IV 2SLS for equation 15 on the subsets of manufacturing and wholesale firms: the suspicion of a confounding role of unobserved heterogeneity between these two groups is high since (1) they were unequally affected by the reform (see section 3.3) (2) they gather firms with presumably very different unobserved characteristics which might have affected their export decisions. If the estimations do not reveal any effects on these subgroups, it would clearly show that these are the unobserved differences between them that have been driving the results.

Table 7 shows that if the results hold for the subset of manufacturing firms, they disappear when I restrict the sample to the wholesale sector. This might point to a role of financial constraints which may be more

[20]The value of $\overline{NPD}_{f,09}^{alt}$ is computed with the ratio $Purchases_f / Sales_f$ at its 2008 value so that $Var\,\overline{NPD}_{ft}^{alt}$ only captures the changes in payment delays.

Table 7: Unobserved firm heterogeneity.

	IV 2SLS (5) - ΔY_{fcit}		IV 2SLS (5) - $Exit_{fcit}$		IV 2SLS (5) - $Entry_{fcit}$	
	Coef./SD	KP/Obs.	Coef./SD	KP/Obs.	Coef./SD	KP/Obs.
Baseline	-0.023^{*}	164.192	0.012^{**}	186.621	-0.002^{***}	250.187
	(0.012)	101 132	(0.005)	130 531	(0.001)	664 700
Manufacturing	-0.017	139.870	0.013^{**}	158.307	-0.002^{**}	209.132
	(0.013)	80 314	(0.005)	102 723	(0.001)	491 900
Wholesale	-0.043	25.614	0.122	25.704	-0.001	15.891
	(0.027)	20 137	(0.011)	27 044	(0.001)	172 800
SME	-0.025	155.079	0.014^{*}	168.106	-0.003^{***}	181.495
	(0.016)	47 407	(0.007)	62 178	(0.001)	386 150
Not SME	-0.024	54.129	0.008	59.726	$-0.7 \cdot 10^{-3}$	64.926
	(0.017)	56 230	(0.006)	71 850	(0.002)	318 850
Financially dependent	-0.015^{*}	129.207	0.006^{*}	149.815	-0.002^{**}	168.352
	(0.009)	34 334	(0.003)	43 628	$(0.7 \cdot 10^{-3})$	193 550
Financially independent	-0.058	14.892	0.029	16.157	-0.003^{*}	15.496
	(0.052)	25 546	(0.018)	33 937	(0.002)	210 050
Insulated	-0.011	54.697	0.019	72.894	-0.002	99.090
	(0.019)	35 582	(0.012)	51 869	(0.001)	310 850

All standard errors are clustered at the firm level. *, **, and *** denote statistical significance at 10, 5 and 1%. Standard errors are given in parentheses. The Kleibergen-Paap statistic (KP stat) tests for the presence of a weak instrument in presence of heteroscedasticity (high values suggest to reject the null hypothesis of weak identification). All estimations are made according to the IV 2SLS (5) model (see tables 4 and 6). *Baseline* denotes the estimations with the standard specification of $Var\,\overline{NPD}_{ft}$; *Cash-poor* (resp. *Cash-rich*) denotes the set of firm whose cash-to-ratio is inferior (resp. superior) to the median; *Financially independent* (resp. *Financially dependent*) denotes the set of firm whose average external financial dependence $\overline{ExtFin}_{f,t\text{-}2}$ is inferior (resp. superior) to the median.

of a concern for manufacturing industries due to their greater needs for external finance. This explanation is supported by lines 3-4 in which I separate the split the sample between *financially dependent* (top 30% of $\overline{ExtFin}_{f,t\text{-}2}$) and *financially independent* firms (lowest 30% of $\overline{ExtFin}_{f,t\text{-}2}$): I find that the variation in net payment delays have causal effects only for financially dependent firms. I then separately look at the effects of variations in *NPD* on SMEs and large firms: they seem only to affect export outcomes of small firms, which is again consistent with the notion that financial constraints are necessary for payments delays to have an impact on real outcomes.

The effects of *NPD* are identified by the exogenous restriction on payment delays on the domestic market. Firms that operates in majority outside of the domestic market should therefore be less exposed to the effects of the reform: I denote to that end firms as *insulated* if their exports to total sales and imports to total purchases ratios are superior to their respective medians. The $Var\,\overline{NPD}_{ft}$ coefficients are non-significant for all the margins of adjustment, which shows that the effects of the reform are only observed for firms that maintains sufficient activity in the domestic market.

The sample is eventually divided in different geographic zones to investigate the role of unobserved heterogeneity between export markets (appendix E). One may in particular be concerned by the role of the US export market which was at the time suffering the consequences of the financial crisis in the estimations: I find that the results are barely unchanged when I exclude all the exports flows to the United States. The variable $Var\,\overline{NPD}_{ft}$ has significant effects on export decisions related to countries that are geographically close (European Union, Europe excluding the EU). However, the effects fade out as I look to more remote destinations (America, Africa, Asia). This finding is coherent with an effect of $Var\,\overline{NPD}_{ft}$ mostly located on small exporters which on average have only access to the markets with the lowest costs of entry (Eaton, Kortum and Kramarz, 2011).

6 Discussion of the results

The results are consistent with the empirical predictions presented in section 1.3: when faced with higher domestic liquidity risk, firms adjust their market portfolio so as to be less exposed to foreign liquidity risk. It is important in this sense that the estimations include the changes in cash holdings as control variable: the estimation of the $Var\,\overline{NPD}_{ft}$ coefficient thus cast aside the impacts of the variation in payment delays on firms' cash holdings to only capture the effects of the modification of firms' anticipations on their ability to maintain a sustainable cash flow in export markets.

These results are in stark contrast with Paravisini et al. (2014) who find that credit supply only affects the intensive margin of exports through the variable cost of exporting. Yet, this apparent contradiction can easily be overcome by noting that the two studies look at the export effects of financing shocks of a very different nature: while Paravisini et al. (2014) look at the impacts of a temporary fall in debt supply, I investigate the role of a permanent shift in liquidity risk[21]. In face of a short-lived credit crisis, it may be optimal to temporarily adjust through shifting towards more expensive sources of financing such as factoring; though raising the variable cost of exporting, this solution allows to keep exporting in the same markets (albeit at a lower rate through the impact on prices) which allows the firm to avoid a costly exit.

The observation that the $Var\,\overline{NPD}_{ft}$ coefficients at the intensive margin are smaller and less significant than on the exit decision is also in line with the fact that the effects of the reform appear to be mostly identified on small firms operating in the European Union or Europe excluding the EU. Since these markets are allegedly not very costly to reach (in particular in the EU), proposition 6 indicates that firms should indeed find optimal to adjust their export activity relatively more at the extensive margin (exit).

Eventually, it is important to recall that these effects might be influenced by the coincident presence of the financial crisis. Theory in this respect does not provide clear guidance on whether the financial crisis tends to go for or against the effects of the reform. On the one hand, since financial constraints were presumably very high during this period, the real effects of payment delays should have been magnified. On the other hand, precautionary motives might have made firms hoarding cash instead of readjusting their portfolio of export markets. Further research on other regulations on payment delays such as the Federal Quickpay Initiative in 2011 in the US or the Directive 2011/7/EU that generalizes the French reform to the whole European Union might show whether the results still hold with more standard financing conditions.

7 Conclusion

The results point to a significant effect of the variation in domestic payment delays on the decisions to enter or to exit an export market for small firms operating in sectors relying on external finance. This finding is of particular interest to the study of export barriers in developing countries: while trade credit is a very important source of financing for firms operating in developing countries (Fisman, 2001), excessive payment delays remain a pervasive source of concern while performing day-to-day operations in those markets (ACCA, 2015). In this way, policies aiming at reducing payment delays (such as simplifying customs procedure, see Hummels (2007)) or fostering the development of factoring firms might allow small firms in developing countries to access international markets.

The theoretical model then suggests a role of operational leverage (that is, how total sales depend on a single customer) on the effects of payment delays. Using client-level export data might generate interesting

[21] The reform might have had an effect on firms' decisions both through (1) permanent changes in liquidity risk and (2) a temporary impact on cash holdings as firms adjust to their new payment contracts. Since I control for $\Delta CashTA_{f,t}$, the regressions should mostly capture the effects of (1) and leave aside (2).

results on how firms adjust their portfolio of clients following a shock on liquidity risk (see Kramarz, Martin and Mejean (2014) for a study of the propagation of individual shocks in exporter-importer networks).

Payment delays might also affect other individual outcomes. In particular, it seems legitimate given the results to believe that *PD* might affect labor decisions (Barrot and Nanda, 2016) since unlike input purchases, wage payment can not generally be delayed; it is possible that in presence of financial constraints, recurrent late payments might deter from hiring since firms fear being unable to meet the additional payroll expenses. Structural estimations might eventually be useful to understand and to estimate the aggregate effects of payment delays on the real economy.

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Appendix A Characterization of the optimal contract - Proofs

The resolution of this type of continuous-time contracts introduced in section 1.1 is based on the constatation that the lifetime expected utility of the agent evaluated at time t

$$U_t^\theta = E^\theta\left[\int_0^{\tau_L} e^{-rt}dc_s + R_{\tau_L\wedge\tau_E}e^{-r(\tau_L\wedge\tau_E)}|\,\mathscr{F}_t^N\right] = \int_0^t e^{-rt}dc_s + e^{-rt}W_t^\theta$$

is a $\mathscr{F}^N$-martingale under the probability measure $\mathbf{P}^\theta$ given by θ. It is useful in this context to introduce the compensated process $M^\theta = \{M_t^\theta\}_{t\geq 0}$ given by

$$M_t^\theta = \int_0^t (dN_s - \lambda_s\theta_s)ds. \tag{17}$$

The process M^θ can be interpreted as the effective amount of payments minus the payments expectation at time t; in line with the Girsanov theorem for Brownian motions, it can be proved that M^θ is a $\mathscr{F}^N$-martingale under $\mathbf{P}^\theta$. In other terms, once the change of probability induced by the process θ is accounted for, the expectation of realized cash-flows should not change over time. The martingale representation theorem for point processes then allows to state that:

Lemma A.1. *The martingale U^θ satisfies*

$$U_t^\theta = U_0^\theta + \int_0^{t\wedge\tau} e^{-rs}H_s^\theta dM_s^\theta \tag{18}$$

for all $t\geq 0$, $\mathbf{P}^\theta$-almost surely, for some $\mathscr{F}^N$-predictable process $H^\theta = \{H_t^\theta\}_{t\geq 0}$.

Proof: see Brémaud (1981). ■
This result shows that the lifetime utility of the agent evolves directly with the compensated process M^θ. Using (10) and (18), the evolution of the continuation utility of the agent W_t^θ can be computed as

$$dW_t^\theta = rW_t^\theta dt + H_t^\theta X_t dM_t^\theta - dc_t \tag{19}$$

This representation of the continuation utility allows to characterize precisely incentive-compatible contracts in delays of conditions on the process H_t^θ. For the agent to prefer to maintain a high rate of cash-flows arrival by choosing $\theta = 1$, it must be that $H_t^\theta \leq 1$ so that

$$\begin{aligned} dW_t^\theta &= rW_t^\theta dt + H_t^\theta X_t(dN_t - \lambda_t\theta_t dt) - dY_t^B - di_t \\ &= rW_t^\theta dt + H_t^\theta X_t(dN_t - \lambda_t dt) + (H_t^\theta - 1)(1-\theta_t)\lambda_t X_t dt - di_t \\ &\leq rW_t^\theta dt + H_t^\theta X_t(dN_t - \lambda_t dt) - di_t. \end{aligned}$$

If this inequality holds, then for all effort intensity θ, the evolution of the continuation utility dW_t^θ is at most equal to the situation with no shirking (last line). This result can be summarized in the following proposition (see Cvitanic and Zhang (2012) for a very detailed proof):

Proposition 7. *A necessary and sufficient condition for the diverting process θ to be incentive-compatible given the contract (i,τ_E,τ_L) is that*

$$\theta_t = 0 \text{ if and only if } H_t^\theta \leq 1 \tag{20}$$

for all $t\in[0,\tau_L[$, $\mathbf{P}^\theta$-almost surely.

As a corollary, it can be deduced that $\hat{\tau} = \inf\{t \geq 0 \,|\, W_t = R_t\} = \tau_L$. Suppose on the contrary that $\hat{\tau} < \tau_L$. Then by proposition 7 with $\delta > 0$

$$W_{t+\delta} \leq R_t + \int_{\hat{\tau}}^{\hat{\tau}+\delta} ((rW_s - \lambda_s X_s)ds + X_s dN_s)$$

For the condition (10) to hold, the integral should be negative $\mathbf{P}^\theta$-almost surely, which is not the case.

Since the principal has the possibility to pay the agent for every W_t, the profit function must verify $b(W_t + \Delta i) \geq b(W_t) - \Delta i$ for all nonnegative payment Δi: hence, $b'(W_t) \geq 1$ for all W_t. On the other hand, writing that for all $W_t \geq R_t$, total surplus $TS(W_t)$ can not be superior to the perfect information case yields $TS(W_t) = b(W_t) + W_t \leq \Pi/r$. These conditions impose that for $W_t \geq R^* = \Pi/r$, $b'(W_t) = -1$.

The following lemma allows to directly show in a Poisson framework that the candidate for the principal's profit function is concave.

Lemma A.2. *Take R such that $R^* > R > 0$ and h a solution (if it exists) of the following differential equation $rh(W) = \Pi + (rW - \Pi)h'(W) + \lambda(h(W + X) - h(W_t))$ (21) with border conditions $b'(W_t) = -1$ for $W_t \geq R^*$ and $\overline{R} = \inf\{W_t \geq R |, |h'(W_t) = -1\}$; thanks to (6), $\overline{R} > R$. Then h is strictly concave on $[R, \overline{R}[$.*

Proof: Suppose that $h'(W_2) \geq h'(W_1)$ with $W_2 > W_1 \in [R, \overline{R}[$. Take $W_a = \arg\max_{[W_1, W_2]} h'(W)$. If $W_a > W_1$, then using (21)

$$(r+\lambda)\frac{(h(W_a) - h(W_1))}{W_a - W_1} \leq rh'(W_a) + \lambda\frac{(h(W_a + X) - h(W_1 + X))}{W_a - W_1}$$

Taking the limit with $W_1 \to W_a$, I have that $h'(W_a) \leq h'(W_a + X)$. If $W_a = W_1$, I know that h' is constant over $[W_1, W_2]$ which implies by a similar reasoning that $h'(W_a) = h'(W_a + X)$. If $W_a + X \geq \overline{R}$, then $h'(W_a) = -1$, contradiction. If $W_a + X \leq \overline{R}$, it is necessary by construction that h' is nondecreasing on an interval of the form $[W_a, W_a + X]$. Using the same reasoning recursively, I obtain that there exists $W_h < \overline{R}$ such that $h'(W_h) = -1$, contradiction. ■

Proof of proposition 1 and 2: For any i, τ_E, θ, H^θ and starting value W_0, defining G_t as

$$G_t = \int_0^t e^{-rt}(dY_t - di_t) + e^{-rt}b(W_t^\theta) \tag{22}$$

with b the principal's profit function, one can see that

$$\begin{aligned} e^{rt}dG_t =& (\Pi_t + b(W_t^\theta + H_t^\theta X_t) - b(W_t^\theta))(dN_t - \lambda_t dt) - (b'(W_t^\theta) + 1)di_t \\ &+ (\Pi_t - rb(W_t^\theta) + (rW_t^\theta - H_t^\theta \Pi_t)b'(W_t^\theta) + \lambda_t(b(W_t^\theta + H_t^\theta X) - b(W_t^\theta)) \\ &+ b'(W_t^\theta)(H_t^\theta - 1)(1 - \theta_t)\lambda_t X_t)dt \end{aligned} \tag{23}$$

Then, using the fact that $b'(W) \geq -1$ and that $H_t^\theta \leq 1$ I obtain the inequality

$$\begin{aligned} e^{rt}dG_t \leq& (\Pi_t + (b(W_t^\theta + X_t) - b(W_t^\theta))(dN_t - \lambda_t dt) \\ &+ (\Pi_t - rb(W_t^\theta) + (rW_t^\theta - \lambda_t H_t^\theta \Pi_t)b'(W_t^\theta) + \lambda_t(b(W_t^\theta + H_t^\theta X) - b(W_t^\theta)))dt \end{aligned} \tag{24}$$

Define the function h^I and h^E as the solutions to the differential equation (21) with the constants and the border conditions given in the propositions 1 and 2 as well as the corresponding G^E and G^I. Using the concavity of h_E thanks to lemma A.2, I obtain that

$$\begin{aligned} e^{rt}dG_t^E \leq& (\Pi_t + (h_E(W_t^\theta + X_t) - h_E(W_t^\theta))(dN_t - \lambda_t dt) \\ &+ (\Pi_t - rh_E(W_t^\theta) + (rW_t^\theta - \lambda_t \Pi_t)h_E'(W_t^\theta) + \lambda_t(h_E(W_t^\theta + X) - h_E(W_t^\theta)))dt \\ \leq& (\Pi_t + (h_E(W_t^\theta + X_t) - h_E(W_t^\theta))(dN_t - \lambda_t dt) \end{aligned} \tag{25}$$

By concavity of h_E, $h_E(W_t^\theta + X_t) - h_E(W_t^\theta)$ is bounded: G_t^E is therefore a $\mathbf{P}^\theta$-supermartingale. I obtain

$$E_\tau^\theta[G_\tau^E] \leq E^\theta[G_0^E] = h^E(W_0) \tag{26}$$

with equality if and only if $H_t^\theta = 1$ and $di_t = 0$ for $W_t^\theta \in [R_E, R^*]$ and $di_t = W_t^\theta - R^*$ for $W_t^\theta \geq R^*$. By definition of b^E, $b^E = h^E$ and proposition 1 follows. A similar reasoning shows $E_{\tau_E\wedge\tau_L}^\theta[G_{\tau_E\wedge\tau_L}^I] \leq E^\theta[G_0^I] = h^I(W_0)$ with equality if and only if $H_t^\theta = 1$, if $di_t = 0$ for $W_t^\theta \in [R_I, W_E]$ and if the contract follows proposition 1 after starting to export, which shows proposition 2. ■

Appendix B Empirical predictions - Proofs

Lemma B.1. *Suppose that W_t evolves as according to $dW_t = rW_t - dI_t + \lambda X dM_t$ in the interval $[R, W^*]$ until W_t reaches R (time τ_L) or W^* (time τ^*). R is a stopping value and W^* might alternatively be a stopping value (transition between state I and E) or a reflecting barrier (upper barrier in state E). I_t is reflecting process in the latter case and is equal to zero in the former.*

Take h_{x,W^*} a function of parameter x and an optimally chosen threshold W^* such that the application $(x, W^*, W) :\to h_{x,W^*}(W)$ is C^2 and such that $W \to \partial h_{x,W^*}(W)/\partial x$ is bounded. If h_{x,W^*} verifies the equation

$$rh_{x,W^*}(W_t) = a + rW_t h'_{x,W^*}(W_t) + \lambda\left(h_{x,W^*}(W_t + X) - h_{x,W^*}(W_t)\right)$$

with boundary conditions $h_{x,W^*}(R) = b$ and either $h'_{x,W^*}(W^*) = c$ (if W^* is a reflecting barrier) or $h_{x,W^*}(W^*) = d$ (if W^* is a stopping value), then noting $\Delta : W_t \to \lambda\left(h_{x,W^*}(W_t + X) - h_{x,W^*}(W_t)\right)$ we have

$$\frac{\partial h_{x,W^*}(W_t)}{\partial x} = E\left[\int_0^{\tau_L\wedge\tau_E} e^{-rs}\left(\frac{\partial a}{\partial x} + \frac{\partial r}{\partial x} W_s h'_{x,W^*}(W_s) + \frac{\partial \Delta(W_s)}{\partial x}\right) ds + e^{-r(\tau_L\wedge\tau_E)}\left(1_{\tau^*<\tau_L} d + 1_{\tau^*>\tau_L} b\right) | W_0 = W_t\right]$$

if W^* is a stopping value and

$$\frac{\partial h_{x,W^*}(W_s)}{\partial x} = E\left[\int_0^{\tau_L\wedge\tau_E} e^{-rs}\left(\frac{\partial a}{\partial x} + \frac{\partial r}{\partial x} W_t h'_{x,W^*}(W_s) + \frac{\partial \Delta(W_s)}{\partial x}\right) ds + \frac{\partial c}{\partial x}\int_0^{\tau_L\wedge\tau_E} dI_t + e^{-r(\tau_L\wedge\tau_E)} b \,|\, W_0 = W_t\right]$$

if W^* is a reflecting barrier.

Proof (DeMarzo and Sannikov, 2006): Using the envelope theorem, we have that

$$\frac{\partial h_x(W_t)}{\partial x} = \frac{\partial h_{x,W^*}(W_t)}{\partial x}\bigg|_{W^*=W^*(x)}$$

Differentiating the differential equation verified by h with respect to the parameter x at $W^* = W^*(x)$ shows that $\partial h/\partial x$ evolves according to

$$\begin{aligned} r\frac{\partial h_{x,W^*}(W_t)}{\partial x} =& \frac{\partial a}{\partial x} + \frac{\partial r}{\partial x} W_t h'_{x,W^*}(W_t) + \frac{\partial \Delta(W_t)}{\partial x} \\ &+ rW_t \frac{\partial}{\partial W}\frac{\partial h_{x,W^*}(W_t)}{\partial x} + \lambda\left(\frac{\partial h_{x,W^*}(W_t + X)}{\partial x} - \frac{\partial h_{x,W^*}(W_t)}{\partial x}\right) \end{aligned} \tag{27}$$

with boundary conditions $\partial h_{x,W^*}(R_t)/\partial x = \partial b/\partial x$ and either $\partial h'_{x,W^*}(W^*)/\partial x = \partial c/\partial x$ (if W^* is a reflecting barrier) or $\partial h_{x,W^*}(W^*)/\partial x = \partial d/\partial x$ (if W^* is a stopping value). Taking the case where W^* is a reflecting barrier, define

$$H_t = \int_0^t e^{-rs}\left(\frac{\partial a}{\partial x} + \frac{\partial r}{\partial x} W_s h'_{x,W^*}(W_s) + \frac{\partial \Delta(W_s)}{\partial x}\right) ds + \frac{\partial c}{\partial x}\int_0^t e^{-rs} dI_s + e^{-rs}\frac{\partial h_{x,W^*}(W_t)}{\partial x}$$

Using the differential equation verified by $\partial h/\partial x$, we get that

$$dH_t = e^{-rs}\left(\frac{\partial c}{\partial x} - \frac{\partial}{\partial W}\frac{\partial h_{x,W^*}(W_t)}{\partial x}\right) dI_t + e^{-rs}\lambda\left(\frac{\partial h_{x,W^*}(W_t + X)}{\partial x} - \frac{\partial h_{x,W^*}(W_t)}{\partial x}\right) dM_t$$

Thanks to Schwartz's theorem,

$$\frac{\partial}{\partial W}\frac{\partial h_{x,W^*}(W_t)}{\partial x} = \frac{\partial}{\partial x}\frac{\partial h_{x,W^*}(W_t)}{\partial W}$$

since I is a reflecting process that differs only from zero when W_t reaches W^* and thanks to the boundary condition $\partial h'_{x,W^*}(W^*)/\partial x = \partial c/\partial x$, we get that H is a martingale ($\partial h_{x,W^*}/\partial x$ is assumed to be bounded). But then

$$\begin{aligned}\frac{\partial h_{x,W^*}(W_0)}{\partial x} &= H_0 \\ &= E[H_{\tau_L\wedge\tau_E}] \\ &= E\left[\int_0^{\tau_L\wedge\tau_E} e^{-rs}\left(\frac{\partial a}{\partial x}+\frac{\partial r}{\partial x}W_s h'_{x,W^*}(W_s)+\frac{\partial\Delta(W_s)}{\partial x}\right)ds+\frac{\partial c}{\partial x}\int_0^{\tau_L\wedge\tau_E} dI_t + e^{-r(\tau_L\wedge\tau_E)}b\right]\end{aligned}$$

The proof is similar when W^* is a stopping value. ■

Corollary 1. *In the case where termination values are exogenous,* $\frac{\partial b_I(W_t)}{\partial\lambda}\geq 0$ *and* $\frac{\partial b_E(W_t)}{\partial\lambda}\geq 0$.

Using lemma B.1, we get that

$$\begin{aligned}\frac{\partial b_E(W_t)}{\partial\lambda} &= E\left[\int_0^{\tau_L} e^{-rs}\frac{\partial}{\partial\lambda_E}\left(\lambda_E\left(b_E(W_s+X_E)-b_E(W_s)\right)\right)ds\,|\,W_0=W_t\right] \\ &= E\left[\int_0^{\tau_L} e^{-rs}\left(b_E(W_s+X_E)-b_E(W_s)-X_E b'_E(W_s+X_E)\right)ds\,|\,W_0=W_t\right]\end{aligned}$$

The integrand is positive by concavity of b_E. The proof is similar for b_I. ■

Proof of proposition 3: If the agent has all the bargaining power, $b^I(W_0)=I$ and $b'^I(W_0)<0$. Differencing the first equation,

$$\frac{\partial b^I(W_0)}{\partial x}+b'^I(W_0)\frac{\partial W_0}{\partial x}=0$$

which gives the effect of $1/\lambda_I$. Moreover, replacing dY_t^R by $\Pi_t dN_t$ in (11) and (12) yields $\partial b_r(W_E)/\partial\Pi_r\geq 0$ for $r\in\{I,E\}$; the prediction on the effect of Π_I follows.

If the bank acts like a monopoly, $b'^I(W_0)=0$ and therefore by (21)

$$rb^I(W_0)=\Pi_I+\lambda(b^I(W_0+X_I)-b^I(W_0)) \tag{28}$$

Take $\lambda_2>\lambda_1$ and b_1,b_2,W_1,W_2 solutions of (28) (subscripts are dropped for more clarity). Suppose that $W_2<W_1$. Then by concavity $b'_1(W_2)>0$ and $\lambda_1(b^I(W_2+X_I)-b^I(W_2))\geq\lambda_1(b^I(W_1+X_I)-b^I(W_1))$ and therefore $b_1(W_2)\geq b_1(W_1)$ by (21), contradiction. The proof is the same for the effect of Π_I. ■

Lemma B.2. *If $\tau_E>0$ (that is if it is not optimal to immediately export), $b'^I(W_E)=b'^E(W_E)\leq 0$.*

Proof (Philippon and Sannikov (2007)): The first equality follows directly from the border conditions given in 1. Suppose then that $b'^I(W_E)=b'^E(W_E)>0$. By concavity of b_I, $b'_I>0$ and thus $b_I(W)\leq b_I(W_E)=b_E(W_E)-K$ for all $W\in[R,W_E]$. Taking W_E^* that maximizes b_E, I see that $b_I(W)\leq b_E(W_E^*)-K$. It would be optimal for the firm and the agent to directly choose $W_0^*=W_E^*>W_0$ and to immediately start to export, which is in contradiction with $\tau_E>0$. ■

Proof of proposition 4: The exporting threshold W_E is then defined by $b_I(W_E)=b_E(W_E)-K$. Calling $V_I=\{\lambda_I,\Pi_I\}$ and $x_E=\{\lambda_E,\Pi_E\}$ I have for $r\in\{I,E\}$ and for $x_r\in V_r$

$$\frac{\partial b_I(W_E)}{\partial x_r}+\frac{\partial b_I(W_E)}{\partial W_E}\frac{\partial W_E}{\partial x_r}+b'_I(W_E)\frac{\partial W_E}{\partial x_r}=\frac{\partial b_E(W_E)}{\partial x_r}+b'_E(W_E)\frac{\partial W_E}{\partial x_r}$$

since W_E is a parameter for b_I. Noticing that

$$\frac{\partial b_s(W_E)}{\partial x_r} = 0 \text{ if } s \neq r,\ b_I'(W_E) = b_E'(W_E) \text{ and } \frac{\partial b_I(W_E)}{\partial W_E} = b_I'(W_E)$$

I get

$$\frac{\partial b_I(W_E)}{\partial x_r} + b_I'(W_E)\frac{\partial W_E}{\partial x_r} = \frac{\partial b_E(W_E)}{\partial x_r}$$

which gives proposition 4 for V_I and V_E. Eventually, $\partial W_E/\partial K = -(b_I'(W_E))^{-1} \geq 0$. ■

Lemma B.3. *For all $\epsilon > 0$, the function $P : W \to E\left[1_{\tau_E<\tau_L}|W_t = W\right]$ is strictly concave (resp. strictly convex) on $[R, W_E - \epsilon]$ if $\lambda_I > r$ (resp $\lambda_I < r$).*

Proof: Noticing first that P is a martingale, writing

$$dP(W_t) = ((rW_t - \Pi_I)P'(W_t) + \lambda_I(P(W_t + X_I) - P(W_t)))dt + (P(W + X_I) - P(W))(dN_t - \lambda_I dt) \tag{29}$$

yields the differential equation verified by P :

$$(\Pi_I - rW_t)P'(W_t) = \lambda_I(P(W_t + X_I) - P(W_t)) \tag{30}$$

On $[W_E - X_I, W_E]$, $P(W + X_I) = 1$ and the differential equation becomes

$$(\Pi_I - rW_t)P'(W_t) = \lambda_I(1 - P(W_t)) \tag{31}$$

On a an interval of the form $[W_E - X_I, W_E - \epsilon]$ with $\epsilon > 0$, this equation can be solved as

$$P(W_t) = 1 - C_\epsilon\left(\frac{\Pi_I - rW_t}{\Pi_I - r(W_E - X_I)}\right)^{\frac{\lambda_I}{r}} \text{ for } W_t \in [W_E - X_I, W_E] \tag{32}$$

with $C_\epsilon > 0$ a constant that depends on ϵ. This function is strictly concave if (resp. strictly convex) if $\lambda_I > r$ (resp $\lambda_I < r$). The following part of the lemma shows that the concavity (convexity) of P "travels" to the rest of the interval through the differential equation (30). Suppose that $\lambda_I > r$ (the other case can be treated by reversing the inequalities in the following) and take $W_\epsilon = \inf\{W_t \in [R, W_E - \epsilon] \,|\, P \text{ is concave}\}$. Let's make the assumption that $W_\epsilon > R$. On $[R, W_E]$, $P'(W_t) = \lambda_I(P(W_t + X_I) - P(W_t))/(\Pi_I - rW_t)$ and thus P'' exists and is given by

$$P''(W_t) = \lambda_I \frac{\left(P'(W_t + X_I) - P'(W_t)(\Pi_I - rW_t) + r(P(W_t + X_I) - P(W_t))\right)}{(\Pi_I - rW_t)^2} \tag{33}$$

By continuity $P''(W_\epsilon) = 0$ and thus

$$(P'(W_\epsilon + X_I) - P'(W_\epsilon))(\Pi_I - rW_\epsilon) + r(P(W_\epsilon + X_I) - P(W_\epsilon)) = 0 \tag{34}$$

Using (30) it can be rewritten

$$P'(W_\epsilon + X_I)(\Pi_I - rW_\epsilon) = (\lambda_I - r)(P(W_\epsilon + X_I) - P(W_\epsilon)) \tag{35}$$

Once again, replacing $(P(W_\epsilon + X_I) - P(W_\epsilon))/(\Pi_I - rW_\epsilon)$ with (30) I eventually get

$$P'(W_\epsilon + X_I) = \left(1 - \frac{r}{\lambda_I}\right)P'(W_\epsilon) \tag{36}$$

The equation (32) shows that $W_\epsilon < W_E - X_I$. On $]W_\epsilon, W_E - \epsilon]$, P is strictly concave. Writing (30) at $W_t = W_\epsilon$ and using the strict concavity of P

$$\begin{aligned}(\Pi_I - rW_\epsilon)P'(W_\epsilon) &= \lambda_I(P(W_\epsilon + X_I) - P(W_\epsilon)) \\ &> \lambda_I \frac{\Pi_I}{\lambda_I} P'(W_\epsilon) \\ &> \Pi_I P'(W_\epsilon + X_I)\end{aligned}$$

where the first inequality comes from $f(y) - f(x) > f'(x)(y-x)$ (which is valid for f strictly concave) and the second inequality from the fact that P' is non increasing on $]W_\epsilon, W_E - \epsilon]$. But then

$$P'(W_\epsilon + X_I) < \left(1 - \frac{rW_\epsilon}{\Pi_I}\right) P'(W_\epsilon)$$

and using (36) I get

$$1 - \frac{r}{\lambda_I} < 1 - \frac{rW_\epsilon}{\Pi_I} \Leftrightarrow W_\epsilon < \frac{\Pi_I}{\lambda_I} < R$$

by assumption (8), contradiction. ■

Proof of proposition 5: The total differential of P with respect to λ_I is given by

$$\frac{dP(W_t)}{d\lambda_I} = \frac{\partial P(W_t)}{\partial \lambda_I} + \frac{\partial P(W_t)}{\partial W_E}\frac{\partial W_E}{\partial \lambda_I}$$

Increasing W_E to $W_E + dW_E$ boils down changing the boundary condition $P(W_E) = 1$ to $P(W_E) = 1 - P'(W_E)dW_E$. We therefore have

$$\frac{\partial P(W_t)}{\partial W_E} = -P'(W_E)P(W_t)$$

But as equation 30 shows, P' is equal to zero at $W_t = W_E$ since $P(W_E + X_I) = P(W_E) = 1$. Using similar arguments as in lemma 1, one can then show that

$$\frac{\partial P(W_t)}{\partial \lambda_I} = E\left[\int_0^{\tau_L \wedge \tau_E} e^{-rs}\big(P_I(W_s + X_I) - P_I(W_s) - X_I P'(W_s + X_I)\big)\, ds \,|\, W_0 = W_t\right]$$

Since the set $\{t \,|\, W_t = W_E - X_E\}$ has a measure of zero one can write

$$\frac{\partial P(W_t)}{\partial \lambda_I} = E\left[\int_{\Omega_E} e^{-rs}\big(P_I(W_s + X_I) - P_I(W_s) - X_I P'(W_s + X_I)\big)\, ds + \int_{\overline{\Omega}_E} e^{-rs}(1 - P_I(W_s))\, ds \,|\, W_0 = W_t\right]$$

where $\Omega_E = \{t \,|\, W_t < W_E - X_E\}$. The first integrand is positive by concavity of P, the second because P is a probability. ■

Proof of proposition 6: The boundary condition at W_E stated in 2 gives that $b_E(W_E) = b_I(W_E) + K$. Using lemma B.1 on b_I, it appears that $\partial b_I(W_E)/\partial K = -1$ which entails $\partial b_E(W_E)/\partial K = 0$. We have then

$$\frac{\partial b_I(W_0)}{\partial K} = -P(W_0) + E[e^{-r(\tau_L \wedge \tau_E}]\frac{\partial b_I(W_0)}{\partial K}$$

Since $E[e^{-r(\tau_L \wedge \tau_E}] \leq 1$, $\partial b_I(W_0)/\partial K$ is of the same sign than $-P(W_0)$. As K increases, $e^{-r\Delta t} b_E(W_E)$ stays therefore unchanged and $\partial b_I(W_0)$ decreases, which proves the proposition. ■

Appendix C Entry of non-exporters

Table 8: Effects of $Var\ \overline{NPD}_{ft}$ at the extensive margin (Entry)

	OLS (1)	OLS (2)	IV 2SLS (1)	IV 2SLS (2)	IV 2SLS (3)
	Entry of non-exporters				All
$Var\ \overline{NPD}_{ft}$	−0.000	−0.000	−0.001	−0.001	-0.002^{**}
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
$\Delta OperMarg_{ft}$		−0.000		0.001	0.006^{*}
		(0.004)		(0.005)	(0.004)
$Size_{f,t\text{-}1}$		0.001^{***}		0.001^{***}	0.003^{***}
		(0.000)		(0.000)	(0.000)
$\Delta CashTA_{ft}$		−0.000		−0.000	−0.000
		(0.000)		(0.000)	(0.000)
$Group_{ft}$		−0.000		−0.000	0.000
		(0.001)		(0.001)	(0.001)
$Var\ \overline{Sales}_{ft}$		−0.003		−0.002	-0.011^{*}
		(0.003)		(0.003)	(0.006)
$\Delta DebtTA_{ft}$		−0.001		−0.002	−0.008
		(0.004)		(0.004)	(0.006)
Observations	91 300	91 300	91 300	91 300	756 050
Product-Destination FE	Yes	Yes	Yes	Yes	Yes
R^2	0.011	0.011	-	-	-
Weak identification (KP stat)	-	-	22.704	21.635	271.545

All standard errors are clustered at the firm level. *, **, and *** denote statistical significance at 10, 5 and 1%. Standard errors are given in parentheses. The Kleibergen-Paap statistic (KP stat) tests for the presence of a weak instrument in presence of heteroscedasticity (high values suggest to reject the null hypothesis of weak identification).

Appendix D Derogations

This appendix gives the maximum contractual payment delays after the date of the invoice authorized by the LME reform. When the limit varies in 2009 (*e.g.* 120 days between January 01 and May 31 2009 and 80 days between June 01 and December 31 2009), I report the average number of days (100 days).

- *Purchases of living cattle:* 20 days
- *Purchases of perishable products, purchases of alcoholic beverages:* 30 days
- *Manufacture and sale of metal food packaging; record industry; recreational fishing; manual, creative and recreational activities:* 75 days
- *Construction industry; bathroom and heating equipment; sailing stores; industrial tooling; industrial hardware; steel products for the construction industry; automotive tools wholesaling:* 85 days
- *DIY stores; stationery and office supplies; tire industry; drugs with optional medical prescriptions; pet trade; garden stores; coatings, paints, glues, adhesives and inks; sports stores ; leather industry; clothing sector:* 90 days
- *Jewellery, gold- and silversmiths' trade; round wooden elements; food supplements; optical-eyewear industry; cooperage :* 105 days
- *Firearms and ammunition for hunting:* 115 days
- *Quads, two- or three-wheeled vehicles, recreational vehicles::* 125 days
- *Agricultural supplies:* 150 days
- *Toy stores:* 170 days

- *Book edition, agricultural machines:* 195 days

Appendix E Unobserved heterogeneity : export markets

Table 9: Unobserved export market heterogeneity.

	IV 2SLS (5) - ΔY_{fcit}		IV 2SLS (5) - $Exit_{fcit}$		IV 2SLS (5) - $Entry_{fcit}$	
	Coef./SD	KP/Obs.	Coef./SD	KP/Obs.	Coef./SD	KP/Obs.
Baseline	-0.023^{*}	164.192	0.012^{**}	186.621	-0.002^{***}	250.187
	(0.012)	101 132	(0.005)	130 531	(0.001)	664 700
Excluding US	-0.022^{*}	162.285	0.013^{**}	184.218	-0.002^{***}	248.443
	(0.012)	98 335	(0.005)	126 656	$(0.8 \cdot 10^{-3})$	653 450
EU	-0.007	214.017	0.008	60.567	-0.003^{***}	250.184
	(0.016)	52 335	(0.005)	60 567	(0.001)	265 880
Excluding EU	-0.049^{**}	83.686	0.019^{*}	111.749	-0.002^{*}	250.186
	(0.020)	48 797	(0.009)	69 964	$(0.9 \cdot 10^{-3})$	398 820
Europe (excl. EU)	-0.070^{**}	117.051	0.023^{*}	149.521	-0.004^{***}	250.161
	(0.033)	8 470	(0.013)	11 671	(0.002)	53 176
America	-0.058	64.148	-0.005	89.328	$0.7 \cdot 10^{-3}$	250.167
	(0.040)	8 278	(0.012)	11 665	(0.002)	66 470
Asia	-0.047	47.084	0.029^{**}	71.609	-0.001	250.182
	(0.032)	16 083	(0.013)	23 188	(0.001)	186 116
Africa	0.023	35.169	0.020	39.596	-0.003^{*}	250.171
	(0.060)	12 605	(0.020)	18 958	(0.002)	79 764
Pacific	0.001	47.749	0.029	57.779	-0.007^{***}	250.077
	(0.062)	3 361	(0.020)	4 482	(0.002)	13 294

All standard errors are clustered at the firm level. *, **, and *** denote statistical significance at 10, 5 and 1%. Standard errors are given in parentheses. The Kleibergen-Paap statistic (KP stat) tests for the presence of a weak instrument in presence of heteroscedasticity (high values suggest to reject the null hypothesis of weak identification). All estimations are made according to the IV 2SLS (5) model (see tables 4 and 6). *Baseline* denotes the estimations with the standard specification.