Payment Contracts and Trade Finance in Export Relationships

CHRISTIAN FISCHER

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Abstract. I examine the use of payment contracts in export partnerships when the importer’s payment moral is uncertain and there is a time gap between the production and sale of traded goods. In the absence of bank finance I find that by deciding upon the payment format the exporter is challenged with a trade-off between maximizing the profits from the current transaction and making use of screening opportunities that differ between format types. Such screening can help to attain information about the reliability of importers which is crucial to develop efficient and intensive export relationships. Trade credit insurance can catalyze export growth and transaction profitability but its positive impact is limited to the initial phase of export relationships.

Keywords: relational contracts, firm-level exports, trade finance, trade dynamics, contract enforcement

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*Department of Economics, University of Bayreuth, Germany. Email: christian.fischer@uni-bayreuth.de.

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1 Introduction

Shipping goods internationally is risky and takes time. Incomplete cross-border contract enforcement exposes trading partners to an omnipresent risk of expropriation (Thomas and Worrall 1994). At the same time, shipping and finally selling goods abroad is time-consuming which challenges firms with a decision of how to finance the working capital necessary for their export transactions. Taken together, these aspects point at the importance of selecting an appropriate payment contract such that risks and costs of exporting goods are managed optimally.\footnote{To finance the time gap between production and sale of traded goods the following categories of payment contracts exist: open account (exporter finance), cash in advance (importer finance) and different types of bank-intermediated finance. For a comprehensive overview of payment methods in international trade, see ITA (2007).}

Which trade-offs do trade partners face in their decision on the optimal payment contract? Existing studies show that the (relative) costs of capital of exporter and importer as well as the (relative) quality of contracting institutions in their respective countries are crucial. When bank finance is considered the efficiency of the relevant banking market also matters (see Schmidt-Eisenlohr 2013). Most of the available literature frames firms’ payment contract choice in a static context, i.e. as a situation where exporters and importers transact only once. However, a substantial share of businesses worldwide interact with their export partners on a repeated basis suggesting that the mechanics of payment contract selection in the dynamic context of business relationships deserve more study.\footnote{There exists plenty of evidence that international business transactions frequently involve long-term collaboration. See e.g. Egan and Mody (1992), Rauch and Watson (2003), Besedeš (2008) and Defever et al. (2016).} It is well-known from a literature on incomplete relational contracts that repeated interaction can allow for self-enforcing agreements between firms that can substitute for well-functioning legal institutions (see e.g. Baker et al. 2002). As a consequence, existing static models on payment contract choice may fundamentally mispredict the effective costs of financing trade and therefore also the role of external bank or insurer finance that can help to facilitate export activities.

In this paper I develop a repeated-game model of payment contract choice that provides highly tractable predictions on the optimal sequence of payment contracts in export relationships. At the same time it is general enough to cover any quality of contracting institutions and applies to a wide range of refinancing costs and demand characteristics that firms may face. The model shows that, when choosing the payment contract type, the exporter faces a trade-off between maximizing the payoffs from the current transaction and making use of the screening opportunities
that differ inherently between format types. Such screening can help to attain information about the reliability of importers which is crucial to develop efficient and intensive export relationships.

Section 2 introduces the model. It considers an exporter (he) who sells a product through an importer (she) abroad. The importer’s type is her private information and acts as a measure of her costs of capital. In every period, the exporter proposes a contract to his importer specifying an export quantity and a payment contract for the current period. This contract can only be enforced with a certain probability that depends on the quality of the contracting institutions of the participants’ countries. The question of how to finance trade is relevant in the model because goods shipped abroad can only be sold in the destination market in the subsequent period.

Section 3 then contrasts cash in advance and open account as diametrically opposed payment contract forms. I derive equilibria that study each of these payment types in isolation and that highlight the fundamental differences between the contracts. Most importantly, I show that while under cash in advance exporters can offer a contract to importers that perfectly picks out reliable types, any open account contract necessarily involves pooling of importers.

With this finding at hand, in section 4 the exporter can freely choose between these two payment contracts leading to the trade-off between information acquisition and payoff maximization sketched above. As a corollary, the result allows to give sharp predictions on the optimal sequence of payment contracts within an export relationship. Most importantly, this sequence depends on the distribution of importer types and the quality of contracting institutions, among other factors.

Sections 5 introduces bank finance into the model and shows how the availability of a trade credit insurance affects and augments the selection of payment contracts in the dynamic context. Such an insurance can help to speed up export growth as it can substitute for weak legal institutions. However, the benefits of such payment guarantees are only temporary because in later periods an importer’s reputation for reliability may make costly insurance redundant. Section 6 concludes.

This paper is relates to several lines of literature. A first strand studies payment contract selection and trade finance in international trade. Schmidt-Eisenlohr (2013) was first to study the optimal choice between payment contracts in a strategic environment, however his analysis is constrained to a static setting. Antrás and Foley (2015) characterize the exporter’s payment contract choice with a similar setup. Their analysis is motivated by stylized, empirical facts emerging from one specific export industry in the United States. They also offer a dynamic version of the model that gives predictions on how firms decide between cash in advance and open ac-
count payment contracts in the course of their export relationships. However, their analysis cannot account for the fact that the two types of payment contracts allow for very different learning possibilities about the importer’s reliability. Furthermore, while their paper does not consider the role of bank finance in the dynamic context, my model incorporates this possibility in the exporter’s choice set.

The role of banks and insurance firms in international trade finance has been the subject of several studies. For the case of export credit insurances that I consider in my model, most of the existing work has an empirical focus. Van der Veer (2015) uses panel data from private trade credit insurers from 1992 to 2006 to show a positive effect of the existence of such insurances on exports. Auboin and Engemann (2014) use data on the subsequent period of the financial crisis to demonstrate that this positive effect remained stable over this time frame, i.e. it did not vary between crisis and non-crisis periods. Felbermayr and Yalcin (2013) study the effect of export credit guarantees on exports in Germany and find qualitatively comparable effects. These consistent findings are very much in line with Proposition 5 of this paper where I show that the exporter can benefit from insuring transactions to certain export destinations. Additionally, the result predicts that this positive effect might be particularly driven by early transactions within export relationships. Beyond export credit insurances, there exist several other types of bank-mediated payment contracts. It is frequently documented, that letters of credit and documentary collections are of particular importance and Schmidt-Eisenlohr and Niepmann (2016) provide an insightful empirical study on the usage of these contract forms. Olsen (2015) studies in a general equilibrium framework how banks’ reputation for payment can be a valuable substitute for the trading partners’ own reputations and weak legal institutions.3

Furthermore, the paper is related to a literature on learning and export dynamics in trade relationships. Araujo et al. (2016) study how contract enforcement and export experience shape firm export dynamics when information about importers is incomplete. The learning mechanics on the importer type under the open account contract in my model are inspired by their setup, however the authors do not use it to study questions related to trade finance. It is due to this learning that exporters increase export volumes over time, a pattern that the authors confirm empirically using a panel of Belgian exporters. Aeberhardt et al. (2014) provide comparable results for French exporters. Building on Araujo et al. (2016), Monarch and Schmidt-Eisenlohr (2016) document that there exists substantial heterogeneity

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3A survey of this literature in the broader context of corporate finance in international trade can be found in Foley and Manova (2015).
in how export-relationships mature in different countries. This is consistent with my model as it predicts that country- and/or industry-specific characteristics (through the quality of legal institutions and the type distribution of importers) matter for the selection of payment contracts.

Finally, my model is related to a literature on self-enforcing relational contracts with incomplete information and adverse selection that were first studied by Levin (2003). More specifically, it adds to a growing literature on non-stationary relational contracts with adverse selection, in which contractual terms vary with the length of relationships. While in my paper learning about the importer induces switching between different payment contracts, previous work has studied non-stationarities in other contexts. Chassang (2010) studies how agents with conflicting interests can develop successful cooperation when details about cooperation are not common knowledge. Halac (2012) studies optimal relational contracts when the value of a principal-agent relationship is not commonly known and, also, how information revelation affects the dynamics of the relationship. Yang (2013) studies firm-internal wage dynamics when worker types are private information. Board and Meyer-ter Vehn (2015) analyze labor markets in which firms motivate their workers through relational contracts and study the effects of on-the-job search on employment contracts. Moreover, Defever et al. (2016) study buyer-supplier relationships in which learning about the quality of a supplier can cause switches in the contractual nature of these relationships.

2 The Model

The model builds on Araujo et al. (2016) and extends their setting to study the dynamic selection of payment contracts. It considers the problem of an exporter from country Home that markets a product in a foreign market (Foreign). The exporter cannot access foreign consumers directly and needs to contract with an importer in order to make products available to consumers. In Foreign, there is a continuum of agents with the ability to internally distribute goods produced by the exporter. Each exporter is a monopolist and has constant marginal costs \( c \) for the production of his output. The revenue from selling \( q \) units of the product in Foreign generates revenue \( R \), which we assume to be a strictly increasing and concave function of \( q \), i.e.

\[
R = R(q), \quad \text{with } R'(q) > 0, R''(q) < 0, \text{ and } R(0) = 0. \quad (1)
\]
Whether the concavity of the revenue function stems from technology, preferences or market structure is not important for the analysis below. The revenue is realized by the importer.

We model the export relationship as a repeated game, where in every period \( t = 0, 1, 2, ... \) an export transaction is performed. The exporter can engage in only one partnership at the same time. Figure 1 gives an intuitive summary of the stage game. In every period \( t \), the exporter first decides whether to start a relationship with a new importer or to keep his previous one. He then proposes a contract to his importer specifying export volume, a payment from importer to exporter and the point in time when this payment is made. Depending on the agreed payment timing, the exporter will receive the transfer either before he ships out his goods (Cash in Advance, \( F_t = CIA \)) or after the importer sells them in Foreign (Open Account, \( F_t = OA \)). The timing of the transfer is directly payoff relevant because shipping the goods from Home to Foreign takes time. We model this aspect by assuming that the goods can be sold in Foreign only at the beginning of the subsequent period \( t+1 \).

![Figure 1: Payment contract determines the stage game timing](image)

As the game shifts from one period to the next players discount their expected payoffs, potentially at different rates. Such an asymmetry may be interpreted as interest rates and thus costs of capital that differ between Home and Foreign, but may also be the result of other institutional differences. Formally, we denote the exporter’s discount factor as \( \delta_E \in (0, 1) \). In order that payment contract selection is non-trivial we assume two types of importers that the exporting firm may encounter. Her type is the importer’s private information. A share \( \hat{\theta} \) of importers is myopic with discount factor \( \delta_M = 0 \), i.e. these importers only give positive value to payoffs that are realized in the current period. The remaining \( 1 - \hat{\theta} \) importers are patient with discount factor \( \delta_I \in (0, 1) \). Absent additional information, the exporter holds the prior belief \( \theta_0 = \hat{\theta} \) that a randomly chosen importer is myopic.

The quality of the contracting institutions in Home and Foreign come into the model through an exogenous country-specific probability that a contract is enforced when firms do not want to fulfill it voluntarily, a concept originating from Schmidt-Eisenlohr (2013). More specifically, in every period of the game a spot contract \( C_t \)
specified below can be enforced in country Foreign (Home) with the i.i.d. probability \( \lambda \) \((\lambda^\ast)\). In the model, \( \lambda \) is the probability that the importer is forced make the agreed-upon payment to the exporter for the period \( t \) transaction while \( \lambda^\ast \) is the probability that the exporter is being forced to produce and ship abroad the agreed-upon volume of exports.

In the following a formal representation of the stage game that introduces further notation and assumptions:

**Stage game.**

1. **Revenue realization.** The \( q_{t-1} \) units shipped in the previous period arrive in Foreign. The importer generates revenue \( R(q_{t-1}) \).

2. **Payment (if \( F_{t-1} = OA \)).** The importer decides whether to transfer \( T_{t-1} = \beta R(q_{t-1}), 0 < \beta < 1, \) to the exporter. He (costlessly) finds an opportunity to only pay a transfer \( T_{t-1} = \gamma R(q_{t-1}), 0 \leq \gamma < \beta, \) with probability \( 1 - \lambda \). Upon contract non-compliance the match is permanently dissolved.

3. **Matching decision.** Whenever unmatched, the exporter starts a new partnership. Otherwise, the exporter chooses whether to stick to the current importer or to re-match with a new partner.

4. **Contracting.**
   - The exporter proposes a one-period spot contract \( C_t = \{q_t, F_t, T_t\} \) to the importer. The contract specifies the units \( q_t \) of the exporter’s product to be sold by the importer, and a trade finance arrangement \( F_t \) for period \( t \), where \( F_t \in F = \{CIA,OA\} \). The choice of \( F_t \) determines the timing of the transfer payment \( T_t = \beta R(q_t) \) from the importer to the exporter that is a fraction of the revenue. We make the restriction to spot contracts to reduce the screening possibilities in the model to a tractable minimum.
   - The importer decides whether to accept or reject the contract. Upon rejection, the match is permanently dissolved and a new match is formed in the following period.

5. **Payment (if \( F_t = CIA \)).** The importer decides whether to transfer \( T_t \) to the exporter. Upon non-payment the match is permanently dissolved.

6. **Production and Shipment.** The exporter decides whether to produce and ship \( q_t \) units of his goods to the importer as specified in the contract. He (costlessly) finds an opportunity to deviate from the contracted terms with
probability $1 - \lambda^*$. Upon non-shipment of the agreed quantity the match is permanently dissolved.

3 The nature of payment contracts

Before discussing how a payment contract is selected in the presence of several alternatives and how this choice varies over time, this section studies each of the two alternatives in isolation. We explore for every payment format separately, how information about the importer is revealed and how the export intensity changes over time. The payment type selection in the dynamic context of the model is discussed in the subsequent section.

In the following, we derive equilibria for both cases, CIA and OA, that are highly comparable but highlight important differences resulting from the nature of the two payment contracts.

3.1 Cash in advance

In this section we study the case where the exporter is restricted to cash in advance, i.e. $F_t = CIA$ for all $t$. Consider the following strategy profile that we will show to be part of a sequential equilibrium of the repeated game.\(^4\)

CIA strategy profile.

- **Exporter strategy**: The exporter forms a new partnership whenever unmatched. He terminates an existing partnership if and only if the importer defaults on the contract. The exporter proposes a contract $C_t$ that maximizes his current period expected payoffs.

- **Importer strategy**: A myopic importer will reject any CIA contract. A patient importer never defaults from the proposed contract.

The importers’ participation constraints for period $t$ are:

$$(\delta_i - \beta)R(q_t) \geq 0, \quad \text{where} \quad i = M, I. \quad (PC_i^A)$$

The constraints state, that tomorrow’s revenue $R(q_t)$ attained by the sale of today’s exports $q_t$ must be larger than the the share $\beta$ of revenue that the importer has to transfer to the exporter before shipping. Because the goods arrive in Foreign only

\(^4\)For adverse selection scenarios as we study them here, sequential equilibrium is the relevant notion of equilibrium, see Mailath and Samuelson (2006), pp. 158–159.
in the following period revenue has to be discounted. Observe that because \( \delta_M = 0 \), \((PC^A_M)\) cannot be fulfilled for any \( \beta \in (0, 1) \). Hence the myopic importer will never accept any CIA contract. The exporter will therefore offer a separating contract to the patient importer and set \( \beta \) to extract all rents from her.

With this in mind, suppose that we are in the initial period \( k = 0 \) of a newly matched export relationship. At the contracting stage, the exporter will set the export quantity \( q_0 \) and a transfer payment \( T_0 \) that maximizes his spot payoffs subject to the participation constraint of the patient importer:

\[
\max_{q_0} (1 - \theta_0)(\beta R(q_0) - cq_0) \quad \text{s.t.} \quad (\delta_I - \beta)R(q_0) \geq 0.
\]

The exporter chooses the exported quantity \( q_0 \) such that it maximizes his share of the revenue \( \beta R(q_0) \) minus the costs of production, and subject to \((PC^A_I)\). The payoff is weighted by the probability of facing a patient importer \( 1 - \theta_0 \) since non-participation of the myopic type leads to zero payoffs. The exporter sets \( \beta^A = \delta_I \) to make the patient importer indifferent between accepting and rejecting the contract and to receive the maximally feasible share of the revenue. This simplifies the maximization problem to:

\[
\max_{q_0} (1 - \theta_0)(\delta_I R(q_0) - cq_0).
\]

The producer’s optimal export quantity under cash in advance, \( Q^A \), is determined by the related first-order condition (FOC):

\[
R'(q_0) = \frac{c}{\delta_I}.
\]

Once an initial CIA export transaction is successful the exporter knows for sure that he is matched with a patient type. We can write the belief that the importer is myopic given \( k \) previous successful transactions under cash in advance as:

\[
\theta_k^A = \begin{cases} \theta_0 & \text{if } k = 0, \\ 0 & \text{if } k > 0. \end{cases}
\]

Because the FOC for the initial transaction is already belief-independent it follows that \( Q^A \) is the same for every cash in advance transaction. The expected payoffs in the initial period of a CIA relationship thus are:

\[
\pi^A_0 \equiv \pi^A(\theta_0^A) = (1 - \theta_0)(\delta_I R(Q^A) - cQ^A).
\]
In any subsequent transaction the exporter expects to receive the following payoffs:

\[ \pi^A \equiv \pi^A(\theta_k^A = 0) = \delta_1 R(Q^A) - cQ^A. \]  

(2)

Because the production and shipment decision is made after the transfer payment under a CIA contract, we need to ensure that the exporter does not have an incentive to deviate and not ship out his goods as agreed upon. The following Lemma gives a simple condition that rules out any such deviation.

**Lemma 1.** For every \( \theta_0 \in (\frac{cQ^A}{\delta_0}, 1) \) there exists a unique \( \delta_E = \frac{cQ^A}{\theta_0} \theta_A \) such that the exporter never deviates at the Production and Shipment stage if and only if \( \delta_E \geq \delta_E \).

**Proof.** See Appendix

Lemma 1 shows that if the mass of myopic types in the population of potential importers is not too small, it is always optimal for sufficiently patient exporters (those with \( \delta_E \geq \delta_E \)) to ship the contracted goods to the importer who paid for them beforehand. If however the mass of myopic types is too small breach of contract by the exporter cannot be avoided because he finds it too likely to draw again a patient type in the following period where, again, he could cash the transfer, refrain from shipping and re-match.

The following Proposition summarizes our findings on the cash in advance equilibrium.

**Proposition 1.** Suppose only cash in advance payments are possible. The exporter starts a partnership whenever he finds a match, maintains the partnership as long as he does not observe a default, and exports \( Q^A \) in each period \( k \) in which the partnership is active. A myopic importer never participates under cash in advance. A patient importer never defaults and never terminates a partnership. This strategy profile together with the belief updating rule \( \theta_k^A \) is a sequential equilibrium.

There are several points noteworthy about the equilibrium. First, a cash in advance contract is very demanding with respect to the financial capabilities of the importer. This aspect is stressed in our model by the fact that impatient importers are fully myopic which precludes them from accepting the contract. Therefore any CIA contract in the present model is a separating contract that perfectly screens out patient importers. As a consequence, learning about the importer’s type under CIA is immediate. After the initial period of interaction, the exporter knows with certainty the type of his current match.
Certainly, assuming full myopia of the impatient type is a strong assumption and immediate separation of types the extreme consequence. However, the result is very illustrative when contrasted with the screening mechanism available under open account introduced in the following section.

3.2 Open account

We now study the case where the exporter is restricted to open account contracts, i.e. \( F_t = OA \) for all \( t \). Essentially, this version of our model is a stripped-down variant of the setup by Araujo et al. (2016). Consider the following strategy profile that we will show to be part of a sequential equilibrium of the repeated game.

**OA strategy profile.**

- **Exporter strategy:** The exporter forms a new partnership whenever unmatched. He terminates an existing partnership if and only if the importer defaults on the contract. The exporter proposes a contract \( C_t \) that maximizes his current period expected payoffs.

- **Importer strategy:** Both, myopic and patient importer accept the OA contract. While the patient importer never defaults, the myopic importer will default whenever she finds the opportunity to do so.

With this strategy in mind we can write the participation constraints of the two types as:

\[
(1 - \beta)R(q_t) \geq 0, \quad (PC^{p}_t) \\
(1 - \lambda\beta)R(q_t) \geq 0, \quad (PC^{m}_t)
\]

where \((PC^{p}_t)\) is the participation constraint of the patient importer and \((PC^{m}_t)\) that of the myopic importer, respectively. While it is possible to construct a separating contract that picks up only patient importers under CIA, this is not possible for OA. Myopic importers only make a transfer when exporters can enforce their contract (which happens with probability \( \lambda \)). This makes their PC more lenient. Because \( 0 < \beta < 1 \), it follows that every feasible OA transaction involves pooling of importer types. Besides, discounting does not affect the importer’s participation decision since revenue realization and payment for a period \( t \) contract are both made in \( t+1 \).

Suppose for the moment that importers behave as prescribed by the strategy profile and consider belief formation. In the initial period of a partnership, \( k = 0 \), the exporter believes that he is matched with a myopic type with probability \( \theta_0 = \hat{\theta} \).
According to the strategy profile patient agents never deviate and myopic types always want to deviate but in every period this is only possible if contracts cannot be enforced. This happens with probability $1 - \lambda$. Hence, if no deviation occurs in the course of the first $k$ transactions, the belief of facing a myopic type in period $k$ is updated by Bayes’ rule as follows:

$$\theta^\Omega_k = \frac{\hat{\theta}\lambda^k}{1 - \hat{\theta}(1 - \lambda^k)}.$$ 

The probability of payment in the initial period can be written as $\Lambda_0 = 1 - \theta_0 + \lambda \theta_0$. More generally, the probability of payment in period $k$ is $\Lambda_k = \frac{1 - \hat{\theta}(1 - \lambda^{k+1})}{1 - \hat{\theta}(1 - \lambda^k)}$.

Observe that in order to make the patient importer behave as described by the strategy profile, it is not enough to merely consider her participation constraint as we did in the CIA case. Under open account, she must be granted a payoff such that she does not seize the revenue realized by her instead of making the transfer payment. We denote the maximal share of revenue that the importer is able to seize by $1 - \gamma$, where $0 \leq \gamma < \beta$ is the exogenous revenue share that the exporter can still claim under any importer deviation. We can formulate the following Lemma:

**Lemma 2.** There exists a unique $\delta_I = \frac{\beta - \gamma}{1 - \gamma}$ such that the importer never deviates at the Payment stage of any period of an export relationship if and only if $\delta_I \geq \delta_I$. Equivalently, a patient importer will never deviate from the contract if and only if

$$\beta \leq \delta_I + \gamma(1 - \delta_I) \equiv \beta^\Omega.$$  

**(IC^\Omega_I)**

**Proof.** See Appendix

The Lemma states, that as long as the share of revenue that has to be transfered to the exporter is below the threshold level $\beta^\Omega$, the patient importer has no incentive to deviate from the accepted contract. Obviously, payment is never incentive compatible for a myopic importer who will refrain from transferring $\beta^\Omega$ whenever possible.

Let us now turn to the exporter’s maximization problem. In any period $k$ of the export relationship he chooses $q_k$ to maximize:

$$\max_{q_k} \delta_E \Lambda_k \beta R(q_k) - c q_k \quad \text{s.t.} \quad \beta \leq \beta^\Omega.$$ 

While the exporter has to bear the costs of production $c q_k$ already today, he will receive the expected transfer $\Lambda_k \beta R(q_k)$ only in the following period which is therefore
discounted by $\delta_E$. The exporter wants to extract the maximum possible transfer from the importer and he will set $\beta$ such that $(IC^\Omega_k)$ binds with equality, i.e. $\beta = \beta^\Omega$. The unconstrained maximization problem of the exporter for transaction $k$ of an export relationship thus is:

$$\max_{q_k} \delta_E \Lambda_k \beta^\Omega R(q_k) - cq_k$$

The FOC to this problem can be written as:

$$R'(q_k) = \frac{c}{\delta_E \Lambda_k \beta^\Omega},$$

implying that the producer’s optimal export quantity under OA, $Q^\Omega_k$, depends on his belief $\theta_k$ and is increasing in $k$ (since the probability of payment $\Lambda_k$ is increasing in $k$). We can write the expected exporter payoff from an open account transaction in period $k$ of the export relationship as:

$$\pi^\Omega_k \equiv \pi^\Omega(\theta^\Omega_k) = \delta_E \Lambda_k \beta^\Omega R(Q^\Omega_k) - cQ^\Omega_k.$$  \hspace{1cm} (3)

Observe that with the export relationship growing mature, the probability of payment $\Lambda_k$ converges to one. The exported quantity therefore also converges to a limit value that we denote by $Q^\Omega$. We denote the payoffs that the exporter receives at this limit as:

$$\pi^\Omega \equiv \pi^\Omega(\theta^\Omega_k = 0) = \delta_E \beta^\Omega R(Q^\Omega) - cQ^\Omega.$$  \hspace{1cm} (3)

The following Proposition summarizes our findings on the open account equilibrium.

**Proposition 2.** Suppose only open account payments are possible. The exporter starts a partnership whenever he finds a match, maintains the partnership as long as he does not observe a default, and exports $Q^\Omega_k$ in the $k$-th period of any active partnership. A myopic importer deviates from the contract whenever she has the opportunity. A patient importer never defaults. Both types never terminate a partnership. This strategy profile together with the belief updating rule $\theta^\Omega_k$ is a sequential equilibrium.

**3.3 Comparing the payment contract equilibria**

There are several noteworthy differences between export relationships with CIA and OA payment contracts. First, while learning about the importer’s type under CIA is immediate (see updating rule $\theta^A_k$) information acquisition under OA is only gradual (see $\theta^\Omega_k$). The reason is that while the exporter can design the CIA contract to only
attract patient importers, OA necessarily involves pooling which makes it necessary for patient importers to build up a reputation for reliability.

Second, since under CIA there is no risk involved in any transaction for the exporter (since payment is made before production) he will export the ex-post optimal quantity $Q^A$ starting with the very first transaction. In contrast, under OA the export decision is risky because payment takes place after production. Additionally, since the exporter can only use pooling contracts the optimal export quantity $Q_k^\Omega$ is adjusted by the importer’s reputation of being a patient type and therefore increases gradually over time (up to $Q^\Omega$, for $k \to \infty$).

The first two points together imply the following for the exporter’s expected payoff. Given that he is matched to a patient type, under CIA the payoff will after the initial period immediately jump from $\pi_0^A$ to the maximum $\pi^A$. Under OA, it will starting from $\pi_0^\Omega$ increase gradually in the course of the relationship up to the maximum $\pi^\Omega$.

4 Dynamic selection of payment contracts

In this section we relax the restriction to one specific payment contract and allow the exporter to freely choose in every period $k$ of the export relationship whether to employ CIA or OA. At the Contracting stage of every period $t$ the exporter thus decides on an element $F_t \in \mathcal{F} = \{CIA, OA\}$. Essentially, we explore how the exporter decides between the CIA and OA equilibrium derived in Propositions 1 and 2 and how this choice varies over time, as beliefs about the matched importer evolve.

For both payment formats the expected exporter stage game payoff is highest with all uncertainty about the importer’s patience being resolved, i.e. when the exporter is certain to be facing a patient type. This is the case when $\theta_k^A = 0$ and $\theta_k^\Omega = 0$, respectively. Comparison of the related payoffs in equations (2) and (3) suggests that $\pi^\Omega \geq \pi^A$ whenever $\beta^\Omega \delta_E \geq \delta_I$, and $\pi^\Omega \leq \pi^A$ otherwise. In the main text, we focus on the scenario where under complete information OA is more profitable than CIA, i.e. the case where $\beta^\Omega \delta_E > \delta_I$. We thus capture the scenario where $\delta_E > \delta_I$, i.e. the exporter has relatively low costs of capital while the importer faces relatively high costs of capital. From a modeling perspective, this case is particularly interesting because while OA is not learning-optimal for the exporter it gives him the largest long-run payoffs. In the Appendix, we also briefly discuss the reverse situation.
4.1 Main result

The comparison of the two payment contracts in section 3.3 hints at the latent trade-off in the design of the dynamically optimal series of spot contracts between acquiring information about the importer and using the payment contract that promises the largest spot payoff. In this section we study how the exporter should optimally design the series of spot export contracts, i.e. how he should over time select between the two possible payment contracts in the form of the two equilibria derived in Propositions 1 and 2. To keep the analysis tractable, we assume that the exporter has to decide for one specific payment contract and cannot propose a whole menu of contracts to the importer.

In order to understand payment contract selection it is important to observe that i) open account is maximizing the exporter’s payoff under full information, i.e. \( \bar{\pi}^\Omega > \bar{\pi}^A \), ii) for each payment contract the exporter’s payoff is maximal under full information, and iii) learning the importer’s type under CIA is immediate. The three points together imply that if a CIA transaction is successfully conducted any further transaction with this importer will be on OA and involve export quantity \( Q^\Omega \) and exporter payoffs \( \bar{\pi}^\Omega \).

With this in mind, let us assume that the importer’s type has not yet been learned, i.e. OA has been played up to period \( k \) of the relationship. In choosing the transaction’s payment contract the exporter has to decide whether he wants to learn the true type of the importer today (through switching to CIA for the current transaction) or whether to continue with the OA format, at least until the following period \( k + 1 \) in which he can reconsider. Formally, the exporter will conduct the \( k \)th transaction through open account if and only if

\[
\bar{\pi}^\Omega_k + \delta_E \pi^A(\theta^\Omega_k) + \frac{\delta^2_E}{1 - \delta_E} \bar{\pi}^\Omega \geq \pi^A(\theta^\Omega_{k+1}) + \frac{\delta^2_E}{1 - \delta_E} \bar{\pi}^\Omega,
\]

where \( \pi^A(\theta^\Omega_k) \) and \( \pi^A(\theta^\Omega_{k+1}) \) denote the exporter’s expected payoffs under CIA for beliefs \( \theta^\Omega_k \) and \( \theta^\Omega_{k+1} \), respectively, that are derived from the open account updating rule. Using this expression we obtain the following Proposition.

**Proposition 3.** Suppose that \( \delta_E > \frac{\underline{\beta}}{\bar{\beta}} \), i.e. OA is payoff-maximal with perfect information about the importer’s type. Also suppose that \( \theta_0 \geq \frac{cAQ^\Omega}{\delta_E \pi^A} \equiv \theta_0 \), i.e. Lemma 1 holds. Consider the \( k \)th transaction in an export relationship. The exporter will conduct this transaction through Open Account if and only if

\[
\bar{\pi}^\Omega_k - \pi^A(\theta^\Omega_k) \geq \delta_E \left[ \bar{\pi}^\Omega - \pi^A(\theta^\Omega_{k+1}) \right]
\]
and ask for Cash in Advance otherwise.

The inequality in (5) is obtained from rearranging (4) and provides a necessary and sufficient condition whether any transaction of an export relationship is conducted through either CIA or OA. Intuitively, it states that OA will be chosen for the current transaction if today’s payoff gain from choosing OA instead of CIA is larger than tomorrow’s payoff gain from OA when using the more screening-efficient CIA contract today. Note, that expression (5) is always fulfilled when the importer’s type has been revealed in the past, e.g. when a CIA has been conducted. I provide a more extensive discussion of the result in the following subsection.

4.2 Discussion

The results up to now are formulated fairly generally and to make their discussion illustrative we make an additional but unrestrictive assumption for the revenue function. We let \( R(q) = \frac{q^1 - \alpha}{1 - \alpha} \), where the parameter \( \alpha \), with \( 0 < \alpha < 1 \), determines the concavity level of the revenue function. Note that this function captures all the properties that we had assumed in (1) and is general enough to capture arbitrary levels of concavity. This functional form allows us to obtain simple expressions for many of the previously derived results. Importantly for the discussion of Proposition 3, \( \pi_k^\Omega = \Lambda_k^\alpha \pi^\Omega \) and \( \pi^\Omega = \left( \frac{\delta E \beta^\Omega}{\delta I} \right) \frac{1}{\alpha} \pi^A \). With \( \Lambda_k' = 1 - \theta_k'(1 - \lambda) \) we denote the probability of payment for some belief \( \theta_k' \). The expressions allow us to rewrite (5) as:

\[
I(\theta_k', \lambda, \delta_I, \delta_E, \alpha, \gamma) \equiv \Lambda_k^\frac{1}{\alpha} - \delta_E + \left( \frac{\delta I}{\delta E \beta^\Omega} \right) \frac{1}{\alpha} \left( \delta E - \Lambda_k' \right) \frac{1 - \theta_k'}{\Lambda_k} \geq 0,
\]

which determines whether the \( k \)th transaction of an export relationship is conducted via OA (if \( I > 0 \)) or via CIA (if \( I < 0 \)). Observe that in \( I(\cdot) \) the variables \( \lambda, \delta_I, \delta_E, \alpha \) and \( \gamma \) are all constants for a given export relationship. Within a relationship the value of \( I(\cdot) \) only changes with the belief \( \theta_k' \) of facing a myopic importer. This belief can be characterized as:

\[
\theta_k' = \begin{cases} 
\theta_k^\Omega & \text{if } I > 0 \text{ for all previous transactions, or when } k = 0, \\
0 & \text{if } I < 0 \text{ in some previous transaction.}
\end{cases}
\]

Note also, that the expression for the minimal initial belief of facing a myopic type from Lemma 1 that is necessary for equilibrium existence simplifies to \( \theta_0 = \frac{1 - \alpha}{\delta E \alpha} \).

The predictions of Proposition 3 in the form of expressions (6) and (7) are best explained by making use of their graphical representations in Figure 2. The subfigures (a) and (b) show for all possible combinations of initial belief \( \theta_0 \) and contract
enforceability in Foreign $\lambda$ which payment contract will be used in the initial and 
(conditional on continuation) in the subsequent period of the export relationship, 
respectively.

First, consider the left panel of Figure 2 where agents are in their initial period of 
interaction, i.e. $k = 0$. The increasing and concave line represents all those points 
where the exporter is indifferent between the use of a CIA and an OA payment 
contract, i.e. $I = 0$. For all parameter combinations in the blue-shaded area the 
exporter prefers CIA in the initial period, i.e. $I < 0$, while OA is preferred above the 
indifference line, i.e. $I > 0$. Note that for initial beliefs left from the dashed line at $\theta_0$ we cannot make predictions since these are not covered by the CIA equilibrium.

The plot predicts, that exports to countries with higher contract enforceability 
are more likely to start out with OA from the beginning compared to countries 
with lower contract enforceability. Furthermore, the higher the share of unreliable 
importers in the population of importers the more likely it is that CIA is used initially. These predictions are implied by the increasing, concave form of the $I = 0$ 
-contour line. I have conducted this plotting exercise for a large variety of model 
parametrizations and this shape was robust over all of them. Analytical proof seems 
impossible since the function is only implicit and highly non-linear. I am however 
confident that this pattern generalizes and the following discussions are done under 
this conjecture.

Next, consider the right panel of Figure 2, where agents are in the second period 
of interaction, i.e. $k = 1$. The updating rule $\theta_k'$ prescribes that exporters who played
CIA initially are, given continuation, sure in $k = 1$ to be facing a patient type and choose OA because under full information $\pi^\Omega > \pi^A$. In addition, because of the concave and increasing shape of the payment contract indifference line all exporters who played OA already in the initial period continue playing OA. This is because their belief is updated to $\theta'_1 = \theta_1^\Omega$ which represents a horizontal shift to the left in the Figure.

In sum, Proposition 3 predicts that if the exporter faces lower costs of capital than the importer CIA contracts can act as a useful tool in the initial phase of export relationships. This is particularly pronounced so when the quality of legal institutions in the destination country is low and the probability of facing unreliable importers is high. Once an importer has build up a reputation for being reliable OA contracts will be used across all destination markets. In the following section, we will study how this result is enriched when exporters have the possibility to ensure the payment in their open account transactions.

5 Trade credit insurance

With a trade credit insurance (CI) the exporter can rule out the risk of importer non-payment in an open account transaction. For its service, the insurer charges a per-transaction fee that we denote by $F_k$. We assume a perfectly competitive insurance market and that the fee can be separated into a fixed and a variable component. It is given by

$$ F_k = m + \delta_E (1 - \Lambda_k^CI)T_k, $$

where the fixed (and time-invariant) component $m$ covers setup and monitoring costs that the bank incurs for insuring the transaction. The second addend represents the variable component that depends on the size of the insured transfer in period $k$, $T_k$, which is weighted by the probability of nonpayment $1 - \Lambda_k^CI$, where $\Lambda_k^CI$ denotes the probability of payment in the $k$th period under insurance.\(^5\) Finally, because potential payment default occurs only in $t + 1$ the variable component is discounted by one period.\(^6\)

Because the insurer has a vital interest that the importer does not default it will

---

\(^5\)The formalization of the insurance fee is inspired by Schmidt-Eisenlohr and Niepmann (2016), in particular by their model of the letter of credit contract. However, they do not study this contract in a dynamic setting.

\(^6\)For the discounting we use the exporter’s discount factor. It would be more appropriate to use the insurer’s own time preference rate here. Because this difference is not of central importance for the study of the exporter’s insurance decision we abstract from this complicating detail here.
engage in importer screening itself before granting a credit insurance.\textsuperscript{7} We model this aspect by assuming that starting an export relationship with a trade credit insurance decreases the proportion of myopic types in the population to $\hat{\theta}^{CI} = \phi \hat{\theta}$, where $\phi \in (0, 1)$ is an inverse measure of the insurer’s ability to screen out myopic types.

The remainder of the section is structured as follows. In section 5.1 we study export relationships when the exporter can only choose insured open account as payment contract. The results bear much resemblance with the open account case in section 3.2. In part 5.2 we then study how trade credit insurance interacts with the non-intermediated payment contracts. It thus complements the analysis from section 4. Finally, in section 5.3 we conduct comparative static exercises.

### 5.1 Insured payment contracts in isolation

We now study the export relationship when restricted to credit insured payment contracts. In order to achieve comparability of results we derive an equilibrium that is based on the same strategy profile as in the open account scenario in section 3.2.

The participation constraints of the importers are the same as in the open account scenario. Also, the payment incentive constraint for the patient importer is the same as under open account. The exporter therefore asks the importer to transfer the revenue share $T_k = \beta^\Omega R(q_k)$. The exporter thus maximizes in period $t$:

$$\max_{q_t} \delta E \beta^\Omega R(q_t) - cq_t - F_t,$$

which by plugging in $F_t$ can be rewritten as

$$\max_{q_t} \delta E A^{CI}_k \beta^\Omega R(q_t) - cq_t - m.$$  

Observe that even though the CI eliminates the risk of non-payment the probability of payment $A^{CI}_k$ still indirectly affects the exporter’s maximization problem through the LC-fee. This can be nicely seen when rewriting (9) to (10). For the calculation of $A^{CI}_k$ the same mechanics as for the calculation of $A_k$ under open account apply. However, as described above the exporter believes to initially face a myopic type with smaller probability $\hat{\theta}^{CI}$ and the belief of facing a myopic type in period $k$ is

\textsuperscript{7}This assumption is endorsed by the fact that credit insurers such as Euler Hermes and AIG advertise their insurance services with their expertise in monitoring the reliability of transaction counterparts.
determined via Bayes’ rule as:

$$\theta_k^{CI} = \frac{\hat{\theta}^{CI} \lambda^k}{1 - \hat{\theta}^{CI}(1 - \lambda^k)}.$$ 

Consequently, the probability of payment in the \(k\)th relationship period under CI is

$$\Lambda_k^{CI} = \frac{1 - \hat{\theta}^{CI}(1 - \lambda^{k+1})}{1 - \hat{\theta}^{CI}(1 - \lambda^k)}.$$ 

With this in mind we can solve the maximization problem in (10). The FOC is:

$$R'(q_t) = \frac{c}{\delta E A_k^{CI} \beta \Omega},$$

and we denote the resulting, optimal export quantity as \(Q_k^{CI}\). The payoff in a CI relationship in the \(k\)th transaction then is

$$\pi_k^{CI} \equiv \pi^{CI}(\theta_k^{CI}) = \delta E A_k^{CI} \beta \Omega R(Q_k^{CI}) - cQ_k^{CI} - m. \quad (11)$$

The following Proposition summarizes our findings on the letter of credit equilibrium.

**Proposition 4.** Suppose only credit insured open account payment contracts are possible. The exporter starts a partnership whenever he finds a match, maintains the partnership as long as he does not observe a default, and exports \(Q_k^{CI}\) in the \(k\)-th period of any active partnership. A myopic importer deviates from the contract whenever she has the opportunity. A patient importer never defaults. Both types never terminate a partnership. This strategy profile together with the belief updating rule \(\theta_k^{CI}\) is a sequential equilibrium.

When all uncertainty about the importer’s type is resolved, equation (11) can be written as

$$\bar{\pi}^{CI} \equiv \pi^{CI}(\theta_k^{CI} = 0) = \delta E \beta \Omega R(Q^\Omega) - cQ^\Omega - m = \bar{\pi}^\Omega - m$$

which shows that \(\bar{\pi}^\Omega > \bar{\pi}^{CI}\). This gives the following Corollary.

**Corollary 1.** Under complete information, insured open account payment contracts are strictly dominated by non-insured open account contracts.

The corollary hints at a result that we will derive in the following when studying the interaction of credit insurances with the other contract forms: Once the exporter attains enough information about the importer’s type it will be better for him to conduct his transactions through open account instead of insuring it.
5.2 When to employ trade credit insurance

In this section, we study the payment contract decision when the choice set now also includes the possibility to insure the OA transaction. We denote the extended choice set by \( C \equiv \{CIA, OA, CI\} \). Because of the independence axiom from expected utility theory we can analyze the payment contract decision in two separate cases:
i) We study under which conditions CI is preferred to OA (and vice versa) given that OA is preferred to CIA, i.e. expression (5) holds.

ii) We study under which conditions CI is preferred to CIA (and vice versa) given that CIA is preferred to OA, i.e. expression (5) does not hold.

First, consider case i) and let us determine under which conditions we will choose CI instead of OA. The respective belief updating rules \( \theta^C_{CI} \) and \( \theta^C_{\Omega} \) are very similar. Their only difference is that the prior probability of being matched with a myopic type under CI is downsized by the factor \( \phi \). Note that we can write the belief under OA for period \( k+1 \) as \( \theta^C_{\Omega,k+1} = \frac{\theta^C_{\Omega,k} \lambda}{1 - \theta^C_{\Omega,k} (1 - \lambda)} \) and that this is an increasing and strictly convex function of \( \theta^C_{\Omega,k} \). As a consequence, given (5), the incentives to employ a credit insured contract are always largest in the initial period of interaction because the exporter’s learning effect through the screening activity of the insurer is largest.

Hence, whenever CI is employed instead of OA it will for sure be employed in the initial interaction. Note also, that since the learning about the importer through insurer screening is permanent, the exporter will not employ CI for more than the initial period.\(^8\) Consequently, the exporter decides for a credit insurance in an export relationship if and only if the payoffs from using a CI in the initial period and OA forever after are larger than the payoffs obtained from using OA in every period. Formally,

\[
\pi^C_{CI,0} + \sum_{k=1}^{\infty} \delta^k \pi^C_{\Omega} (\theta^C_{CI,k}) > \sum_{k=0}^{\infty} \delta^k \pi^C_{\Omega} (\theta^C_{\Omega,k}).
\]

This expression can be rearranged to:

\[
\sum_{k=0}^{\infty} \delta^k [\pi^C_{\Omega} (\theta^C_{CI,k}) - \pi^C_{\Omega} (\theta^C_{\Omega,k})] > m,
\]

which intuitively means that CI is employed (and only so in the initial period) if the continued benefits from importer screening through the insurer are larger than the fixed costs of the one-period insurance contract \( m \).

Next, consider case ii) and let us determine under which conditions we will choose CI instead of CIA. The problem simplifies by recognizing that after one period of

\(^8\)This is implied by our assumption of only two types of importers and that their type is constant.
CI it is dominated by OA. In addition, switching from CIA to CI is never profitable because the exporter will have complete knowledge of the importer type after the first CIA transaction (which leads to OA by Corollary 1). Hence, if the exporter uses CI in the present scenario he will do it only in the initial transaction. CI is preferred to CIA in the initial period if and only if:

$$\pi_{CI}^{0} + \delta_{E}^{2} A(\theta_{1}^{CI}) + \frac{\delta_{E}^{2}}{1 - \delta_{E}} A^{0} \geq \pi_{A}(\theta_{n}) + \frac{\delta_{E}}{1 - \delta_{E}} A^{0}.$$ 

The equation can be simplified to:

$$\pi_{CI}^{0} > \pi_{A}(\theta_{0}^{0})$$ (13)

The following Proposition gives a complete summary for every period and beliefs in the export relationship which payment contract will be used:

**Proposition 5.** An exporter will consider to conduct a transaction through credit insurance only if in the initial period of an export relationship. This transaction will be conducted with CI if and only if either of the following is true:

- a) (5) holds and (12) holds, or
- b) (5) does not hold and (13) holds.

All later periods of the export relationship are captured entirely through expression (5).

Because it is more illustrative, in analogy to section 4.2, we conduct the discussion of the results for the case of a parameterized revenue function. The following Corollary restates the differences in Proposition 5 when using the revenue function from before.

**Corollary 2.** Suppose that \( R(q) = q^{1-\alpha} \). Then the exporter conducts the initial transaction with CI if and only if either of the following is true:

- a) \( I > 0 \) holds and \( J \equiv \sum_{k=0}^{\infty} \delta^{k} \left[ (\Lambda_{k}^{CI})^{\frac{1}{\alpha}} - (\Lambda_{k})^{\frac{1}{\alpha}} \right] - \kappa > 0 \), or
- b) \( I < 0 \) and \( K \equiv (\Lambda_{0}^{CI})^{\frac{1}{\alpha}} - \delta_{E} - \kappa + \left( \frac{\delta_{E}^{2}}{\pi_{E}^{\alpha}} \right)^{\frac{1}{\alpha}} \left[ \delta_{E}(1 - \theta_{1}^{CI}) - (1 - \theta_{n}^{0}) \right] > 0 \) holds.\(^9\)

\(^9\)Without loss of generality we define and use \( m \equiv \kappa \pi_{E}^{\alpha}, \kappa > 0, \) since \( \pi_{E} = (\delta_{E}\beta)^{\frac{2}{\alpha}} e^{\frac{\pi_{E}}{1-\alpha}} \) is a constant.
The implications of the Corollary are best studied the graphs in Figure 3. For the same parameter values that we also use in Figure 2, sub-figures (a) and (b) show for all possible combinations of initial belief $\theta_0$ and contract enforceability in Foreign $\lambda$ which payment contract will be used in the initial and (conditional on continuation) in the second period of the export relationship, respectively.

![Figure 3: Payment contract choice over time (parameterization: $\delta_I = .6, \delta_E = .85, \alpha = .8, \gamma = .3, \phi = .65, \kappa = .14$)](image)

First, consider the left panel in Figure 3 where agents are in the initial period of interaction. As in Figure 2 the blue line represents the contour line where $I = 0$ and the exporter is indifferent between OA and CIA. For the area above this line, part a) of the Corollary applies and if $J > 0$ CI will be chosen (the orange area denoted by $CI_2$ in the graph), while OA is preferred otherwise.\(^{10}\) On the other hand, consider the area below the blue line where part b) of the Corollary applies. Then CI will be chosen whenever $K > 0$ holds (the orange area denoted by $CI_1$ in the graph) and CIA otherwise. Note from the graph that exporters’ credit insurance usage is particularly pronounced for an intermediate range of contract enforceability. This pattern emerges for many parameterizations and how it changes is discussed in the following comparative statics section in more detail.

Next, consider the right panel of Figure 3 where agents are in the second period of interaction. For those parameters where CIA was played initially, by the same logic as in section 4.2, OA will be played for sure. For those parameter combinations resulting in the area $CI_2$ in the left panel we will surely move into OA in $k = 1$ since

---

\(^{10}\)For the contour line at $J = 0$ the infinite sum in part a) of the Corollary was numerically approximated for the given parameter values.
for the previously discussed reasons no further value can be attained from continuing to insure the transaction. The behavior of exporters starting a relationship in area Cl₁ is more intricate. Surely, they will not engage in Cl anymore for the same reasons as in the first case. However, depending on the belief \( \theta_{CI}^{Cl₁} \), they might either conduct the transaction through OA or CIA. If OA is employed the exporter will continue to use OA for any subsequent period since the \((I = 0)\)-contour line is increasing and concave. If CIA is used then the exporter will switch to OA from \( k = 2 \) onwards. Generally, we can conclude that for any combination of parameters a transaction will be conducted via open account for \( k \geq 2 \).

To sum up, Proposition 5 predicts that trade credit insurances can act as a valuable tool in the initial phase of export relationships when the importer’s expected reliability is low. The graphs in Figure 3 (as well as the robustness-checks in the following subsection) suggest that the usage of credit insurances is particularly pronounced for intermediate qualities of contracting institutions. An intuitive rationalization for this pattern is that credit insurance is particularly attractive when, on the one side, insurance is not too expensive. It could be too costly because of the high risk of expropriation at low values of \( \lambda \). On the other side, its value is potentially marginalized when facing strong legal institutions at high \( \lambda \). Empirically, this pattern finds traction through the results by Schmidt-Eisenlohr and Niepmann (2016) who report for the U.S. that letter of credit insurances matter most for exports to countries with intermediate levels of risk.¹¹ The analysis shows that while exporters can initially benefit from the insurer’s screening abilities once importers have build up a reputation for reliability, behavior will converge towards OA that in the medium- and long-run yields the largest flow payoffs.

5.3 Comparative statics

To gain some intuition on how the payment contract choice varies with parameter values, Figures 4 and 5 depict how the left panel of Figure 3 differs when conducting ceteris paribus changes on selected parameters. The exercise confirms the pattern that the usage of credit insurances is particularly pronounced at low levels of expected importer reliability and intermediate levels of institutional quality.

Figure 4 considers changes in the costs and quality of the trade credit insurance. The left panel shows that the range of parameters where CI is used is reduced when the insurance contract becomes more expensive through an increase in the fixed

¹¹Letters of credit have a similar insurance effect for the exporter when compared to trade credit insurances. The major difference is that letters of credit are typically issued by the importer’s bank while trade credit insurances do not necessarily have a bank involvement.
costs parameter $\kappa$. The usage of insurances now is strongly restricted to high levels of $\theta$ and intermediate levels of $\lambda$. A very similar pattern emerges when the insurer’s ability to screen out the myopic types declines as can be seen in the right panel of the figure. Figure 5 then considers an increase in market demand as well as a variation in the exporter’s costs of capital. Both scenarios confirm the highlighted pattern.

Figure 4: Ceteris paribus parameter changes to Figure 3 as indicated ($k = 0$)

Figure 5: Ceteris paribus parameter changes to Figure 3 as indicated ($k = 0$)
6 Conclusion

In this paper, I have developed a dynamic model of payment contract choice in international trade where an exporter is challenged to choose the optimal form of trade finance in a sequence of export transactions. In doing so, he has to find the optimal balance between acquiring information about the quality of a potentially unreliable importer and handling the costs of capital and risk profiles of different payment contracts – a trade-off novel to the literature on payment contracts in international trade. To the best of my knowledge this is also the first study to incorporate trade credit insurances into a dynamic model of payment contract choice.

The model can be extended in various directions. For example, I have focused on the case where all decision power on the payment contract is focused on the exporter. While this may be a plausible assumption for situations where a large exporter can absorb all of the bargaining power on his side, other situations may come to mind in which importers have decisive influence. However, this does not impair the importance of the paper’s main result that gives guidance on how to choose a payment contract that manages the potentially differing costs of capital between the contracting parties efficiently.

A central challenge for further research is the collection of data that can be used to discipline the predictions of a dynamic model of payment contract choice. Calibration of my model would require data that offers matched transaction-level information on the payment contracts that firms use in their export activities. Currently, such data is unavailable for a representative sample. Antràs and Foley (2015) use highly detailed panel data to study payment contract choice over time, however it only covers one single exporter firm. This leaves plenty of scope for further investigations.

References


APPENDIX

Proof of Lemma 1

At the Production and Shipment stage of any period $k$ of any export relationship the exporter will not deviate from the contract if and only if:

$$-cQ^A + \frac{\delta_E}{1 - \delta_E} \pi^A \geq (1 - \lambda^*) \left( \delta_E \pi^A_0 + \frac{\delta_E^2}{1 - \delta_E} \pi^A \right) + \lambda^* \left( -cQ^A + \frac{\delta_E}{1 - \delta_E} \pi^A \right)$$

Equation (14) states that making the effort to produce the contracted output plus the future payoff from continuing the current export relationship (where the exporter can be sure to interact with a patient type) must result in a higher payoff than deviating by not producing and shipping the agreed quantity $Q^A$. Note that deviation is
possible only if contracts cannot be enforced which happens with probability $1 - \lambda^*$. Simplification of (14) gives:

$$\delta_E \geq \frac{cQ^A}{\theta_0 \pi^A} = \delta_E$$

(15)

Observe that the equilibrium does exist if and only if $\delta_E < 1$. Consequently, a necessary and sufficient condition for existence is $\theta_0 > \frac{cQ^A}{\pi^A}$.

Observe that the proof holds for every relationship period and not only for $k = 0$ because deviation implies re-matching. This is the case, because the importer anticipates to again not receive the goods in the following transaction with again leads to a loss for her. It is therefore better for her to terminate the relationship. Hence, the exporter must re-match.

**Proof of Lemma 2**

At the Payment stage of any period $t + 1$ it is incentive compatible for the patient importer to transfer the contracted share $\beta$ of the revenue $R(q_t)$ if and only if:

$$\delta E \geq \frac{cQ^A}{\theta_0 \pi^A} \equiv \delta_E$$

(15)

Observe that the equilibrium does exist if and only if $\delta_E < 1$. Consequently, a necessary and sufficient condition for existence is $\theta_0 > \frac{cQ^A}{\pi^A}$.

Observe that the proof holds for every relationship period and not only for $k = 0$ because deviation implies re-matching. This is the case, because the importer anticipates to again not receive the goods in the following transaction with again leads to a loss for her. It is therefore better for her to terminate the relationship. Hence, the exporter must re-match.

**Proof of Lemma 2**

At the Payment stage of any period $t + 1$ it is incentive compatible for the patient importer to transfer the contracted share $\beta$ of the revenue $R(q_t)$ if and only if:

$$-\beta R(q_t) + (1 - \beta) \sum_{k=t+1}^{\infty} \delta_k^{k-t} R(q_k) \geq \lambda \left( -\beta R(q_t) + (1 - \beta) \sum_{k=t+1}^{\infty} \delta_k^{k-t} R(q_k) \right) - (1 - \lambda) \gamma R(q_t)$$

Simplifying gives:

$$\left(1 - \beta\right) \sum_{k=t+1}^{\infty} \delta_k^{k-t} R(q_k) \geq (\beta - \gamma) R(q_t)$$

(16)

Note, that $\Lambda_k \to 1$ for $k \to \infty$ which implies that the optimal export quantity $Q_k^\Omega$ under open account and therefore revenue $R(Q_k^\Omega)$ are increasing with relationship duration $k$. This observation allows us to derive a simple expression for the incentive compatible transfer share $\beta$ from (16). Observe that the deviation incentive is largest in the limit (for relationship length $k \to \infty$) and denote the associated export quantity by $Q_k^\Omega$. We can rewrite the IC-constraint to:

$$t \to \infty : \quad (1 - \beta) \frac{\delta_l}{1 - \delta_l} R(Q_l^\Omega) \geq (\beta - \gamma) R(Q_l^\Omega) \iff \beta \leq \delta_l + \gamma (1 - \delta_l) \quad (IC_l^\Omega)$$

If (IC_l^\Omega) holds, the patient importer will never deviate from the contract no matter how large the exported volume under open account.
When the importer is more patient than the exporter

Noting that CIA now leads to larger flow payoffs than OA under full information we can derive by steps analogue to the main text a result equivalent to Proposition 3 but which now covers the case when $\delta_I > \delta_E \beta^\Omega$. This yields:

**Proposition 3’**. Suppose that $\delta_I > \delta_E \beta^\Omega$. Consider the $k$th transaction in an export relationship. The exporter will conduct this transaction through Open Account if and only if

$$\pi^\Omega_k - \pi^A(\theta^\Omega_k) \geq \delta_E \left[ \pi^A - \pi^A(\theta^\Omega_{k+1}) \right] \quad (17)$$

and ask for Cash in Advance otherwise.

The result gives the following behavioral predictions. Suppose that parameters are such that the initial transaction of the export relationship is conducted through CIA, i.e. expression (17) does not hold. Then any subsequent transaction with the same importer will be conducted through CIA as well since $\pi^A > \pi^\Omega$. Therefore no switching between contracts occurs. On the other side, suppose that OA is played initially which can be the case when $\pi^\Omega_0 > \pi^A_0$ (and additionally, (17) holds). However, because $\pi^A > \pi^\Omega$ it must be the case that in some $k$ behavior will switches to CIA and then stays there forever.