Payment Choice in International Trade: Theory and Evidence from Cross-country Firm-Level Data

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May 6, 2015

Abstract

When trading across borders, firms choose between different payment contracts. Theoretically, this should allow firms to trade-off differences in financing costs and enforcement across countries. This paper provides evidence for this hypothesis employing firm-level data from a large number of developing countries. As predicted, international transactions are more likely paid after delivery when financing costs in the source country are high and when contract enforcement is low. We extend the theory and also show empirically that the more complex an industry is, the more important is contract enforcement and the less important are financing costs for the contract choice.

Keywords: trade finance, payment contracts, industry complexity, developing countries
JEL-Codes: F12, F3, G21, G32

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1 Introduction

When trading goods within and across borders, firms choose between different payment contracts. The key decision is whether the payment should be made before the delivery (cash in advance) or after the delivery (open account). This is an important aspect of any trade transaction as it determines both which trading partner has to pre-finance the transaction and who bears its risk. As shown theoretically in Schmidt-Eisenlohr (2013), payment contracts in international trade should therefore be chosen by firms to optimally trade-off differences in financing costs and enforcement between countries.

The payment contract choice affects several key aspects of international trade. First, as payment contracts allocate financing and risk across countries they determine how source and destination country legal and financial conditions affect variable trade costs. This also determines on which country's financial sector trade predominantly relies and thus influences the direction in which financial shocks may be transmitted internationally. Finally, the payment choice model predicts that conditions in the source and destination country are equally important for trade to be successful. This suggests that policy makers interested in promoting trade not only need to improve institutions at home but also need to help their trading partners in improving their legal and financial environment. The payment choice is thus relevant both for academic economists to better understand trade frictions as well as for policy makers interested in supporting international commerce.

This paper provides evidence on firms' payment contract choices from a large number of countries, showing that country characteristics are indeed central determinants. As predicted by the theory, international transactions are more likely paid after delivery when financing costs in the source country are high and when contract enforcement is low. We extend the original theory and use the firm-level data to test one additional prediction on the role of industry characteristics. More specifically, we show that in more complex industries contract enforcement is key to the choice of the payment contract, whereas for less complex industries financing costs are more relevant.

The basic trade finance model is quite intuitive. Due to the time gap between production and sales, any transaction in international trade requires working capital financing and implies a commitment problem. If pre-delivery payment (cash in advance) is chosen, the importer finances the transaction and a commitment problem arises on the side of the exporter. Post-delivery payment (open account) implies the reverse. The exporter has to pre-finance the required working capital and the importer's commitment problem needs to be resolved.

This setup delivers clear predictions on how country-level variables affect the contract choice. Post-delivery payment (open account) should be used more if finance in the source country is cheap and if enforcement in the source country is weak. The former directly affects profits under open account while the latter reduces the profitability of the alternative cash in advance and thereby makes open account more attractive.

To test these predictions, this paper uses data from the World Bank Enterprise survey, complemented by measures for contract enforcement and financing costs. The survey is conducted across a wide range of developing countries, where each firm is surveyed once. From the survey we obtain the share of pre- and post-sale payments and export intensities as well as other firm-level control variables. The unique advantage of the dataset in relation to the existing literature is that we are able to exploit the variation in enforcement and

financing costs across the exporter's countries, relating it to a firm's export intensity and payment contract choice.[1]

Our identification strategy rests on three results developed in the theory section. First, we show that there is a difference between payment contract choice for domestic and international transactions. In the former, both parties find themselves in the same legal and financial environment while in the latter this is not the case. Country characteristics should hence be more important for the payment contract choice for international than for domestic transactions. Second, we show that it is sufficient to rely on variation across source countries to identify the trade-off between different payment contracts. Third, we show that an interaction effect between the firms' export intensities and country-level financing costs and enforcement can be estimated to obtain the main coefficients of interest. Building on these results, we test the payment contract choice between post-delivery payment and its alternative pre-delivery payment by using interaction terms between firms' export intensities, and country-level enforcement and financing costs as the independent variables.

In the theoretical model, one seller is matched with one buyer. Both firms are risk neutral and play a one shot game. The seller can make a take it or leave it offer to the buyer, specifying the price and the quantity of the goods sold and the timing of the payment. If payment is demanded before delivery (cash in advance), the importer has to borrow money in her local financial market. As she pays in advance, there is an incentive for the seller not to deliver the goods. This is prevented by courts with an exogenously given probability that depends on legal institutions in the source country. If the seller chooses payment after delivery (open account), she has to borrow on her financial market. Now, the buyer, who receives the goods before payment, has an incentive to deviate from the contract. With an exogenous probability that depends on destination country, however, courts enforce the contract.

The optimal payment contract choice thus depends on the relative financing costs and the relative probabilities of contract enforcement of the buyer and the seller, respectively. If the buyer and seller are in the same country, the choice only depends on firm-specific factors. If the two trading partners are located in different countries, the choice is also affected by country-level variables. For international sales, *country-level* characteristics thus influence the payment contract choice at the *firm level* while they do not affect domestic choices.

In the baseline specification of the empirical section we exploit the difference between domestic and foreign sales using the information on the firm's export intensity and post-sale payments from the survey. In particular, we interact the firm's export intensity with the measures of enforcement and financing costs to test the prediction that firms with a higher export intensity react more to country-level variations in financing costs and contract enforcement than firms with a larger share of domestic sales.[2] The empirical results are exactly as predicted by the theory. That is, for international sales, better enforcement in the source country increases the use of pre-delivery payment and reduces the use of post-delivery payment. Higher financing costs in the source country imply that more contracts are on pre-delivery payment and less contracts are on post-delivery payment terms.

[1] In contrast, Antràs and Foley (2011) use the variation across importer's enforcement and financing costs and Schmidt-Eisenlohr (2013) uses country-level trade flows without any payment contract information.

[2] Our main measure of contract enforcement is the inverse of days it takes to enforce a contract in court, while financial costs are captured by the net interest rate margin.

Contract enforcement depends on the verifiability of contracts in court. It can be argued that this is more difficult for complex products which are often relationship-specific. When products are not widely traded or produced exclusively for a specific counter-party, it may be difficult for courts to determine whether quality standards and other product requirements have been met by the supplier, making enforcement harder. This is analyzed in an extended version of the model and tested in the second empirical specification where we use the complexity measure from Nunn (2007) to classify industries. Triple interactions between financing costs and enforcement, export intensity and the complexity of an industry are then added to the estimation equation. In line with the extended model, we find that the strength of contract enforcement is relatively more important for the contract choice in complex industries, while financing costs are more relevant for the choice in less complex industries.

We check the robustness of our results and show that they are very similar when alternative measures of legal and financial conditions are used. Running regressions with data aggregated to the industry level and alternatively using a fractional response model delivers similar findings to the OLS regressions.

To our knowledge, only two papers have tested the payment contract choice model empirically.[3] Schmidt-Eisenlohr (2013) derives implications of contract choice for bilateral trade flows and uses them for an indirect test of the model with aggregate trade data. Antràs and Foley (2011) are closest to this paper as they directly test the choice between payment contracts. They extend the model in Schmidt-Eisenlohr (2013) and test its predictions in regard of destination country variation in enforcement with data from one large US food seller. Their paper furthermore exploits the rich time dimension of the data to study dynamic aspects of payment contract choice in international trade. This paper adds to this line of research by providing evidence on the contract choice across many independent firms in many source countries and by testing for differences across industries.[4]

This study focuses on the effects of international differences in legal and financial conditions on the payment contract choice for international and domestic trade. It therefore complements the large literature on trade credit that explains the use of supplier credit within a country.[5] The analysis also relates to the wider literature on financial conditions and trade. First, there are several papers that have studied whether conditions in the source country can affect bilateral trade patterns and sectoral specialization.[6] A second group of

[3] Glady and Potin (2011) focus on letters of credit and analyze how their use is affected by country-level contract enforcement and financing costs, but do not test for choices between different payment contracts.

[4] For theoretical contributions to trade finance see Schmidt-Eisenlohr (2013), Ahn (2010), Antràs and Foley (2011), Engemann et al. (2011), Eck et al. (2011) and Olsen (2013). See Schmidt-Eisenlohr (2013) for a review. Several policy papers also discuss trade finance. See for example Menichini (2011) and Ellingsen and Vlachos (2009).

[5] For recent empirical contributions see Giannetti et al. (2011) and Klapper et al. (2012). For theoretical aspects of trade credit see among others Biais and Gollier (1997), Petersen and Rajan (1997), Wilner (2000), Burkart and Ellingsen (2004) and Cunat (2007). Mateut (2012) extends the analysis of trade credit to prepayments which she denotes as reverse trade credit. Demirguc-Kunt and Maksimovic (2001), Choi and Kim (2005) and Love et al. (2007) study the effect of country-level variables on trade credit use. Their analysis does, however, not distinguish between domestic and international sales. Klapper et al. (2012) contains an excellent review of the trade credit literature.

[6] See, in particular, Beck (2002), Beck (2003) and Manova (2013).

papers have tested whether financial constraints can be a detriment to international trade, in particular at the extensive margin.[7] Third, several papers tested for the effects of financial shocks on trade in times of crisis.[8]

By deriving and testing new results on the interaction between the product complexity and enforcement, the paper also adds to the work in this area by Nunn (2007) and Levchenko (2007). Finally, Eck et al. (2011) use similar data on the shares of pre- and post-delivery payments in total sales to test for effects of trade credit on the extensive and intensive margins of trade.

The rest of the paper is organized as follows. Section 2 develops the theoretical model and derives the predictions for the empirical analysis. In section 3, we present the empirical results of the paper and report our robustness exercises. Section 4 concludes.

2 Theory

This section starts with a simplified version of Schmidt-Eisenlohr (2013), focusing on the choice between cash in advance and open account.[9] It then extends the model to allow for differences in contract choice between domestic and international sales and for a role of industry complexity.

Setup There is one seller S who is matched with one buyer B. Firms are risk neutral. The seller and the buyer play a one-shot game. The seller makes a take it or leave it offer to the buyer. The buyer can accept or reject the offer. Then, the seller can produce and send goods to the buyer. The goods arrive at the buyer in the next period and sales revenues are realized. Firms can be of a good and bad type. η and η^* denote the shares of good firms in the source and destination country, respectively. A good firm always fulfills a contract whereas a bad firm breaks it whenever this is profitable. Production costs are given by K and revenues are given by R. There is a time gap between the dispatch of the goods by the seller and their arrival at the buyer. This gives rise to a working capital need that has to be financed by one of the two parties. Let source and destination country interest rates be denoted by $1 + r$ and $1 + r^*$.

In addition to the financing requirement, the time gap also leads to a commitment problem of bad firms. If the buyer pays in advance, the seller has an incentive not to deliver the goods after receipt of the payment. When the buyer only pays after the goods arrive (open account), she has an incentive not to transfer the money. In either case a firm can be brought to court by its trading partner. Assume that litigation takes place in the location where the breach of contract occurs and that enforcement is successful with exogenously

[7] See among others Greenaway et al. (2007), Muûls (2008), Berman and Héricourt (2010), Bricongne et al. (2012) and Manova (2013).

[8] See Paravisini et al. (2011), Amiti and Weinstein (2011), Ahn (2013) and Niepmann and Schmidt-Eisenlohr (2013b).

[9] In the original model there is a third payment contract, letter of credit, that we abstract from in the analysis as we cannot separately identify it in our data. We discuss letters of credit in more detail below. Given the similarity with the setup developed in Schmidt-Eisenlohr (2013), the exposition of the baseline model is kept brief.

given probabilities λ and λ^*, respectively.[10]

The seller is by definition always located in the source country and therefore faces enforcement probability λ and interest rate r. The buyer can be in the same country facing the same country conditions or she can be in another country. Then she faces enforcement probability λ^* and interest rate r^*. For the general case we start by denoting the buyer variables with subscript B.

Cash in Advance Cash in advance corresponds to a full pre-payment by the buyer. That is, before delivery, the buyer pays an amount C^{CIA} to the seller. A bad seller defaults on the contract, but with probability λ she is forced to deliver the goods anyways.[11] The optimal contract depends only on the choice of a good seller.[12] Maximizing profits delivers:[13]

$$\mathrm{E}\left[\Pi_S^{CIA}\right] = \frac{\eta + (1-\eta)\lambda}{1+r_B} R - K. \tag{1}$$

As cash in advance requires complete pre-financing by the buyer, only her financing costs $1 + r_B$ affect expected profits. The commitment problem is in regard of the seller. Thus, only contract enforcement λ and the share of good firms η in the source country are relevant for expected profits.

Open Account Open account represents full payment after delivery. First, the seller produces the goods and delivers them to the buyer. When the goods arrive, the buyer sells them. While a good buyer pays the amount due, a bad buyer tries to default on the contract, but is forced to pay with probability λ_B.[14] Maximized expected profits are:

$$\mathrm{E}\left[\Pi_S^{OA}\right] = \frac{\eta_B + (1-\eta_B)\lambda_B}{1+r} R - K. \tag{2}$$

Open account represents exactly the reverse case from cash in advance. Now, pre-financing is done completely by the seller and thus only her financing cost $1 + r$ affects expected profits. The commitment problem arises on the side of the buyer and therefore solely the enforcement probability λ_B and the share of good firms η_B influence expected profits.

[10] Parties may agree on another country as place of litigation. However, any ruling requires enforcement in the location where the assets or collateral are located. Hence, even in the case where litigation takes place in a third country, local legal conditions are still key for contract enforcement.

[11] A pooling or separating case can arise. In the pooling case, a bad firm imitates the behaviour of good firms. Alternatively, bad firms can choose to deviate. Throughout the paper, it is assumed that parameters are such that only the pooling case arises, which requires that $\frac{R}{K} \geq \frac{1+r^*}{\eta}$. In this, we follow the assumption in Schmidt-Eisenlohr (2013). See the online appendix for details.

[12] In the following all expressions on expected profits are in regard of good sellers under pooling. Subscript g for good seller and superscript p for the pooling case are dropped for expositional purposes.

[13] See the online appendix for details.

[14] The exporter now chooses between a pooling case where both types of buyers accept the offered contract and a separating case where the demanded payment is so high that only bad buyers agree to it. Again, we assume that parameters are such that the pooling case arises which is the case if $\frac{R}{K} > \frac{\eta^*(1+r)}{\eta^* - (1-\eta^*)(1-\lambda^*)}$. See the online appendix for details.

Letters of Credit As we cannot observe it in our data, we abstract from a third type of payment contract, letter of credit (LC).[15] An LC can be provided by a bank in the country of the importer and guarantees payment to the exporter against the presentation of a set of documents. The importer only receives these documents from the bank after paying the amount due. An LC therefore fulfills two roles. First, similar to trade credit insurance, it shifts the risk of non-payment from the exporter to the issuing bank in the destination country. Second, it works as a commitment device for the importer to pay and thereby reduces the real risk of the transaction. Letters of credit are currently employed for about 8.8 % of all U.S. exports (see Niepmann and Schmidt-Eisenlohr (2013a)). For more details on the role of letters of credit and empirical evidence on its use see Niepmann and Schmidt-Eisenlohr (2013a), Ahn (2010) and Olsen (2013).[16]

Optimal Contract Choice Assume that there is a firm-specific additive shock to the profitability of open account denoted by Z_i that is proportional to R, that is $Z_i = z_i R$.[17] In the following, the optimal payment contract choice in international trade and domestic trade are studied separately. The differences between the two are key to the identification strategy.

Suppose that the buyer and the seller are in two different countries, so that $r_B = r^*$ and $\lambda_B = \lambda^*$. Then, the seller chooses open account over cash in advance iff:

$$\mathrm{E}\left[\Pi_S^{OA}\right] > \mathrm{E}\left[\Pi_S^{CIA}\right] \Leftrightarrow \frac{\tilde{\lambda}^*}{1+r} - \frac{\tilde{\lambda}}{1+r^*} + z_i > 0 \tag{3}$$

For domestic trade both firms face the same country level interest rate and enforcement probability, that is $r_B = r$ and $\lambda_B = \lambda$. The condition thus simplifies to:

$$\mathrm{E}\left[\Pi_S^{OA}\right] > \mathrm{E}\left[\Pi_S^{CIA}\right] \Leftrightarrow z_i > 0. \tag{4}$$

These results are summarized in the following Proposition:

Proposition 1. *The optimal choice of payment contract is uniquely determined by equation* (3) *for international transactions and by equation* (4) *for domestic transactions.*

Proof. Omitted. □

The payment contract choice in international trade depends on the financial conditions and the legal environment both in the origin and the destination. For domestic trade, however, the choice only depends on the firm-level shock. The country-level financing costs

[15] In the data, letters of credit are most likely to be reported as on-delivery sales. To address the concern that unobserved LCs may affect our results, we also run regressions where we only use information about sales that are not on-delivery. See the empirical section for details.

[16] Additionally, readers may be interested in Ahn (2013) and Niepmann and Schmidt-Eisenlohr (2013b), who study the role of letter of credit supply shocks and Demir et al. (2013) who look at the role of Basel II for the supply of letters of credit.

[17] While not the focus of our analysis, these shocks are necessary to generate heterogeneity across firms that is observed in the data.

and payment probabilities do not affect the contract choice for domestic transactions because with domestic sales they do not differ between the buyer and the seller.[18]

Let $\bar{z}^I$ denote the value at which a firm is indifferent between using open account and cash in advance for an international transaction. This cutoff can be derived easily from equation (3) as:

$$\bar{z}^I = \frac{\tilde{\lambda}}{1+r^*} - \frac{\tilde{\lambda}^*}{1+r} \tag{5}$$

All sellers for which $z_i > \bar{z}^I$, choose open account terms for their international sales. The share of open account in international transactions thus increases weakly if and only if $\bar{z}^I$ decreases.

Let $S^{OA,I}$ denote the share of open account in international transactions. The following Proposition derives the effects of source and destination country characteristics on the payment contract choice for international sales:

Proposition 2. *Weakly more export contracts are on open account terms if*

i) contract enforcement in the source country is worse: $\frac{\partial S^{OA,I}}{\partial \lambda} \leq 0$

ii) financing costs in the source country are lower: $\frac{\partial S^{OA,I}}{\partial (1+r)} \leq 0$

Proof. Note that $\frac{\partial S^{OA,I}}{\partial \bar{z}^I} \leq 0$. Then, i) and ii) follow directly from taking the derivative of $\bar{z}^I$ with respect to the two variables of interest. □

More firm pairs use an open-account contract for international sales if financing costs at the source are low. Furthermore, open account is used more if enforcement in the source country is weak as this reduces the profitability of the alternative cash in advance.

Interaction Terms In the data, we observe the share of open account in total sales. There is, however, no information on the split of this variable between domestic and international sales. In the following, we show that it is possible to test the predictions on contract choice for international sales by employing interaction terms between export intensity and the country-level variables. This works because country-level characteristics affect the payment contract choice for international sales but not for domestic sales as derived in Proposition 1. Note that the share of open account can be expressed as:

$$S^{OA} = S^{OA,I} XS + S^{OA,D}(1 - XS), \tag{6}$$

where S^{OA}, $S^{OA,I}$ and $S^{OA,D}$ are the shares of open account in total, international and domestic sales, respectively. XS is the share of exports in total sales.

The following Proposition summarizes the effect on changes in country level characteristics on firms with different export intensities:

[18] Firms within a country of course often face different financing costs and can have heterogeneous abilities to enforce contracts. In our setup any such differences at the firm level would be mapped into the error term z_i.

Proposition 3. *An exporter uses weakly more open account than another exporter who generates a smaller share of her revenues abroad if*

i) contract enforcement in the source country is worse: $\frac{\partial^2 S^{OA}}{\partial XS \partial \lambda} \leq 0$

ii) financing costs in the source country are lower: $\frac{\partial^2 S^{OA}}{\partial XS \partial (1+r)} \leq 0$

Proof. $\frac{\partial S^{OA}}{\partial XS} = S^{OA,I} - S^{OA,D}$. Noting that $S^{OA,D}$ is independent of λ and r, the rest follows directly from Proposition 2. □

Source-country characteristics affect the payment contract for international sales but not for domestic sales. Any change in the share of open account in total sales that is related to changes in country-level variables can therefore be attributed to adjustment of international sales contracts. The cross-derivatives of the share of open account in total sales with respect to the export intensity and the two country variables therefore give us the marginal effects of interest. Hence, interaction terms between export intensities and financing costs and enforcement, respectively, can be employed to estimate the relationships.

Complexity of products Nunn (2007) and Levchenko (2007) have shown that product complexity affects the patterns of trade. Does product complexity also affect the payment contract choice? Sales of complex products often involve customization and other relationship-specific investments on the side of the seller. These expenditures as well as the quality of the delivered product can be difficult to verify in court. Contract enforcement should therefore be harder for complex products. The involved parties might thus be particularly keen to choose the payment contract that shifts the commitment problem to the country with better legal institutions when products are more complex.

In the following this idea is introduced and its effects on the contract choice are analyzed. Assume that there is a complementarity between product complexity and contract enforcement. That is, better courts improve contract enforcement more for complex products than for non-complex products. Let $\gamma \in [0,1]$ denote the complexity of a product and assume that the probability of enforcement now equals λ^γ. For $\gamma = 0$, the product is the least complex and the country level enforcement factor equals one. The higher γ, the more complex is the product and the harder is enforcement in court. For international trade, this implies that:

$$\mathrm{E}\left[\Pi_S^{OA}\right] > \mathrm{E}\left[\Pi_S^{CIA}\right] \Leftrightarrow \frac{\eta^* + (1-\eta^*)\left(\lambda^*\right)^\gamma}{1+r} - \frac{\eta + (1-\eta)\lambda^\gamma}{1+r^*} + z_i > 0 \tag{7}$$

From this, the following proposition can be derived:

Proposition 4. *Suppose* $\lambda > 1/e$. *Then, the effect of* λ *on the payment contract choice, as stated in Proposition 3 is the larger, the higher the product complexity* γ. *The effect of* $1+r$ *on the payment contract choice is the smaller, the higher the product complexity* γ. *That is: i)* $\frac{\partial^3 S^{OA}}{\partial XS \partial \lambda \partial \gamma} \leq 0$*; ii)* $\frac{\partial^3 S^{OA}}{\partial XS \partial (1+r) \partial \gamma} \geq 0$.

Proof. See Appendix A. □

The Proposition predicts that exporters in complex industries should put relatively more weight on cross-country differences in contract enforcement and relatively less weight on differences in financing costs.[19] Note that the prediction that financing costs matter less for the payment choice in more complex industries represents an indirect effect. While for both industries financing costs affect profits the same way, they are relatively less important for decisions in complex industries as in those industries going for the country with the strongest contract enforcement is the dominating motive.

3 Empirical Results

3.1 Data

The main data source for the analysis of the payment contract choice is the World Bank Enterprise Survey. It is a comprehensive firm-level survey, conducted in a wide range of developing countries. The analysis is based on a cross-section of firms from data collected between 2006-2009. Each firm was interviewed once.

In the survey, a firm was asked which percentage of its annual sales in the last fiscal year was paid before-, after- or on-delivery. We classify payment before-delivery as cash in advance. Payments on- and after-delivery are assigned to open account. Both in the case of on- and after-delivery payments, the exporter bears the risk of non-payment and has to finance the transaction.[20] From the survey we also use the export intensity, defined as the share of exports in total sales as well as a set of firm-level controls.[21]

The survey data contains rich information about the payment structure of sales for a large number of firms from many countries. This allows for the first time to test for the role of source country characteristics on the payment contract choice and to study the role of industry characteristics. There are, however, several data limitations that are important to note. One drawback of the data is that we cannot observe separately if firms employ letters of credit. LCs are most likely reported as on-delivery payments and thus represent an additional reason why distinguishing between post-delivery and on-delivery payments might be useful. In a robustness exercise, we therefore ignore the information about on-delivery payments and redefine the share of open account as the share of post-delivery payments in all transactions that are either on pre-delivery or post-delivery terms. Results remain unchanged when employing this alternative measure of open account. Another shortcoming of the data set is that the timing of payments is only reported at the firm level. Ideally, one would like to observe this information separately for exports and domestic sales. As discussed earlier and spelled out in more detail below, we can overcome this limitation of the data by employing interaction terms between export intensities and the variables of interest. Finally, the data are only a cross-section, so we cannot include firm fixed effects in the regression. The survey allows, however, to control for a broad set of firm-level variables.

[19] The condition $\lambda > 1/e$ is quite weak as $1/e \approx .37$.

[20] There is a notable difference between the two as post-delivery payment requires a longer financing period and can imply a larger risk for the buyer than on-delivery payment.

[21] The additional firm-level controls are sales per worker, age, manager's experience, state-owned and import status.

The firm-level data is augmented by two additional sources to proxy for enforcement and financing costs in the different countries. First, we use the number of days it takes to enforce a commercial dispute in a country, which is extracted from the World Bank Doing Business database. We interpret a delay in payment contract as weaker enforcement. For ease of interpretation, the measure is inverted.

Second, we capture the financial conditions at the country level by using financial variables from Beck et al. (2009). In the baseline regression financing costs are proxied by the net interest rate margin. It is an ex-post efficiency measure for the overall banking sector and is calculated as the ratio of the net interest revenues over total assets of all banks in a country. In addition we use the private credit over GDP and overhead costs as alternative proxies for financing conditions. Private credit over GDP is a proxy for general financial development. The higher this measure, the lower should be the financing costs for firms. Our third variable is given by the sum of all overhead costs of a banking sector over total bank assets. This is another measure for the efficiency of a banking system. Lower overhead costs should imply lower costs of financial services. All three proxies for financing costs are commonly used in the literature on financial conditions and trade.

We also make some adjustments to the data set to reduce measurement error and to bring it in line with the model. First, only data on manufacturing firms is used for the analysis as for this sector standard trade theory seems most appropriate. Data for all other sectors are dropped from the sample. Furthermore, as the theory mainly applies to trade at arm's length, firms that are affiliates of multinational companies or are owned fully or partially by foreigners are excluded.[22] In the survey, interviewers can indicate at the end of the interview whether they believe that answers of firms where truthful and reliable. To limit measurement error, observations for which interviewers do not believe this to be the case are dropped.[23] Finally, additional observations are lost when merging in the additional data sets containing our measures of contract enforcement and financing costs.

Summary statistics of the final data set are reported in table 1. While the original survey data set contains 9,616 observations of exporters in the manufacturing sector from 92 developing countries, the data set used for the baseline regression has 3,762 observations of exporters from 53 countries.

Data Discussion Both open account shares and export intensities of firms take values anywhere in the range between zero and one. No strong clustering can be observed. While there is a mass point of open account at one, there is a large variation in the use of open account.[24]

The data set is well balanced in regard of country observations as shown in table 2. While there is some heterogeneity, no single country's observations dominate the data set. Also, from table 1 we see that with a mean below 50% and a high standard deviation, the export intensity of firms seems well balanced. According to the sample note, the survey is biased

[22]One way to resolve the commitment problem discussed in the theory is to become a multinational firm. When we run regressions on affiliates only, the effects of enforcement indeed lose their significance as expected.

[23]This is the case if the interviewer chooses answer 3 for questions a16 or a17 in the survey.

[24]In the sample, 28% of firms have a post-delivery payment share of one. If we calculate the share of firms with a combined on-delivery and post-delivery share of one, this number rises to 58%.

towards larger firms. The summary statistics suggest that there is a sizeable variation in both the log sales per worker and the log employment. In our estimation, we also control for reputation effects on the payment contract choice by including the age of the firm and the manager's experience. The average firm is about 15 years old, whereas the average manager has an experience of 20 years. Both variables have a high variance. In the dataset only a small fraction of firms is state owned (0.8%). The mean on the importer dummy shows that a large fraction of the firms are importers (76%). All proxies for enforcement and financing conditions have high standard deviations, indicating a substantial cross-country heterogeneity in contract enforcement and financing conditions in our sample.

3.2 Methodology and Specification

Methodology The baseline regressions employ OLS estimation at the firm level. We report robust standard errors in all regressions. In the robustness section we follow two alternative approaches. First, to mitigate the problem of endogeneity at the firm level, we estimate the relationships for industry averages. Second, because the share of open account is between 0 and 1, we use a fractional response model to directly take this restriction into account. All estimation techniques deliver similar results.

Identification Identification is based on the theoretical results summarized in Proposition 3. Proposition 3 states that for an exporter that generates more of her revenues abroad than another exporter, country level financial conditions and contract enforcement have a larger effect on the payment contract choice. We exploit this result for our identification by including interaction terms between the export intensity and our measures of enforcement and financing costs, respectively. To ensure identification and to meet the assumptions of the theoretical model we focus on firms with a positive export intensity, dropping all other firms from our dataset.

Proposition 1 justifies the use of the export intensities for identification. Domestic sales, in contrast to exports, should not be not affected by changes in enforcement and financing costs because the seller and the buyer face the same country level conditions. Furthermore, we show in Proposition 2 that it is sufficient for identification to rely on source country variation.

Main Specification The dependent variable is the share of open account payments in total sales. Note that only one equation needs to be estimated as all remaining transactions are classified as cash in advance. The equation takes the following form:

$$OA_{it} = \psi_0 + \psi_1 XS_{it} + \psi_2 XS_{it} \times ENF_{ct} + \psi_3 XS_{it} \times INT_{ct} + \Psi X_{it} + \nu_j + \nu_c + \nu_t + \epsilon_{it}. \quad (8)$$

An observation is the share of open account OA_{it} in the total sales of firm i in year t. The regressions include the firm-level controls as well as industry (j), country (c) and year fixed effects.[25] XS is the export intensity. ENF represents contract enforcement and INT

[25]The firm-level controls are listed in table 1.

denotes the net interest rate margin.[26]

The main prediction of the model is on the coefficients of the two interaction terms between export intensity and enforcement, ψ_2, and export intensity and financing costs, ψ_3, respectively. In international transactions, the share of open account should decrease in source country enforcement, as this makes cash in advance more attractive. It should also decrease in source country financing costs, because this reduces profits from open account. For domestic transactions, open account use is independent of these variables. Taken together, this implies that the coefficients on both interactions ψ_2 and ψ_3 should be negative.

Industry Complexity Proposition 4 predicts that the extent to which contract enforcement affects the payment contract choice should be related to the complexity of the industry the exporter is operating in. More precisely, the contract choice of a firm in a more complex industry should be more affected by differences in contract enforcement and less influenced by interest rate differentials.

In the theory section we argue that a product is complex if it involves customization and other relationship-specific investments. In industries where relationship-specific investments are high, the judicial quality should matter more, because it is more difficult to verify whether the quality of the produced good meets the specification. When products are more specific, firms therefore have a stronger incentive to default when courts are weak in their country. We measure the degree of complexity by adopting the classification developed in Nunn (2007), which is based on intermediate inputs. Industries that use a large share of intermediate inputs that are either not traded on an exchange or where no reference price exists tend to be more contractually intensive and are classified as more complex.[27] For example, in our data, the manufacture of refined petroleum products (ISIC code: 2320) is classified as an industry of low complexity whereas motor vehicles production (ISIC code: 3410) is classified as a complex industry. It is quite intuitive that the quality of petroleum products should be easier to verify than the quality of motor vehicles, which consist of a large number of complex parts. The classification in Nunn (2007) is developed using the US input-output table. A drawback of this approach is that one needs to assume that the complexity measure constructed with US data can be applied to all countries in the data set. To test the predictions of Proposition 4, the following specification is estimated:

$$\begin{aligned} OA_{it} &= \psi_0 + \psi_1 XS_{it} + \psi_2 XS_{it} \times ENF_{ct} + \psi_3 XS_{it} \times INT_{ct} \\ &+ \psi_4 XS_{it} \times ENF_{ct} \times COM_j + \psi_5 XS_{it} \times INT_{ct} \times COM_j \\ &+ \psi_6 XS_{it} \times COM_j + \psi_7 ENF_{ct} \times COM_j + \psi_8 INT_{ct} \times COM_j \\ &+ \nu_j + \nu_c + \nu_t + \epsilon_{it}. \end{aligned} \tag{9}$$

The two coefficients of interest are ψ_4 and ψ_5 on the triple interactions between the export intensity, industry complexity and source country enforcement and financing costs, respec-

[26]Note that the data is not a panel but a cross-section of firms from 53 countries, and the vast majority of countries (51) appear in the data only once. As we have already included country fixed effects there remains little variation within countries across years to identify the effects of ENF and INT on their own.

[27]To use the industry classification in Nunn (2007), it is mapped to the industry classification of the data set. A correspondence from SITC to ISIC developed for this purpose is available on request.

tively. The model predicts $\psi_4 < 0$ and $\psi_5 > 0$. That is, the more complex the industry of a firm, the stronger the effect of contract enforcement and the weaker the effect of financing costs on the international payment contract choice.

3.3 Results

Baseline In table 3 column 1 we report the results for the baseline specification. All results are highly statistically significant and all coefficients have the signs predicted by the theory. The coefficient on the interaction between contract enforcement and the export intensity is negative as expected. Firms use less open account for international sales if contract enforcement in the source country is better. The estimated coefficient on the net interest rate margin interaction is negative. The share of open account in international transactions thus decreases in the financing costs.

To check the robustness of our results the net interest margin is replaced by alternative financial measures. Substituting in either private credit over GDP or overhead costs over total assets in columns 2 and 3 in table 3 respectively, delivers very similar results. Note that the coefficient on private credit is positive because it is an inverse measure of financing costs, that is a higher private credit over GDP ratio should capture lower financing costs.

Industry Complexity The results for the estimation of equation (9) are summarized in columns 4 to 6 of table 3. The coefficients for the two triple interactions in column 4 have the predicted signs. The estimated coefficient on the enforcement triple interaction is highly significant, large and negative. It implies that the more complex an industry, the larger the effect of contract enforcement on the payment contract choice. The net interest rate margin triple interaction has the predicted positive sign. It is, however, only significant at a 20% level. Note that the coefficient has roughly the same magnitude as the one estimated for the interaction between the net interest margin and the export intensity. This suggests that for firms in the most complex industries, financing costs do not affect the payment contract choice. Indeed, we cannot reject the null hypothesis that both coefficients add to zero. Firms in non-complex industries, however, use substantially less open account if financing costs are high. As predicted by Proposition 4, the contract choice in industries that produce more complex products is hence more affected by the legal environment whereas financing costs are more relevant in less complex industries.

Again, we estimate the same relationship for the different proxies of financing costs and enforcement in the remaining columns of table 3. The results are robust to the use of alternative variables. If we use private credit as the proxy for the financing conditions, the coefficient on the triple interaction is highly significant and has the predicted negative sign. The coefficient for the enforcement triple interaction has the right sign but is insignificant. When we use the overhead costs as our financial proxy we get similar results to using the net interest margin. Both signs of the triple interaction coefficients are as predicted. They are significant for enforcement but insignificant for overhead costs. While not always significant, all estimated coefficients are in line with the predictions of the model.

Quantitative Size of Effects What is the economic size of the estimated effects? As discussed in the theory section, the estimates on the interaction terms of financing costs and contract enforcement with the export intensity exactly identify the effects of interest, that is $\frac{\partial S^{OA,I}}{\partial(1+r)}$ and $\frac{\partial S^{OA,I}}{\partial \lambda}$. To evaluate the size of these effects, consider a country at the 25 percentile in enforcement and financing costs. Suppose this country improved both its legal and financial conditions such that it moves to the 75 percentile in both measures.[28] By how much would the share of open account in international sales increase? Table 4 shows the results of this experiment. According to the estimates, the increase in enforcement would decrease the share of open account by 6.3 percentage points, while the increase in financing costs would decrease the share by 5.0 percentage points.

Columns 2 and 3 show the results for industries of high and low complexity, respectively, and column 4 reports their difference. Again, we consider the experiment described above. In an industry of low complexity, the share of open account is predicted to decrease by 7.1 percentage points in response to the higher interest rates. The change in enforcement does not imply a significant change in open account. In a highly complex industry, a change in enforcement should decrease the open account share by 1.5 percentage points. The coefficient is, however, insignificant. The difference in the changes in open account between the two industries following the increase in enforcement is predicted to be -3.3 percentage points. That is highly complex industries increase their cash in advance share relative to less complex industries.

3.4 Robustness

In the following, we show that the qualitative results are robust to running regressions at the industry level and to estimating a fractional response model.[29]

Industry Level Variation A potential concern is the endogeneity of the export intensity at the firm level. To address this issue, we aggregate the data to industry-country level and re-estimate our main specifications. The results from the industry level regressions are reported in table 5. Columns 1 to 3 show our findings for the baseline specification. The coefficients on the interactions between enforcement and the export intensity are highly significant and negative, confirming the firm-level estimation results. Coefficients on the interaction between the variables measuring financing costs and the export intensity of firms have the predicted signs. They are, however, insignificant.

Regressions including the triple interactions with complexity are reported in columns 4 to 6. The triple interaction coefficients for enforcement have the predicted negative signs and are highly significant. For the financing-cost proxies, the coefficients on the net interest margin and the overhead costs have the predicted positive signs and are highly significant. It turns out that at the industry level, these two coefficients are estimated more precisely than at the firm level, suggesting that firm variation adds more noise than information along this

[28] The percentiles correspond to the following countries and values: Enforcement: El Salvador (p25) 0.0012723 (786 days); Turkey (p75) 0.002381 (420 days); Interest Margin: Lithuania (p25): 0.032 ; South Africa (p75): 0.072.

[29] We found that our results also hold when using a Tobit model for lognormal data. Results are available upon request.

dimension. The coefficient on the private credit has the predicted sign but is insignificant. Overall, the results at the industry level are fully consistent with our firm-level regressions. In particular, we find strong support for the predictions on industry complexity and payment contract choice.

Fractional Response Model The share of open account is by definition constrained to lie between 0 and 1. Additionally, as should be expected, there are mass points for open account both at values 0 and 1. To directly account for these aspects of the dependent variable we use a fractional response model.[30] The results are presented in table 6. Because the fractional response model is non-linear we report the average marginal effect for each variable in the table. In the main specification all coefficients of interest have the expected sign and are highly significant, with the exception of the private credit interaction term in column 2. This confirms that our results in the baseline regressions are robust towards the mass point at an open account share of one. In two of the three specifications where it is included, the triple interaction coefficient for enforcement is highly significant and has the predicted sign. The coefficient on the triple interaction with enforcement in column 5 is statistically not significant, as in the baseline specification.[31] The triple interaction terms for our proxies of financing costs are only significant in the case of private credit in column 5.[32] Overall, the results presented on enforcement and financing costs as well as complexity, using OLS regression are robust towards the mass point and fractional nature of the dependent variable.

To summarize, the payment contract choice model is strongly supported by the data. Running regressions for the industry average delivers almost identical results to the firm-level regressions. Employing a fractional response model instead of OLS does not change our findings. Replacing the baseline proxy for financing costs, the net interest rate margin, by other measures hardly changes the estimated relationships.

4 Conclusions

Complementing research on aggregate data by Schmidt-Eisenlohr (2013) and on a single US firm by Antràs and Foley (2011), this paper uses firm-level survey data to test for the determinants of the payment contract choice of firms. The empirical findings support the predictions of Schmidt-Eisenlohr (2013) as well as our new theoretical results on the role of product complexity. Legal and financial conditions in the source country affect the contract choice as expected and the data is in line with the idea that enforcement and product complexity are complements. Different to Antràs and Foley (2011), the paper is able to study the effects of source country variation and analyze differences across industries. We find both aspects to be highly relevant for the contract choice of firms.

For future research better data is essential. Ideally, new payment contract data would contain information at the country-pair level to fully test the choice model developed in

[30] For details on the methodology see Papke and Wooldridge (1996). See Ramalho et al. (2011) for a survey.

[31] The sign of the coefficient is positive, while in the baseline it is negative.

[32] Similar to the baseline specification with complexity, the interaction between the net interest margin and complexity is insignificant, although marginally when using the fractional response model.

Schmidt-Eisenlohr (2013) and extended here. A further analysis of the role of firm and industry characteristics following this paper as well as more work on dynamic aspects of payment contract choice along the lines of Antràs and Foley (2011) should lead to interesting new results and help shed more light on exporter-importer relationships.

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A Proofs

Proof of Proposition 4 Note that $\frac{\partial^2\left(\mathrm{E}\left[\Pi_E^{OA}\right]-\mathrm{E}\left[\Pi_E^{CIA}\right]\right)}{\partial\lambda\partial\gamma} = -\frac{(1-\eta)\lambda^{\gamma-1}}{1+r^*}\left[1+\gamma\ln\lambda\right]$. This is smaller than zero if $1+\gamma\ln\lambda>0$. This is less likely the case for higher γ. Inserting the maximum value of $\gamma=1$ delivers the sufficient condition $\lambda>1/e$. The rest of the proof follows the previous proof for Proposition 3. Taking the triple derivatives with respect to XS, γ and λ and $1+r$, respectively, the claims are easy to verify.

Table 1: Summary Statistics

	Mean	Standard Deviation	Observations
OA	.6261124	.3686646	3762
Export intensity	.4408045	.3672502	3762
Log Sales per Worker	13.17973	2.857682	3762
Log Employment	4.315473	1.335444	3762
Ln Age	2.746627	.7937053	3762
Manager's Experience	20.27698	11.62479	3762
State Owned	.0079452	.0744263	3762
Importer	.7666135	.4230423	3762
Enforcement	.0019462	.0009509	3762
Private Credit	.4298971	.2757892	3762
Interest Margin	.0535854	.0261838	3762
Overhead Costs	.0449765	.0256605	3741
Industry Complexity	.5493759	.1959645	3762

B Tables

Table 2: Number of Observation by Country

Country	No of Observations	Country	No of Observations
Albania	12	Madagascar	21
Angola	2	Malawi	5
Argentina	166	Mali	45
Armenia	36	Mauritius	30
Bangladesh	235	Mexico	73
Benin	13	Moldova	99
Bolivia	65	Mozambique	9
Botswana	7	Nepal	31
Brazil	99	Niger	2
Bulgaria	243	Nigeria	22
BurkinaFaso	11	Panama	26
Cameroon	32	Paraguay	49
Chile	116	Peru	144
Colombia	178	Philippines	116
Ecuador	55	Poland	102
ElSalvador	141	Romania	22
Fyr Macedonia	70	Russia	101
Gambia	4	Senegal	40
Georgia	15	SouthAfrica	113
Guatemala	119	Swaziland	6
Honduras	52	Tanzania	24
Indonesia	16	Turkey	304
Kazakhstan	6	Uganda	22
Kenya	108	Uruguay	91
Kyrgyz Republic	7	Vietnam	258
Latvia	65	Zambia	26
Lithuania	108		

Table 3: Payment Contract Choice

This table presents the main results and robustness checks for the financial proxy. Robust standard errors are reported in brackets. ***, ** and * denoting significance at the 1%, 5% and 10% levels respectively. The standard errors are robust. The dependent variable is the sum of post-sale and on-sale payment (OA). Enforcement is proxied by the inverse days to enforce a contract. The financial proxies are the net interest rate margin, private credit and overhead costs. The industry complexity is measured as the share of the intermediates used, which are not traded on an exchange or no reference price exists. All regressions include country, industry and year fixed effects and the firm-level controls discussed in the text.

	(1)	(2)	(3)	(4)	(5)	(6)
Export intensity	0.132***	0.034	0.120***	0.037	-0.189**	-0.026
	(0.049)	(0.029)	(0.043)	(0.133)	(0.082)	(0.122)
Enforcement x Export intensity	-56.921***	-63.683***	-54.955***	48.178	-32.493	50.365
	(13.605)	(15.809)	(13.370)	(37.851)	(44.419)	(37.535)
Interest Margin x Export intensity	-1.248**			-2.886**		
	(0.555)			(2.257)		
Private Credit x Export intensity		0.104**			0.550***	
		(0.052)			(0.145)	
Overhead x Export intensity			-1.361***			-1.900
			(0.517)			(1.315)
Enforcement x Export intensity x Complexity				-191.846***	-51.735	-193.618***
				(64.741)	(76.836)	(63.386)
Interest Margin x Export intensity x Complexity				2.887		
				(2.257)		
Private Credit x Export intensity x Complexity					-0.848***	
					(0.247)	
Overhead x Export intensity x Complexity						1.016
						(2.234)
Export intensity x Complexity				0.176	0.409***	0.268
				(0.223)	(0.135)	(0.201)
Enforcement x Complexity				109.760***	39.784	107.719***
				(36.268)	(40.885)	(36.124)
Interest Margin x Complexity				-0.003		
				(0.896)		
Private Credit x Complexity					0.387***	
					(0.125)	
Overhead x Complexity						0.455
						(1.050)
R-squared	0.321	0.321	0.323	0.326	0.328	0.327
N	3,762	3,762	3,741	3,762	3,762	3,741

Table 4: Average Effects

This table computes an example to evaluate the economic relevance of our estimates. Robust standard errors are reported in brackets. ***, ** and * denoting significance at the 1%, 5% and 10% levels respectively. The dependent variable is the sum of post-sale and on-sale payment (OA). The table shows by how many percentage points Open Account would change in financing costs and enforcement in the source country, respectively, increased from the 25th percentile to the 75th percentile.

	Baseline	Low Complexity (25th pctl)	High Complexity (75th pctl)	Difference (75th-25th pctl)
	(1)	(2)	(3)	(4)
Enforcement	-0.063***	0.018	-0.015	-0.033*
	(0.015)	(0.029)	(0.026)	(0.018)
Interest Margin	-0.050**	-0.071**	-0.029	0.042
	(0.022)	(0.035)	(0.028)	(0.026)
N	3,762	3,762	3,762	3,762

Table 5: Payment Contract Choice: Industry-Country Averages

Notes: This table reports robustness checks where the data is aggregated to the industry-country level. Robust standard errors are reported in brackets. ***, ** and * denoting significance at the 1%, 5% and 10% levels, respectively. The standard errors are robust. The dependent variable is the sum of payments at post- and on-sale delivery (OA). The industry complexity is measured as the share of the intermediates used, which are not traded on an exchange or no reference price exists. All regressions include country, industry and year fixed effects.

	(1)	(2)	(3)	(4)	(5)	(6)
Export intensity	0.102**	0.091***	0.124***	0.148*	0.057	0.147*
	(0.050)	(0.035)	(0.046)	(0.078)	(0.055)	(0.076)
Enforcement x Export intensity	-64.313***	-73.013***	-66.644***	26.447	-29.154	21.354
	(15.878)	(17.894)	(15.730)	(27.030)	(37.544)	(27.173)
Enforcement x Export intensity x Complexity				-161.048***	-72.186	-153.217***
				(48.514)	(72.048)	(47.429)
Interest Margin x Export intensity	-0.067			-3.302***		
	(0.539)			(1.103)		
Interest Margin x Export intensity x Complexity				6.074***		
				(1.817)		
Private Credit x Export intensity		0.057			0.164	
		(0.053)			(0.126)	
Private Credit x Export intensity x Complexity					-0.223	
					(0.246)	
Overhead x Export intensity			-0.511			-3.314***
			(0.540)			(1.143)
Overhead x Export intensity x Complexity						5.426***
						(1.949)
Export intensity x Complexity				-0.087	0.059	-0.065
				(0.112)	(0.080)	(0.103)
Enforcement x Complexity				70.118***	13.275	64.979***
				(18.361)	(31.114)	(17.699)
Interest Margin x Complexity				-2.356***		
				(0.554)		
Private Credit x Complexity					0.050	
					(0.115)	
Overhead x Complexity						-2.382***
						(0.612)
R-squared	0.305	0.306	0.307	0.316	0.315	0.319
N	1,141	1,141	1,132	1,141	1,141	1,132

Table 6: Fractional Response Model

This table presents the results of the baseline specification and robustness checks for the financial proxy. Robust standard errors are reported in brackets. ***, ** and * denoting significance at the 1%, 5% and 10% levels respectively. The standard errors are robust. The dependent variable is the sum of post-sale and on-sale payment (OA). Enforcement is proxied by the inverse days to enforce a contract. The financial proxies are the net interest rate margin, private credit and overhead costs. All regressions include country, industry and year fixed effects and the firm-level controls discussed in the text.

	(1)	(2)	(3)	(4)	(5)	(6)
Export intensity	1.343**	0.228	1.072**	0.690	-1.410*	-0.011
	(0.534)	(0.315)	(0.459)	(1.397)	(0.856)	(1.238)
Enforcement x Export intensity	-496.127***	-492.707***	-441.188***	102.779	-502.495	171.648
	(132.820)	(157.920)	(126.691)	(340.970)	(391.399)	(332.514)
Enforcement x Export intensity x Complexity				-1056.779**	80.099	-1101.751**
				(529.849)	(601.663)	(514.165)
Interest Margin x Export intensity	-14.703***			-25.926*		
	(5.535)			(13.728)		
Interest Margin x Export intensity x Complexity				20.438		
				(22.296)		
Private Credit x Export intensity		0.808			4.765***	
		(0.517)			(1.275)	
Private Credit x Export intensity x Complexity					-7.530***	
					(2.014)	
Overhead x Export intensity			-14.511***			-16.688
			(5.239)			(12.786)
Overhead x Export intensity x Complexity						4.256
						(21.335)
N	3,762	3,762	3,741	3,762	3,762	3,741