

Banks in International Trade: Incomplete International Contract Enforcement and Reputation*

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Abstract

Banks are important facilitators of international trade. Besides providing liquidity they guarantee payment for around a fifth of world trade, in particular when the contract enforcement of the importing country is weak.

But if contract enforcement is too weak to trust the payment of an importer, why trust the importer's bank? I argue that reputational mechanisms can provide the answer. Weak contract enforcement introduces a limited-enforcement problem – an importer can renege on payment after receipt of the shipment – which repeated interaction alleviates. For importers too infrequently engaged in international trade to establish a credible reputation, a bank can increase credibility by guaranteeing multiple importers, but only if exporters can collectively punish the bank should it renege on one of them. Mutually confirmed bank guarantees overcome the need for collective punishment and further increase credibility as bilateral claims between banks reduce the net amount to be reneged on. In effect, mutually confirmed guarantees partially transform international obligations into domestic obligations, which are more easily enforced.

While this paper focuses on banks, reputational mechanisms can also shed light on both large intermediaries and export credit agencies.

JEL codes: C73, F19, G21, L11, L14

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1 Introduction

Banks are important facilitators of international trade. Besides providing liquidity they guarantee payment for around a fifth of world trade. As argued by Rodrik (2000) and Rauch (2001), international contract enforcement is weak and bank guarantees provide a way of ensuring trade, especially when local courts are unable or unwilling to enforce payment from importers. This paper asks why banks can perform this role and argues that reputation is crucial. Though the paper is not the first to formalize incomplete international contract enforcement, it emphasizes reputation as an important mechanism for overcoming this and argues that banks – and other large entities in international trade – can be viewed as mechanisms for establishing credibility through reputation.

I develop a dynamic model with repeated interaction between exogenously matched buyers and sellers in a world in which contracts between international parties cannot be perfectly enforced and analyze the role of reputation as a substitute for formal enforcement of contracts. With imperfect contract enforcement, the importer can refuse payment, but the resulting loss of future cooperation serves as an incentive for honest behavior. This incentive is of little value to firms engaging infrequently in international trade or frequently with new partners. I show that for such importers credibility of payment can be established through the introduction of a bank that *sequentially* guarantees payment to exporters on behalf of multiple importers but only if exporters can collectively observe and punish deviations against any one of them. This assumption can be dropped by having a local bank in the exporters' country confirm the guarantees. The introduction of two banks mutually confirming each other guarantees further introduces the possibility of "netting": with mutual obligations, the banks can at most renege on the net amount outstanding, and credibility is further increased. Besides answering the question of *how* banks can provide guarantees by establishing higher credibility through size, the model answers the question of *why* banks (as opposed to other large entities) provide these guarantees, by arguing that enforcement of the contract with the importer is best achieved by a bank already engaged in monitoring that importer. At the same time it argues that banks are poor guarantors of proper quality on behalf of exporters and argue that large non-financial intermediaries (trading companies) can provide this role through similar mechanisms; they arise to ensure credibility of honest behavior where individual firms are unable to do so.

The model replicates the most salient features of the industry for bank guarantees: it is highly concentrated, the providers of guarantees are predominantly local banks, banks engaged in long standing relationships confirm each other's guarantees, and the demand for such guarantees can increase during times of uncertainty. It further shows that a small change in the confidence in the guaranteeing bank can lead to discontinuous changes in its credibility for issuing guarantees. This is in line with observations from the Asian crisis in the 1990s when banks in affected countries quickly lost credibility. The model conceptually separates

banks' roles as providers of liquidity and guarantees and focuses primarily on guarantees. It is, however, demonstrated that the two are naturally bundled together consistent with actual practice. A financial crises can affect trade through both banks' provision of liquidity and their credibility in guaranteeing trade.

The model further demonstrates how the relative importance of reputations is higher for countries with weaker contract enforcement and for specialized goods. This is consistent with empirical evidence. For instance, Rauch and Trindade (2002) find that these are the types of goods for which Chinese ethnic networks are most important. Collective punishment between members allows these networks to function as enforcement mechanisms such that reputation can substitute for legal enforcement.

Although banks' roles as providers of liquidity are important, the main focus of this paper is on their role as providers of guarantees, and the provision of liquidity is treated as an extension.

Clearly, guarantees can be analyzed only in a setting where contract enforcement is imperfect. To this end, the model analyzes a hold-up problem between an importer (a distributor) and an exporter (a producer) dealing on an open account basis: the exporter makes and ships the goods and bears the production cost, whereas the importer earns the revenue from selling the goods. The importer is required to pay only when she has the goods in hand, but once she does, she can refuse to pay and courts are only imperfectly able or willing to force her to do so. The exporter realizes this before shipment, and in a non-repeated framework the quantity of trade is constrained (analogous to under-investment in the model by Grossman and Hart (1986)).

There is widespread evidence that firms rely on relational contracts in order to ensure cooperation from their partners (Ellickson, 1991 and Kreps, 1996). In the context of international trade, Rauch and Trindade (2002) and Rauch (2001) argue that networks are important predictors of international trade, as the possible ostracization from the community gives an incentive for honest behavior. Antràs and Foley (2010) find that a large US exporter is more likely to trust buyers to pay after receipt of goods in the case of long-lasting relationships.

In the present paper, importers and exporters are exogenously matched, and the interaction is restricted to take place *every other* period. Simple trigger strategies allow them to achieve higher trade than for a non-repeated interaction, but the interaction is too infrequent to achieve the profit maximizing quantity. Though the model is framed in terms of infrequent trade, other interpretations such as a low discount factor or high turn-over rate are readily possible. The introduction of a bank that guarantees payment to exporters on behalf of multiple importers *every* period can increase credibility. Yet, this is not self-evident. In place of an agency problem between the importer and the exporter, the introduction of a bank creates two new agency problems: between the importer and the bank and between the bank and the exporter. The bank can provide guarantees only if both new relationships allow larger quantity of trade.

First, this suggests that the issuer of the guarantee should be a bank located in the country of the importer dealing with the importer in other respects, as this allows for better monitoring and thereby better enforcement. Second, the more frequent interaction with exporters enables the bank to establish a stronger reputation and thereby a higher cost of renegeing than each of the individual importers (who only rarely import) could individually. In effect the more frequent interaction works analogously to increasing the discount factor.

Direct guarantees to exporters, however, rely both on sufficient profit for the bank and the ability of exporters to collectively punish the bank by withholding future business should it renege on its obligations to one of them. Positive profits are necessary to introduce a cost from renegeing in terms of future profits, and collective punishment implies that all future profits are lost by renegeing in on period. I show that the underwriting of guarantees by an additional bank in the exporting country eliminates the need for collective punishment as the role of claimant on the importers' bank is now performed by a single agent: the exporters' bank. But this is not the only role an underwriting bank in the exporters' country serves: Bilateral trade implies that although large gross amounts might be outstanding the two countries banks, as both issuers of and underwriters of each others' guarantees, will hold mutual claims on each other, restricting default to the net amount. In effect, the mutual confirmation of guarantees transforms international obligations into domestic obligations, which are more easily enforced. This further increases the credibility of a bank guarantee, enabling the financial system to support substantial amounts of trade that would otherwise not have taken place.

In line with the work of Petersen and Rajan (1997), I show that considering the outside value of the goods to the exporter naturally leads to the distinction between trade credit – the extension of credit by a non-financial seller to a buyer – and trade finance – the provision of credit by a third party financial institution – and show how a shock to the financial sector will disproportionately affect those firms that rely *less* on trade credit and more on trade finance, in line with recent evidence.¹ I further demonstrate that small changes in the probability of a bank ceasing to exist can lead to discontinuities in their ability to guarantee imports, underlining the fragility of the banking system.

I extend the basic model underlining the importance of size and rent for the credibility of bank guarantees. First, I show that the introduction of competition in the market for issuing guarantees drives down profits and can reduce the credibility of bank guarantees and thereby reduce trade. Second, I consider pre-payment, an alternative method of non-bank mediated trade in which payment is done before shipment, and argue that this changes the agency issue from a risk of non-payment from importer to a risk of non-delivery or delivery of low quality

¹Although, there seems to be some occasional confusion trade credit and trade finance are distinct concepts. Trade credit is a well-defined term in the corporate finance literature, usually referring to the extension of credit by a seller to a buyer, and distinct from trade finance, which is the extension of credit by a third party financial institution.

goods by the exporter. As banks are inherently better at providing a payment than insuring the quality of a good, they are a poor substitute for pre-payment, but large intermediaries can serve a similar role. Through size they can establish a larger reputation and can credibly guarantee the shipment of high quality goods even when a single exporter cannot.

Reputation through size and the decremental effect of competition on profits and credibility both suggest a concentrated industry in which local banks provide guarantees, which is well in line with observed patterns in most countries.

Naturally, the paper relates to an emerging (mostly empirical) literature on whether trade finance was a prominent cause of the “trade collapse”. During the crisis world trade fell with around 30 per cent whereas domestic trade declined with only around 5 per cent (Baldwin, 2009) and rates on trade finance increased substantially. Besides providing a theoretical framework for analyzing bank intermediated trade this paper qualifies the question by arguing that international trade is crucially different in weaker enforcement of contracts and longer transportation time. The prediction is therefore not a uniform disproportionately larger drop in international trade (compared with domestic), but particularly for long-distance trade and trade to countries with poorer enforcement of contract. We should therefore not expect trade, say, within the European Union (short distances and relatively good contract enforcement) to differ substantially from domestic trade. This is in line with preliminary evidence.

This paper is related to two strands of the literature: the mostly historical literature on the establishment of private institutions to overcome poor formal contract enforcement (Greif, 1989, Greif, 1993, and Greif, 2006), and a large literature on financial contracting. Greif (1993) argues that Maghribi traders (A group of Jewish traders in the Mediterranean during the 11th century) were able to encourage honest behavior from their agents by collectively punishing agents by withholding future business, despite a lack of any formal enforcement. Milgrom *et al.* (1990) model medieval European trade where traders frequently interact in a market but only rarely with the same party and neither keeping informed about the past behavior of all actors nor binding legal enforcement are possible. They show that private adjudication (the law merchant) emerged as a means of efficient collection and dispersion of information about past behavior of traders, which helped sustain honest behavior. Although the mechanism here is different, the end-result is the same: private institutions – here a financial institution offering guarantees, in Milgrom *et al.* (1990) a law merchant providing information – create a reputation mechanism that would otherwise not have been present. Modern analogies can be found in the recent emergence and success of websites such as eBay and Amazon’s Marketplace, which facilitate transactions between individuals by providing information about users’ past behavior.²

²Amazon’s Marketplace further handles the shipment between buyer and seller, and Lewis (2010) emphasizes the role eBay Motors plays in reducing the disclosure costs of sellers, and by providing standard contracts. Similar services are provided by banks in international trade, but are not considered here.

The paper further relates to a large literature on financial contracting. Diamond (1984) first formally defined the “who monitors the monitor” problem of financial intermediaries, and argued that financing several (not perfectly correlated) projects, lowers the overall variance of the bank’s portfolio and thereby the enforcement costs of monitoring. In the present model, the banks’ engagement in numerous relationships is essential as well, although no uncertainty is required, and it is crucial that they are of a *sequential* and not *simultaneous* nature. Chemmanur and Fulghieri (1994) analyze the reputation of investment banks for properly assessing the “quality” of the shares that are sold through them. Although, the setup is very different, investment banks can provide a role only because they sequentially deal with multiple entrepreneurs just as in the present model. Petersen and Rajan (1997) and Ellingsen and Burkart (2004) analyze the choice between the extension of credit by suppliers (trade credit) and credit extended by banks and argue that suppliers’ superior ability to monitor the buyer and liquidate assets in case of non-payment can give rise to the dual existence of both types of credit. In Cuñat (2007) suppliers can have an advantage in that they can stop the supply of intermediate goods. The choice between bank - or supplier-monitored credit has a direct analogue in the present setting in the choice between using bank guarantees or not. Schmidt-Eisenlohr (2009) analyzes open account, pre-payment, and bank guarantees but are predominantly interested in the optimal choice between these. Ahn (2010) analyzes the choice of trade finance in a screening model and show that letters of credit can dominate when a foreign bank has a superior screening technology, but credibility of banks is captured by an exogenous parameter. Unlike these papers, I derive the higher credibility of banks endogenously, analyze the conditions under which they can serve a role, relate the findings to the market structure of the industry, and argue that both financial and non-financial intermediaries can be seen as mechanisms for establishing reputation for honest behavior.

The remainder of this paper is structured as follows. In section 2, I describe the inherent risks of international trade and the means available to firms to overcome these. In section 3, I initially consider the interaction between an importer and an exporter. It is demonstrated that incomplete contract limits the scope for trade and the role of reputation in overcoming the enforcement problem is analyzed. In section 4, multiple importer-exporter pairs are introduced and it is demonstrated that a banks guaranteeing multiple importers can improve efficiency. This relies on the assumption that exporters are able to observe and collectively punish deviation by the bank against one exporter. In section 5, bilateral trade between the two countries is explicitly introduced and it is demonstrated that confirmed guarantee makes the assumption of collective punishment unnecessary and further introduces “netting”, ie. a bank can only default on the net amount. Extensions are treated in section 6 and Section 7 concludes.

2 The Risks of International Trade

Firms engaged in international trade face a number of risks, which are either not present or less severe for domestic trade. These include risk pertaining to the counterparty, such as the risk of insolvency or fraud, and risks pertaining to the country of the counterparty, such as the possibility of war, political unrest, exchange rate movements, or unexpected import bans or tariffs. Although comprehensive data is unavailable, it is clear that firms are keenly aware of country and partner risks and take both into account when engaging in international trade, both in the design of the sales contract and also in the possible inclusion of third parties to smooth the transaction.

The inherent transportation time in most international trade implies that most transactions are of a sequential nature. If the exporter requires payment after he has made a shipment, he runs the risk of non-payment by the importer, and if the importer pays before receiving the shipment she runs the risk that the exporter – already having secured his payment – will cheat on quality or not make the shipment. International sales contracts take a number of forms, but for the purpose of this paper can be grouped into three categories *open account*, where payment is due after the arrival of the goods, *pre-payment*, where payment is due before shipment is made, and *bank intermediated guarantees*, usually through *letters of credit*, for which a bank provides a guarantee for payment on behalf of the importer. Antràs and Foley (2010) analyze the effects of contract enforcement (as measured by Knack and Keefer, 1997) on the choice of financing for a large US exporter and find that whereas pre-payment is required for around 80 per cent of sales to countries at the worst third of contract enforcement, it is only required for around 8 per cent of sales to countries in the best third.³ They further find that established relationships (as measured by accumulated previous sales) have a positive effect on the extent to which the exporter uses open account shipments.

Should neither party be willing to bear the risk they can have a bank issue a letter of credit. Figure 1 illustrates the workings of a letter of credit. Instead of an open account shipment, the exporter gets a bank (the issuing bank), usually located in the same country as the importer, to issue a letter of credit which guarantees the payment on behalf of the importer and puts the responsibility of claiming the money from the importer in the hands of the issuing bank.

Should the exporter seek further confirmation, he can have the letter of credit confirmed by having an additional bank (the confirming bank) issue the additional guarantee that it will honor the payment, as well as collect the money directly from the issuing bank. A confirming bank is often located in the exporting country, but need not be. Standard practice is that a confirmed letter of credit comes bundled with liquidity, as the exporter can obtain credit from

³In practice international sales contract incorporate elements of both pre-payment and open account, say 20 per cent payment in advance, and the rest upon delivery, and Antràs and Foley (2010) document more than a 100 different financing terms in their sample. Convex combinations between open account and pre-payment is a natural consequence of the theory presented below, but is not explicitly modeled.

the confirming bank (often in the exporting country) *before* shipment and production take place. This is discussed further in an extension 5.1 below.

Figure 1. Letters of credit

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Risks of international trade are naturally not a recent concern. The origins of the letter of credit dates back at least to the *letters of payment* of twelfth century Italian City States (McCullough, 1987). Even though the purpose of these was to facilitate the safe transport of gold – inter-city trade was plagued by highwaymen and pirates – and not to enforce payment, the mechanisms underlying the two contracts are similar. Instead of risking the transport of gold, a merchant from Venice would have his local bank issue a letter of payment for the purchase of goods in Milan. The letter, being of little value to potential robbers, could be exchanged for gold by a bank in Milan, which would debit the amount for the account held by the bank of Venice. The gold, however, would still have to be transported at some point, and these systems relied on i) bilateral trade, in that the banks need only transfer gold of the net value of trade between cities, ii) increasing returns to scale in protecting (it was cheaper to protect 100 pounds of gold in one transaction, than 1 pound separately for a hundred transactions), and iii) reputational concerns, as until the 17th century there seems to have been no legal obligation for either bank to honor the letters of exchange. This paper argues that the functioning of a modern day letter of credit in enforcing payments relies on three parallel features. However, whereas bilateral trade and reputational concerns will have obvious and direct parallels in the present model, the increasing returns to scale does not come from an exogenous assumption on increasing returns to scale in protection but endogenously from increasing returns to scale in credibility.

The market for letters of credit is highly concentrated, with a few local banks dominating the issuance of letters of credit in each country.⁴ The confirmation of letters of credit is usually done between banks that have long-standing relationships, both in the issuing of letters of credit and other financial transactions. HSBC, Citi Bank, and JP Morgan Chase are large international players in confirming letters of credit.⁵ Although data is scarce, it is estimated that around 15-20 per cent of world trade is guaranteed through the issue of letters of credit

⁴In the United States 75 per cent of the dollar valued of issued letters of credit were done by 10 banks in 2005 (Klein, 2006, using data from Documentary Credit World), whereas for general banking the three-firm concentration rate is 13.3 per cent (Allen and Gale, 2001, measured by total assets). Personal communication with Mr. Klein suggests that the market is more concentrated today. In most other countries the market is even more concentrated, and issuers are usually local banks, with the exception of certain South American countries (Chile and Argentina), where Santander is dominant, and some Asian countries where HSBC is dominant (Hong Kong). Rates vary substantially, but can be as high as 8 per cent for the guarantee alone. A report by the ICC Banking Commission (2010) finds that rates have increased substantially in developing countries during the crisis.

⁵Letters of credit are sometimes referred to as documentary credit, as the issuing of credit relies solely to the shipping documents and not the underlying goods themselves. This is distinct from documentary collection,

(ICC Banking Commission, 2010), though the fraction depends crucially on the destination country. The figure below shows the fraction of sales depending on letters of credit for a sample of 8,000 U.K. exporters in 2002. Whereas only around 10 per cent of sales to the European Union and North America were financed through letters of credit, around half of sales to the Middle East and Africa relied on this additional guarantee. According to the ICC Banking Commission (2009) around half of Chinese trade relies on letters of credit.

Figure 2. The use of letters of credit

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An alternative to the guarantees provided by the use of letters of credit is insurance from export credit agencies. These large, often partly government-owned and -funded agencies are estimated to insure or finance around 12 per cent of world trade (Gianturco, 2001), either directly to exporters or through private banks. The primary purpose of these agencies is to finance projects of longer maturity (from six months to several years, whereas bank issued letters of credit usually have maturities of less than 6 months), and the provision of insurance against non-payment with the backing of the government of the exporter makes this option virtually risk free for an exporter unwilling to bear any risk from international trade.

Though there are many risks in international trade, the present paper is concerned with incomplete international contract enforcement, the associated inefficiencies, and the role that letters of credit can play in overcoming these inefficiencies. Weak contract enforcement is likely to be more acute internationally than domestically. In addition to the longer transportation time, sales between countries typically involve two or more judicial systems, with possible contradictions and complications as to which set of legal rules apply (Stephan *et al.*, 2004). Second, and relatedly, the parties are likely to be less familiar with the laws of their counterparty than their own, naturally increasing the uncertainty in the event of a dispute. Third, bias of courts in favor of their own citizens is, if not a fact (Johnson, 1996), then at least a well established belief among those engaged in international legal disputes (Clermont and Eisenberg, 1996).⁶ Fourth, when a court case is heard in a foreign country, the distance itself presents a number of complications and costs, all likely to reduce the chance of an honest hearing. This is not meant to imply that weak contract enforcement is more of a problem for all international transactions than for all domestic transactions: an exporter from a country with weak contract enforcement selling to a country with strong contract enforcement might find it easier to enforce international contracts. The point is that *given* the contract enforcement in the country of the buyer, the international aspect by itself weakens enforcement. Casella (1996) argues that international arbitration is a possible, albeit expensive solution.

where the bank merely facilitates the transfer of documents and is not itself liable. A more detailed description of the workings of letters of credit can be found in appendix 8.1.

⁶Even James Madison held this belief and voiced it during the debates for the adoption of the federal constitution : “We well know, sir, that foreigners cannot get justice done them in these courts...” (Elliot, 1876).

The main focus of the model is on open account, in which payment is due after the shipment has arrived. This is partly because this is the predominant form of contract in international trade, but more importantly, bank guarantees are likely to be better substitutes for open account than for pre-payment. Whereas, the inherent problem of open account is non-payment, a service which a bank can deliver, the inherent problem of pre-payment is the delivery of a good of low quality, which is more difficult for the bank to guarantee against. Though the formal model is about the role of letters of credit in overcoming the enforcement issues of open account, I will discuss export credit agencies, and the role that intermediaries can have in overcoming the enforcement issues of pre-payment,

3 Weak international contract enforcement and reputations

The formal model will be introduced in three steps. First, the interaction between a single importer and an exporter is analyzed, and the benefits of repeated interaction are analyzed. Then multiple importer-exporter pairs are introduced as a necessary requirement for a bank to provide credibly guarantees. Finally, mutually confirmed guarantees are modeled through the introduction of bilateral guaranteed trade. The model is deliberately kept in a “partial equilibrium” framework, but could be modeled specially in a quasi-general equilibrium setting with Dixit-Stiglitz preferences.

3.1 Open account

Consider the transaction between a home importer and a foreign exporter. The two are exogenously linked and are restricted to trade every other period indefinitely. In a parsimonious fashion this setup captures the fact that, although a country continuously imports, some firms do so only rarely, although alternative specifications such as high turn over rate would return equivalent results.⁷ Formally, the advantage of the bank will be derived through more frequent interaction, and interaction every other period by the importer is the simplest way of getting. First, the stage game is analyzed in isolation to demonstrate the inefficiency from weak contract enforcement, and then standard “folk theorem” arguments are used to show that the infinitely repeated game can support a larger quantity of trade.

The foreign exporter can produce quantity q of the good at cost c^*q , which the importer sells at home to earn revenue $R(q) = p(q)q$ with $p(q)q = q^{\frac{\sigma-1}{\sigma}}$. An open account contract, (q^O, T^O) requires the initial shipment by the exporter (he) of a quantity q^O of the good, which is sold and yields revenue of $p(q)q$ to the importer (she), at which point the contract requires for her to pay the exporter $T^O q^O$. (for notational convenience T^O is the *per unit* transfer).

⁷Alessandria, Kaboski, and Midrigan (2010) show that higher fixed costs and uncertainty about arrival time leads to imports that are less frequent, but larger, than domestic purchases, and provide evidence for this in Alessandria, Kaboski, and Midrigan (2009).

The importer has no initial cash and can pay only $T^O \leq p(q^O)$. The stage game is shown in the figure below. The sequence of events is illustrated in Figure 3 and is as follows. i) The two parties simultaneously decide whether to engage in trade.⁸ ii) The importer offers a contract (q^O, T^O) . iii) The exporter decides whether to reject the contract by shipping $q = 0$ or to accept it by shipping $q = q^O$. iv) If the shipment was $q = q^O$, the importer decides whether to honor the contract and pay $T^O q^O$ or refuse the contract. If she pays, the stage game ends, she gets $(p(q^O) - T^O) q^O$, and the exporter gets $(T^O - c^*) q^O$. If she does not pay and the shipment was $q = q^O$ of high quality, the court rules in favor of the exporter with probability ϕ , in which case the payment of $T^O q^O$ is enforced. With probability $(1 - \phi)$ the courts rule in favor of the importer in which case she is not required to pay and the legal rights to the goods are returned to the exporter. The outside value to the exporter of these goods is βq^O with $\beta < c$. I allow for efficient renegotiation with full bargaining power to the importer such that she buys the goods at βq^O and obtains revenue $p(q^O) q^O$ (this captures the special case of $\beta = 0$ where importer can just refuse payment and still keep the goods).⁹ If the goods can easily be resold elsewhere (β is high), then the bargaining situation is more favorable to the exporter and the hold-up problem is less severe.

Figure 3. The stage game with open account

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The assumption of full bargaining power to the importer for ex post renegotiation is not essential for the result, but simplifies the IC constraints. Note that by assumption, the exporter has no possibility of under-delivering by, say, shading on quality. This is not to say that such concerns are not important in international trade but to focus on the renegeing behavior of the importer. The issue is further discussed in section 6.2, where it is argued that this relates to the existence of non-financial intermediaries (trading companies) who are better equipped at establishing reputation for not shading on quality than banks.

From the game tree it follows directly that for any $T^O > \beta$, the importer will refuse payment, and that the exporter will accept no $T^O < c^*$. With $\beta < c^*$ it follows that in the one shot game no contracts will be accepted by the exporter and honored by the importer.¹⁰ Using this it follows, that the importer will choose the best contract that guarantees positive shipment

⁸The first action by both parties is the simultaneous choice of whether to engage in trade or not where trade requires the consent of both parties. This implies that “no trade” is a Nash equilibrium in the one stage game. This is not essential for the results but considerably simplifies the analysis as a simple trigger strategy arises as the natural equilibrium.

⁹Attempt by counterparties to renege on payment or try to renegotiate a contract is a reoccurring concern for practitioners. Documentary Credit World (2010) cites a risk manager dealing with Chinese counterparties: “very minor inconsistencies such as punctuation and spelling have been used as grounds for canceling a contract”. In addition a survey of American exporters find that around half of respondents would not do trade with Chinese counterparties even with a letter of credit issued by a Chinese bank.

¹⁰In this setup it is irrelevant whether the parties renegotiate to avoid taking the case to court. With no costs of hearing a case, there is no surplus to be bargained over. This would not be the case if there were costs to a

realizing that she will renege and the exporter will get only $\phi T + (1 - \phi) \beta$ in expectation:

$$\max_{q,T} (p(q) - [\phi T + (1 - \phi) \beta]) q,$$

subject to an Individual Rationality constraint for the exporter:

$$[\phi T + (1 - \phi) \beta] q \geq c^* q,$$

and $p(q) \geq T$.¹¹ Which imposes the following constraint on quantity:

$$\phi (p(q) - c^*) \geq (1 - \phi) (c^* - \beta). \quad (1)$$

If the unconstrained profit maximizing price, $p^F = \sigma / (\sigma - 1) c^*$, satisfies the inequality, it is the optimal price.¹² If not, then the (unique) lowest $p(q)$ that satisfies constraint (1) is optimal, and this is the unique subgame perfect equilibrium with positive shipment in the one-shot stage game. Imports are constrained by poor contractual enforcement (low ϕ), as the chance of the exporter receiving payment is correspondingly lower, and further by the good being specialized (low β) as this leaves lower outside option and thereby worse bargaining situation for the exporter. Though this is related to the existing literature on institutional quality and trade there is a distinct difference. Whereas domestic contract enforcement and financial development are shown to be important for comparative advantage in Nunn (2007) and Manova (2008), respectively, in this setting imperfect contract enforcement restricts a country's ability to *engage* in trade internationally (as argued in Anderson and Marcouiller, 2002 and Berkowitz *et al.*, 2006).

Reputation, through various forms of repeated interaction, has been emphasized as a possible solution for the problem of weak international enforcement of contracts. Marin and Schnitzer (1995) present a model of courtertrade where a developing country's inability to commit to pay for imports after receipt is overcome by the exporter from a developed country committing to import goods for the same country *after* payment from the developing country. In this way, the promise of a profitable future export encourages payment, even when there is no legal enforcement. Rauch (2001) argues and Rauch and Trindade (2002) show that ethnic networks are important in overcoming problems of contractual incompleteness. As Weidenbaum and Hughes (1996) argue: "if a business owner violates an agreement, he is blacklisted.

court hearing. In such a case parties could profitable renegotiate and avoid the court costs, and the price after bargaining would depend on the relative court costs of the parties. In this setting unfamiliarity with a foreign legal system, bias, or distance could be represented by the relatively higher court costs of the exporter. I have investigated this setting. It yields qualitatively similar results, but with added complexity.

¹¹Without this assumption, the parties could achieve efficiency for any $\phi > 0$ by writing a contract that even if breached would prescribe such a high payment that even a small probability of court enforcement would be sufficient to ensure sufficient expected payment to the exporter. In this setting, the expected gain for the producer is $[\phi T + (1 - \phi) \beta] q$, which can be made arbitrarily large by increasing T .

¹²I will misuse terminology slightly and let " F " refer to first best despite a standard monopoly distortion. This is inconsequential.

This is far worse than being sued, because the entire Chinese network will refrain from doing business with the guilty party.” Greif (1993) argues that collective punishment was crucial for the international activities of the Maghribi traders. In an analysis of the choice between open account and pre-payment Schmidt-Eisenlohr (2009) show that repeated interaction increases the cost of renegeing, and suggests that enforcement between banks is easier as they are engaged in long-term relationships. Common to all of these explanations are reputational aspects in terms of loss of future profits from dishonest behavior. The following section introduces repeated interaction between the importer and the exporter to establish a future loss for the importer from renegeing.

3.2 The repeated game

Whereas trade in the one-shot stage game always leaves the importer with an incentive to renege, repeated interaction can allow for a better outcome. As is typical in repeated games, a large set of equilibria exists, but I restrict attention to simple trigger strategies of the form: importer offers and honors (q^O, T^O) and exporter ships $q = q^O$ as long as no deviation has occurred previously. If a deviation occurs, the exporter will expect violations and will accept only contracts as described in section 3.1. Both will choose not to participate at the first decision node of the stage game if any deviation has previously occurred. I will find the contract that maximizes importer payoff while still being supportable by a subgame perfect equilibrium of the type described. This is with little loss of generality, as the appendix demonstrates that there exists no subgame perfect equilibrium that can support higher value for the importer. Defining V^I and V^X , as the discounted value of continued cooperation for importer and exporter, respectively, the object is to find a contract (T^O, q^O) so as to maximize V^I , ensuring that it adheres to an Individual Rationality (IR) constraint of the exporter, and an Incentive Compatibility (IC) constraint of the importer. No IC constraint of the exporter is necessary. The problem is:

$$V^I = \max_{q, T} p(q)q - Tq + \delta^2 V^I, \quad (2)$$

subject to:

$$\text{IR exporter: } V^X = Tq - c^*q + \delta^2 V^X \geq 0, \quad (3)$$

$$\text{IC importer: } p(q)q - Tq + \delta^2 V^I \geq p(q)q - \phi Tq - (1 - \phi)\beta q. \quad (4)$$

The per period profit of the importer is the revenue received when sales are made less the transfer to the exporter. Since trade takes place only every other period, the discount factor is δ^2 . The incentive constraint of the importer requires that adhering to the contract, which yields $(p(q) - T)q$ per period and ensures the continuation of the relationship, is preferable to non-payment, which will discontinue the relationship. As there are no incentive issues for the exporter $T = c^*$ and $V^X = 0$ are optimal. Substituting a binding equation (3) in equations (2) and (4) gives:

$$V^I = \max_q \frac{1}{1 - \delta^2} (p(q) - c^*) q, \quad (5)$$

subject to

$$\frac{\delta^2}{1 - \delta^2} (p(q) - c^*) \geq (1 - \phi) (c^* - \beta). \quad (6)$$

By construction the incentive to deviate is linear in q , but a downward sloping demand curve implies that a higher quantity must be followed by lower price and thereby lower profits per unit. Constraint (6) puts a lower limit on the surplus *per unit* and thereby the price. The downward sloping inverse demand function, $p(q)$, implies that this puts an upper limit on quantity. As the paper's focus is on the role of reputation in overcoming contractual incompleteness, it is natural to assume.

Assumption 1 *Firms are sufficiently patient to gain from repeated interaction:*

$$\frac{\delta^2}{1 - \delta^2} > \phi.$$

From this the following proposition follows immediately:¹³

Proposition 1 *Open Account Shipment.* *The profit maximizing shipment under open account, q^O , is given by the first best shipment $p(q^F) = p^F = \sigma / (\sigma - 1) c^*$ if:*

$$\frac{\delta^2}{1 - \delta^2} (p^F - c^*) q^F \geq (1 - \phi) (c^* - \beta) q^F, \quad (7)$$

and otherwise by the unique highest value of q^O for which:

$$\frac{\delta^2}{1 - \delta^2} (p(q^O) - c^*) q^O = (1 - \phi) (c^* - \beta) q^O, \quad (8)$$

The optimal shipment is weakly increasing in contractual enforcement ϕ , and the outside value of the good, β . The optimal shipment is weakly increasing in the discount factor δ .

Formal contracts and reputations are substitutes in the sense that:

$$\frac{\partial}{\partial \delta^2} \left(\frac{\partial q^O}{\partial \phi} \frac{\phi}{q^O} \right) < 0, \quad (9)$$

¹³It might seem crucial for the results that I am looking at the best subgame perfect equilibrium for the importer. In the appendix it is demonstrated that the analysis easily extends to the full set of trigger strategies, where the constrained price is given by $\zeta(\sigma, \gamma) \frac{\delta^2}{1 - \delta^2} (p(q) - c^*) = (1 - \phi) (c^* - \beta)$ and varying $\gamma \in [0, 1]$ traces out the set of equilibria with γ being the weight on the importer's profits. $\zeta(\sigma, 1) = 1$ returns the special case above. It is easily demonstrated that $\zeta(\sigma, 1) \leq 1$, reflecting the fact that given some surplus to the exporter reduces the profits for the importer, and requires a smaller shipment. An analogue to Proposition 1 still holds.

Proposition 1 relates the cost of renegeing (the left hand side of equation (8)) to the short run gain (the right hand side), where the cost equals the discounted present value of future profits. More patience in importers (a higher δ) increases the cost of renegeing and allows the parties to sustain a lower consumer price, $p(q)$, allowing for a (weakly) higher shipment. This effect is less pronounced for better institutions (higher ϕ); with better contract enforcement the extra gain from repeated interaction serves a smaller role. This is the sense in which reputations and contract enforcement are substitutes.

There is plenty of evidence that firms engage in repeated interaction with the same parties. While this is perfectly consistent with other theories (informational frictions, relationship specific investments, or search costs), the theory presented here suggests that reputations can overcome the difficulties of enforcing contracts at a distance. Although the model is couched in terms of the repeated interaction between just two firms, the analysis remains unchanged if firms deal with a community or network, and bad behavior towards one party is punished by all. The analysis here suggests that such networks would be relatively more important for countries with worse institutions. Consistent with a story in which networks are more important in overcoming contractual incompleteness in countries with worse contractual enforcement, Gould (1994) presents evidence that immigration to the United States increases U.S. bilateral trade with the immigrants' country of origin, but more so for U.S. exports than U.S. imports. Rauch and Trindade (2002) further find that Chinese networks are important predictors of trade, but more so for differentiated products. The authors interpret this as networks providing a role in facilitating the transfer of information which is more important for differentiated goods, but interpreting the outside value, β , as an inverse measure of differentiation, the same prediction follows from the present model without informational asymmetries. Blum *et al.* (2009) further find that although bilateral trade between Colombia and Chile features a large number of small firms and only a few large ones, almost all trade includes at least one large player. If small players are at least partly able to observe the behavior of large players towards other small players, such a system can encourage the honest behavior of large players. The theory would further predict contract terms that place the incentive to deviate with the large player (open account if he is the buyer, pre-payment if he is the seller). Examining whether this is the case is an interesting topic for future research, but the result in Antràs and Foley (2010) that the accumulated size of previous purchases matter for a large American exporter is in line with this prediction.

Even though reputations are important for understanding international trade, it is unlikely that repeated interaction can completely overcome contractual incompleteness. Gereffi and Korzeniewicz (1994) argue that turnover is high, and Ranjan and Lee (2007) argue that this prevents relationships from completely overcoming weak international contract enforcement, as firms are unlikely to have complete information about a new business partners past behavior.

As is standard in models of repeated interaction, a slight extension of the model shows how uncertainty about the future will reduce shipments. Consider an ε probability every period that the relationship will cease to exist. The highest shipment will then be given by equation (8) but with δ replaced with $\delta(1 - \varepsilon)$, which for $\varepsilon > 0$ directly results in a lower shipment demonstrating how uncertainty will make it more difficult to sustain honest behavior. In such situations the demand for alternative methods of shipments, such as bank guarantees, is likely to rise. In a survey of banks, ICC Banking Commission (2010) finds that respondents experienced an increase in demand for bank guarantees in 2009 as a consequence of the financial crisis. For future use, define the shipment using open account as $q^O(\beta, \phi)$ and the corresponding profits of the importer as $\Pi^O(\beta, \phi) \equiv [p(q^O(\beta, \phi)) - c^*] q^O(\beta, \phi)$. Profits are weakly increasing in the exporter's outside value, β and contract enforcement in the importing country, ϕ .

4 Bank guarantees

Firms can overcome contractual incompleteness through repeated interaction, but interact only every other period. This section demonstrates that banks, through more frequent interaction, can establish a cost of renegeing and thereby increase credibility. As Figure 1 illustrates, the use of an unconfirmed letter of credit substitutes two agency problems in the place of the single one between an importer and an exporter: one between the importers and the issuing bank, and one between the issuing bank and the exporters. Further, the use of a confirmed letter of credit replaces these two agency problems with three: i) between the importers and the issuing bank, ii) between the issuing bank and the confirming bank, and iii) between the confirming bank and the exporters. I first consider the unconfirmed letter of credit, and then discuss the limitations to its use before analyzing the confirmed letter of credit.

4.1 The bank's problem

In section 3.1, the optimal contract for an open account shipment between importer and exporter was studied in isolation. As the higher credibility of the bank is obtained through the more frequent interaction with multiple importers and exporters, this section explicitly considers the interaction between the bank and multiple importer exporter pairs. Let there be a mass of 2 importer-exporter pairs, a mass of one trading every period. A single bank is introduced in the home country and the bank is allowed to make a take-it-or-leave-it offer to the importers. In this model the bank's credibility depends on the profits they can extract and this assumption makes this point the clearest. As above introducing bargaining between the bank and the importer would leave the qualitative conclusions unchanged. In section 6.1 two competing banks in home are introduced and competition formally modeled and shown to reduce profits and thereby credibility. I continue to consider the home country.

The set of players in the full game is $\{(I_i)_{i=0}^2, (X_i)_{i=0}^2, B\}$, where I_i and X_i refer to the importer and exporter of pair i , respectively, and B is the bank. $\{I_i, X_i, B\}$ is the corresponding set of players in *partial* game i of pair $i \in [0, 2]$ and the bank. Importantly, in this section, I allow for *collective punishment*; that is, I allow the strategies of importers and exporters in partial game i to depend on the bank's behavior in partial game $j \neq i$. The goal is to find contracts supportable by subgame perfect strategies, where a set of contracts $((q_i^G, T_i^G, F_i^G))_{i=0}^2$ requires the shipment of q_i^G high quality units from exporter i to importer i , the importer is required to pay $(T_i^G + P_i^G) q_i^G$ to the bank, and the bank is required to pay $T_i^G q_i^G$ to the exporter, *regardless* of whether the importer pays it or not (half the importers are inactive every period, but are included in the set of contracts for notational convenience. The contract offered to these is empty). The amount $F_i^G q_i^G$ is the fee the bank extracts from pair i .

A stage game in the partial game is as follows. i) The bank offers a contract (q_i^G, T_i^G, F_i^G) to importer i . ii) The importer decides between this contract or an open account transaction. If she chooses open account the game proceeds as described in section 3.1 above. If she chooses the letter of credit contract the stage game proceeds as follows. iii) The importer and exporter simultaneously decide whether to engage in trade. iv) The exporter decides whether accept the contract by shipping q_i^G high quality units. v) The importer decides whether to pay the bank $(T_i^G + P_i^G) q_i^G$ or not, and the bank simultaneously decides whether to honor its obligation of $(T_i^G q_i^G)_{i=0}^2$ to exporters (the assumption of simultaneous moves is irrelevant and is made for notational convenience). The stage game is illustrated in Figure 4 and formally described in appendix 8.5.

Figure 4. The stage game with letter of credit

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In line with the analysis above I assume probabilistic court enforcement. Should the importer refuse the payment of $(T_i^G + P_i^G) q_i^G$ to the bank, the bank has probability $\hat{\phi} > \phi$ of winning in court. The international obligations are now between the exporters and the bank, and I keep the assumption of enforcement with probability ϕ between international parties.¹⁴

I continue to consider trigger strategies of permanent punishment and restrict attention to the set of contracts that maximize the profits of the bank and are supportable by a subgame perfect equilibrium of the following form: i) The bank offers contract (q^G, T^G, F^G) every period to all importers if all players have previously adhered to their prescribed strategies. If any

¹⁴In order to derive – and not impose exogenously – higher credibility of the banks, I assume that exporters have the same enforcement against a bank when using letters of credit as they do against an importer when using open account. Although a letter of credit leaves little room for renegeing on payment due to low quality product, there is plenty of room for discrepancies over the documents required for the letter of credit. According to the Uniform Customs and Practice 600 (ICC, 2007), 70 per cent of documents presented under letters of credit are rejected on first presentation. Typically, the bank still honors the payment, suggesting that reputational concerns are important.

deviation has occurred the bank offers $(0, 0, 0)$. ii) Importers choose a contract (q^G, T^G, F^G) and pay $T^G q^G$ as described if no deviations have occurred. If the bank has previously deviated from its prescribed strategy towards any exporter (in any partial game), the importer will reject any letter of credit contract and offer the open account contract described in section 3.2. If any other player has deviated, it will reject the letter of credit contract and no longer engage in trade. iii) The exporter will ship q^G as required if no other deviation has occurred, will accept the open account shipment described in section 3.2 if only the bank has deviated, and will accept no contracts if any other player has deviated. iv) The equilibrium is required to give the importer at least the profits she would get from the open account transaction: $p(q^G) q^G - (T^G + F^G) q^O \geq \Pi^O$. There are two IC constraints, reflecting the fact that a letter of credit introduces two agency problem. When the importer IR binds the problem is:¹⁵

$$W^G = \max_{q, P} (p(q) q - c^* q - \Pi^O) + \delta W^G, \quad (10)$$

subject to:

$$\text{Importer IC: } \frac{\delta^2}{1 - \delta^2} (p(q) - (c^* + F)) q \geq (1 - \hat{\phi}) (c^* + F) q, \quad (11)$$

$$\text{Bank IC: } \frac{\delta}{1 - \delta} [p(q) q - c^* q - \Pi^O(\phi, \beta)] \geq (1 - \phi) c^* q, \quad (12)$$

where W^G is the value function of bank when offering guarantees, and the discount rate of the bank is δ as it is guaranteeing shipments every period. The IC constraint of the bank is $\delta / (1 - \delta) F^G q^G \geq (1 - \phi) c^* q^G$ which requires for the present value of the fees to cover the the incentive to deviate. Substituting this into the binding IR constraint of the importer: $p(q^G) q^G - (T^G + F^G) q^O = \Pi^O$ returns equation 12.¹⁶ The following proposition follows:

Proposition 2 *Consider the problem defined by equations (10) – (12). The bank can provide additional credibility through unconfirmed letters of credit only if:*

- i) the bank has better enforcement towards importers,*
- ii) the bank interacts more frequently with exporters (to build higher reputation), and*
- iii) exporters can observe and punish deviations collectively.*

When the importer IR constraint is binding and $p = p^F = \sigma / (\sigma - 1)$ satisfies both equation 11 and 12, then first best shipment is offered. If not, then the highest quantity that satisfies both equations is offered.

¹⁵The bank IC is the constraint when the bank reneges on payments for all outstanding liabilities at once. With collective punishment, it is never optimal for a bank to only partially renege.

¹⁶The exporter IR constraint is not binding for all parameter values, as in some cases it can be worthwhile for the bank to offer higher profits to increase the reputational concern for the importer. The case where the importer IR is not binding is considered in appendix 8.5 where it is demonstrated that the same qualitative conclusions hold: the bank must have better enforcement towards importers ($\hat{\phi} > \phi$) and a more frequent interaction to credibly offer guarantees.

A letter of credit introduces two IC constraints in the place of the single IC for open account transactions. They both must support $q > q^O$ (as defined by equation (8)) for the bank to credibly guarantee higher shipment than open account. Whereas equation (12) relates to the question of how banks can offer more credible commitments than importers separately, equation (11) relates to the question of why banks – as opposed to other large entities – provide these services. This is discussed in the following section

4.2 The two agency problems of bank guarantees

First, the bank IC concerns the obligations of the bank towards the foreign exporters, and is the only international liability of a letter of credit contract. It differs from the open account IC constraint of the importer towards the exporter in three ways: First, the reputational concern is increased by a higher discount factor (δ instead of δ^2), second, decreased by the fact that the bank must leave some of the rent with the importers to meet their IR constraints, and third, the outside value of the good, β , is irrelevant, as the bank need not engage in negotiations with the exporter if it reneges on payment (the importer is contractually obligated to pay the bank regardless). As only the more frequent interaction loosens the IC constraint, it is clear why the bank needs to sequentially guarantee the shipments; if only one importer were guaranteed, the reputational effect would be insufficient to secure payment. It is important to note that it is not the size of the bank in itself that guarantees better credibility, but the more frequent interaction. If importers imported every period, the bank would serve no role *regardless* of whether collective punishment is possible. Size, however, plays an indirect role through the importance of rents. A monopolist can extract more rent from importers and can therefore credibly guarantee larger shipment. This is not just a feature of the assumption of full bargaining power to the bank. In section 6.1 it is demonstrated that the introduction of an additional bank and competition between the two banks – keeping the assumption off take-it-or-leave-it offers – reduces rents and thereby banks’ ability to guarantee trade.

While the IC of the bank towards the exporters (equation (12)) provides a theory for *how* banks can credibly issue guarantees in international trade, there is nothing inherent in size that requires financial institutions. A possible explanation for *why* banks provide these services is provided by the IC of the importer towards the bank (equation (11)) Compare the importer IC towards the bank (equation) with that of the importer IC from the open account problem towards the exporter (equation (6)). For given q , equation (11) differs from equation (6) of the open account in three ways: the probability that the bank can reclaim the money is $\hat{\phi} (> \phi)$, the bank cannot seize the goods in case of non-payment by the importer,¹⁷ and finally there is a fee to the bank for the service, making the cost higher for the importer and the incentive

¹⁷Some letters of credit require for the importer to pay the bank before receiving the goods. In this case $\beta = 0$ reflects the fact that the bank has no use of the goods. As argued in Petersen and Rajan (1997), the bank is disadvantaged as a creditor compared with a supplier in that it has a lower resell value for claimed inventory.

to renege higher. Only the first effect supports a higher shipment using letters of credit, so $\hat{\phi} > \phi$ is a necessary requirement for banks to serve a role. It is important to note that $\hat{\phi}$ must be more than marginally higher than ϕ for the bank to credibly guarantee shipments. To see this, rewrite equation (11) to get:

$$\frac{\delta^2}{1-\delta^2} (p(q) - c^*)q - (1-\phi)q + (\hat{\phi} - \phi)c^*q \geq \left[\frac{\delta^2}{1-\delta^2} + (1-\hat{\phi}) \right] Fq,$$

and note that the two first terms represent the net incentive to deviate had q been shipped using an open account for the case of $\beta = 0$. Using proposition 1, $q > q^O$ implies that the sum of these terms is negative so $\hat{\phi}$ marginally higher than ϕ allows only for a fee, Fq , that is marginally higher greater than zero. This is, however, insufficient to guarantee credible payment from the bank, as can be seen from the IC constraint $\delta/(1-\delta)Fq \geq (1-\hat{\phi})c^*q$. The incentive to honor the contract (left hand side) is proportional to the profits obtained from the transaction, Fq , but the incentive to deviate (right hand side) is proportional to the *entire* liability of the bank c^*q : the bank only collects a small fraction of the profits but it can renege on the entire amount outstanding. For $\hat{\phi}$ sufficiently close to ϕ , the rent collected is insufficient to credibly guarantee payment. This provides a natural explanation for why a local bank – typically the regular bank of the importer – provides the guarantees. It is familiar with the local legal framework and has already sunk the cost of monitoring the importer for other purposes, enabling it to establish significantly higher enforcement with the importer than the exporter could.¹⁸

Using proposition 2, it is straightforward to demonstrate how trade varies with the legal framework ϕ , and the exporters' outside value of the good, β . If (11) is binding the analysis is straightforward: the profits that the importer collects is increasing in both ϕ and β and this makes deviation more costly so more trade can be supported.

The more interesting case is when the shipment is constrained by the bank's incentive to renege on payment; that is when q^G is constrained by equation (12). Figure 5 illustrates. The right hand side of the equation is the bank's incentive to deviate and the left hand side is the rent it captures. With a binding importer IR, the bank must guarantee a quantity strictly higher than open account shipment to capture positive profits, and can only guarantee those

¹⁸Though the bank's better enforcement towards the importer is an exogenous assumption, expressions analogous to equation (11) could be derived endogenously in a setting like this in at least three ways. i) Let the importer interact with two exporters sequentially every other period, and let neither observe behavior towards the other. This yields the IC constraint of equation (6) when using open account. Using a letter of credit for both with the same bank would yield an IC constraint of $\frac{\delta}{1-\delta} (p(q) - (c^* + F))q \geq (1-\phi)(c^* + F)q$, which can improve enforcement. ii) Alternatively, let the bank and importer interact every period in other respects, and let the importer receive rents R over and above what could be achieved with another bank, and let D be the corresponding gain from deviation leading to an IC constraint of $\frac{\delta^2}{1-\delta^2} (p(q) - (c^* + F))q + \left(\frac{\delta}{1-\delta}R - D \right) \geq (1-\phi)(c^* + F)q$. As long as $\frac{\delta}{1-\delta}R > D$, the bank obtains better enforcement. iii) Finally, increasing returns to scale in monitoring would let the size of the bank matter along an additional dimension, as enforcing of multiple importers would make enforcement towards each cheaper or more efficient.

for which the cost from deviating is higher than the incentive to deviate, as shown in the figure.

Figure 5. The bank IC constraint

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The quantity $q^G(\phi, \beta)$ is the highest point (weakly lower than first best) for which this is true. Both β and ϕ increase Π^O and reduce the profits and credibility of the bank. An increase in ϕ has the additional effect of making bank deviation more costly and decreases the incentive to deviate. In general the overall effect is ambiguous.

4.3 Bank credibility and financial crises

The quantity guaranteed, $q^G(\phi, \beta)$, is not continuous in either ϕ or β . This can be seen directly from the figure: if the set of quantities that can credibly be guaranteed (the set of points above “cost from deviation” and below “incentive to deviate”) is small, minor changes to the parameter space can leave the bank unable to offer any guarantees. It is easily demonstrated that this is the case for ϕ close to 1 or β close to c^* as this ensures shipment of almost profit maximizing quantity leaving little rent for the bank. Banks therefore have nothing to offer when the initial hold-up problem of the open account transaction is small, and the model would predict little use of letters of credit when the contract enforcement of the destination country is sufficiently strong or outside value is too high.

A parallel to the latter is studied in a domestic context by Petersen and Rajan (1997). They analyze the choice between trade credit (extended by a supplier) and bank finance and find that the extent to which a supplier can resell the goods is positively correlated with the extension of trade credit. This implies that sellers extending *more* trade credit would rely *less* on trade finance by banks, and trade would be less sensitive to changes in the bank health, in line with the findings for US exports in Levchenko *et al.* (2010). Interestingly, they do not find this effect for US imports, suggesting that guarantees are less of a concern with the relative strong contract enforcement of the US.

Extend the model slightly such that there is a probability ε that the bank will go bankrupt. As is standard in models of repeated games, this effectively changes the discount rate of the bank to $\delta(1 - \varepsilon)$. The quantity guaranteed is naturally decreasing in the probability of bankruptcy, ε , but as from the analysis above, the change can be discontinuous. Auboin and Meier-Ewert (2003) and Auboin (2007) argue that the confidence in Asian banks constrained their ability to credibly issue letters of credit, which constrained Asian imports during the Asian crisis. Bernard *et al.* (2009) show that whereas exports to the US from countries suffering from the Asian crisis showed similar patterns for related parties and arm’s length trade, imports from the US to the same countries were quite distinct: arm’s length trade dropped by around 20 per cent, but imports through related parties dropped only a few per

cent. Amiti and Weinstein (2009) find a similar distinction between arm’s length and related parties trade for Japan in the nineties. As trade between related parties presumably rely less on bank guarantees this is consistent with this theory.

The model suggests that the effect of financial crises should be viewed through banks’ dual role of providing liquidity and guarantees of payment. As argued in Amiti and Weinstein (2009) both channels are likely to affect international trade more than domestic trade, as bank guarantees are more commonly used in international trade and the transportation time – and thereby liquidity need – of international trade is typically longer.¹⁹ Combining Hummels’ (2001) work on transportation time and the study by Djankov *et al.* (2010) on time spent in customs, a shipment can often take 6 weeks from exporter to importer, implying a substantially longer liquidity need. Amiti and Weinstein (2009) and Levchenko *et al.* (2009) find that transportation time is an important predictor for the drop in trade during the 2008-2009 crisis in Japan and the US, respectively, although interestingly only for US imports.

The significant drop in international trade during the 2008-2009 crisis (Eaton *et al.*, 2010 find that global trade to GDP declined by nearly 30 per cent during recession) has initiated a discussion about the impact of trade finance. Though the present paper does not seek to answer this question, the analysis presented here suggests that it is important to consider *how* international trade differs from domestic trade. If the two channels presented here are important we should see trade dropping disproportionately for importing countries or sectors where contract enforcement is more of an issue and for trade between more distant parties. Interestingly, whereas the analysis in Eaton *et al.* (2010) finds that the lion’s share of the drop can be explained by changes in demand and leave little room for trade frictions such as trade finance, their data set predominantly includes OECD countries. If the theory presented here is right, and transportation time and enforcement issues are important, then we should expect to see little disproportionate effect for international trade in this sample, which is dominated by European countries of high proximity to each other and with good institutions. Interestingly, in their analysis it is exactly for China and Japan – the countries the farthest away from the core of the OECD – that trade frictions have increased the most.

4.4 Reputation through size in international trade

The two IC constraints of equations (11) and (12) represent the how and why of bank guarantees in international of this paper: larger reputational capital allows for more credible promises of payment and thereby a role for large institutions, and the better enforcement and monitoring

¹⁹I examined an extension of the model with liquidity provision: If time between production and sales is T periods, and per period gross interest rate is $(1 + r)$, it is straightforward to demonstrate that for unconstrained trade the sensitivity to the interest rate is given by $\frac{\partial q^O}{\partial r} \frac{1+r}{q^O} = -T\sigma$, and for constrained trade $\frac{\partial q^O}{\partial r} \frac{1+r}{q^O} < -T\sigma$, such that longer transportation time increases the sensitivity to the cost of liquidity both for constrained and unconstrained trade, but more so for constrained trade. The reason is that for constrained trade, the higher liquidity cost reduces the rent to be obtained and the payment due, both of which increases incentive to renege.

that comes with providing financial services suggest that the role can naturally be performed by the regular bank of the importer.

As there is nothing inherent in the reputational aspect of the story that requires banks, the theory can accommodate other large players in international trade such as large intermediaries and Export Credit Agencies (ECA). Rossman (1984) shows that 300 (non-manufacturing) Japanese firms accounted for 80 per cent of Japanese trade in the 1980s, and Ahn *et al.* (2010) show that currently intermediaries account for 20 per cent of both Chinese exports and imports. They argue that such intermediaries allow a large set of firms to export indirectly when they cannot afford to do so directly. They focus on exogenous fixed costs of exporting, but this model suggests an alternative explanation: Many Chinese firms are too small to credibly engage in international trade, so these intermediaries facilitate the trade. Again this requires two things: they have to be better able to enforce quality and payment from Chinese firms, which suggests they should be placed in China, and their larger size allows them to credibly engage in international trade. This fits well with the empirical fact that these intermediaries are larger, focus more narrowly on particular countries than firms that export directly – such that a reputation is more easily build – and trade in a wider range of products. This is further discussed in section 6.2, where it is further argued that intermediaries are a more natural substitutes for pre-payment contracts than letters of credit.

Around 12 per cent of world trade is mediated by ECAs (Gianturco, 2001). Although part of the role of these large intermediaries is to provide liquidity, their ability to enforce payment on behalf of foreign importers is an important aspect. Whereas a letter of credit is usually issued by a bank in the importer’s country, the guaranteeing ECA is often located in the country of the exporter. The source of their higher ability is two-fold: with ECA being partially government-owned and the importer often partially or fully owned by the government of the importing country, the liability takes on a role similar to sovereign debt with substantially higher political cost of default. Second, the Berne Union, an association of ECAs in London, requires all of its members to provide a list of “bad payers” (Levit, 2005), and the organization thereby increases the cost of deviation for these importers. Both can be directly interpreted as a higher $\hat{\phi}$.

4.5 The bank as a “long-run” player

This paper is closely related to the literature on the interaction between “long-run” and “short-run” players. Fudenberg, Kreps and Maskin (1990) derive “folk theorems” for this type of games, and demonstrate that long-run players can be encouraged to cooperate if deviations against one short-run player is punished by subsequent short-run players. Although technically, there are no short run players in the present setting, the infrequent interaction of importer-exporter pairs serve a similar role, and for increasingly infrequent transactions (replace 2 by

k and let $k \rightarrow \infty$), the two are mathematically identical. Kreps (1996) and Bull (1987) both analyze the interaction between a long-lived firm and short-lived workers, and argue that the existence of a reputation for honest behavior enables the players to escape short-run self-interest. In Bull (1987), the infinite life of a firm allows it to establish a reputation for paying out end-of-carrier bonuses for high effort, which again induces short-lived employees to provide effort. Klein and Leffler (1981) analyze the interaction between a long-lived firm and a series of short-lived consumers, and argue that concern of reputation prevents the firm from exploiting short-run gains from producing inferior quality. An important additional feature of the present paper, is the fact that whereas “real” short-run players are completely myopic, the importers here do have some concern for the future that can support trade, and the extent to which they can undermines the ability of the bank to credibly guarantee payments.

These papers are all careful in stating that a required assumption is the ability of one short-run player to be informed of and punish the long-run player based on behavior towards *previous* short-run players. For the market for letters of credit, this is not an entirely unreasonable explanation. A number of surveys are carried out each year where issuers of trade finance in a number of countries are assessed by exporters based on criteria such as size, price, and customer service. These are readily available online (for instance www.gfmag.com). Below, I relax the assumption of collective punishment by introducing an additional bank, on the side of the exporters, to serve the role as an additional long-run player.

5 Mutually confirmed letters of credit

A great deal of letters of credit are confirmed by an additional bank, often located in the country of the exporter. The following section explicitly introduces an additional bank, one in foreign and one in home, that can each make take-it-or-leave-it offers to their domestic importers as described in section 4. As demonstrated below this removes the need for collective punishment, as the international transaction is only conducted by two parties. To make the effects of a confirming bank the clearest, I will make the following assumption

Assumption 2 *Collective punishment is not possible, that is the actions of the importer and exporter in partial game i , cannot be made contingent on actions taken in partial game $j \neq i$.*

From proposition 2, unconfirmed bank guarantees are not possible under assumption 2. The analysis so far has focused on the enforceability issues of imports to home, but analogous expressions hold for foreign imports (exports from home). In particular, a bank in the foreign country will guarantee the payment to home exporters on behalf of foreign importers. This bilateral trade introduces an additional reason for mutually confirmed bank guarantees: If banks mutually confirm each others’ guarantee, the net amount necessary to transfer between the two

countries – and thereby the amount to be defaulted on – can be considerably smaller.²⁰ In effect, mutually confirmed guarantees partially transform international obligations into domestic obligations, which are more easily enforced. This effect is the topic of this section.

As can be seen from Figure 1, the confirmation introduces three agency problems in the place of the two from the unconfirmed letter of credit. The enforcement between the issuing bank and the importers is the same as before, and to avoid repetition I will assume $\hat{\phi}$ sufficiently high such that the limited enforcement problem between importers and the importers’ bank is never a constraint. The only international obligations are now between the two banks, but in addition the exporter must ensure that he can collect from the confirming bank. This could be a serious concern in cases where contract enforcement in the exporting country is weak. Since the main focus of this paper is on the enforcement of international contracts, I will set aside the enforcement problem between the exporter and the confirming bank in this section but address it in 5.1 and show that this naturally relates to the bundling of liquidity and guarantee in the letter of credit.

Recall that every period there is a mass 1 of home importers buying differentiated goods from a mass 1 of foreign exporters, but now introduce a mass α of foreign importers buying differentiated goods from the home country every period. The parameter captures the relative reliance of home exporters on letters of credit, and will determine the extent to which “netting” is possible. For low values of α only few home exporters rely on letters of credit when exporting to the foreign country.²¹

The netting is illustrated in figure 6. The solid lines represent shipments of goods from a home exporter to a foreign importer, and from a foreign exporter to a home importer. The dotted lines represent money transfers corresponding to these transactions. The length of the lines correspond to the dollar value of the shipment or transaction. If the two banks mutually confirm each others’ guarantees, the net amount to be transferred, and thereby the possibilities

²⁰In the law literature, the concept is referred to as “set-off” or “netting” (McKnight, 2008 and Wood, 1980). Although, the specific details vary across judicial systems, English law is clear on the matter: if a claim that is due is not honored, the debtor has the right of set-off, and in the case of insolvency or bankruptcy, even contract clauses specifically specifying no set-off will typically be ignored (Wood, 1980, 7.4). Under French law, matters seem to be somewhat less clear, but parties usually specify in letters of credit either international arbitration or that a dispute is to be heard in London implying English law. This introduces an additional point: as conflicts are often heard in English courts, the expertise of these courts, as well as the relative strong contract enforcement of English law, would give an additional argument in favor of letters of credit. Such is not modeled explicitly here.

²¹Alternative set-ups would lead to similar conclusions. I investigated a setup with heterogeneous firms where a fraction endogenously chooses to rely on letters of credit depending on the institutional quality of the importing country. This adds considerable complexity, but little insight on top of the ad hoc assumption presented here.

of renegeing, are substantially reduced.

Figure 6: Mutually confirmed letters of credit

itbpF3.8945in3.0544in0inFigure

Trade using letters of credit is higher from foreign to home.

“Netting” allows for smaller outstanding.

To formalize this, I slightly alter the game in section 4 such that the two banks initially simultaneously offer (q^M, T^M, F^M) to $n \leq 1$ home importers and (q^{M*}, T^{M*}, F^{M*}) to $n^* \leq \alpha$ foreign importers every period (Recall that there is a mass 2 of importers in the home country, and 2α in the foreign country, half of which import every period). Then the home bank offers the foreign bank the option of mutually confirming the letters of credit with a net transfer from home to foreign bank of Λ , and the foreign bank either accepts or rejects. If it accepts the offer the stage proceeds as described in section 4. Again, I consider the case where the importer IR is binding

I will look for a subgame perfect equilibrium of the same type with the addition that if a bank at any point deviates from the prescribed strategies, the other bank will refuse to deal with it again. The assumption that collective punishment is not possible then prevents future trade by letters of credit. By guaranteeing home importers, the home bank collects $p(q^M)q^M - \Pi^O$ from each of n home importers, and by confirming the letters of credit of the foreign bank, it will take upon itself the obligations of paying T^*q^{M*} to each of n^* home exporters (the exporter IR is binding so $T = c^*$ and $T^* = c$). Analogous expressions hold for the foreign bank, yielding per period profits of, respectively:

$$U = n [p(q^M)q^M - \Pi^O] - n^*cq^{M*} - \Lambda, \quad (13)$$

$$U^* = n^* [p(q^{M*})q^{M*} - \Pi^{O*}] - nc^*q^M + \Lambda. \quad (14)$$

By the assumption of perfect contract enforcement domestically, the banks cannot renege on the promise to pay their respective exporters. In equilibrium $\alpha < 1$ implies that at most the home bank IC will be binding. The IC constraint of the home bank is:

$$\frac{\delta}{1-\delta}U \geq (1-\phi)\Lambda. \quad (15)$$

Before explicitly solving for a subgame perfect equilibrium, consider first the situation in which banks keep their international obligations and only confirm each others' letters of credit without charging additional fees. In this case the transfer from home to foreign is the difference between what is owed foreign exporters and home exporters: $\Lambda = nc^*q^M - n^*cq^{M*}$. Using (13) and (15) this gives:

$$\frac{\delta}{1-\delta} [p(q^M)q^M - c^*q^M - \Pi^O] \geq (1-\phi)c^*q^M - (1-\phi)\frac{n^*}{n}cq^{M*}, \quad (16)$$

which differs from the IC constraint of the unconfirmed letter of credit (condition (12)) only in the term to the far right: by mutually confirming letters of credit, the banks transform international obligations from banks to overseas exporters into domestic obligations from banks to domestic exporters, which are typically more easily enforced (here perfectly). The term is naturally increasing in n^*/n , the relative importance of foreign obligations, as the net amount to be renegeed on is smaller.

In the analysis of unconfirmed letter of credit with only one bank the assumption that the bank had all bargaining power was natural and served to emphasize the role that positive profits play in ensuring the credibility of guarantees (and was not crucial for the analysis). With confirmed guarantees, two banks exist and assigning full bargaining power to one would be arbitrary. Instead, I trace out the subgame perfect equilibria that maximize a Nash bargaining weight of their respective profits:

$$\max (U)^\gamma (U^*)^{1-\gamma}, \quad (17)$$

subject to conditions (13) and (14) with $n \leq 1$ and $n^* \leq \alpha$. It is demonstrated in the appendix that $n^{M*} = \alpha$ and $p(q^M)q^M = \sigma\Pi^O$ is optimal for an interior solution. With an added restriction that the foreign bank guarantees first best shipment for foreign importers ($q^{M*} = q^{F*}$), the problem is reduced to choosing n^* and Λ to maximize (17) under the condition of (15).²²

Besides the fact that the assumption of collective punishment is no longer needed, confirmed letters of credit rely crucially on bilateral trade in guaranteed shipments to facilitate higher trade than what is possible under unconfirmed letters of credit. This is summarized in the following proposition.

Proposition 3 *Without collective punishment (assumption 2), confirmed letters of credit can increase trade. With mutually confirmed letters of credit*

- a) *Efficient trade can be supported for foreign importers: $n^{M*} = \alpha$ and $q^{M*} = q^{F*}$.*
- b) *The amount of trade that can be guaranteed by home banks, $n^M q^M$, is increasing in α , the number of foreign importers using letters of credit.*
- c) *The amount guaranteed is increasing in γ , the weight on the home banks utility function.*

Proof. In appendix ■

The proposition makes the two advantages of mutually confirmed letters of credit clear. First, the assumption of collective punishment is no longer necessary, and second, netting reduces the amount outstanding to be defaulted on, and increases credibility.

²²Imposing $q^{M*} = q^{F*}$ is a restriction. Were q^{M*} allowed to vary freely $q^{M*} > q^{F*}$ would be optimal; that is the foreign bank would guarantee a shipment higher than first best, as this would increase the obligations of the foreign on towards the home bank, which reduces the home bank's incentive to renege. Allowing this would complicate the graphical analysis but would qualitatively yield the same results. The question of whether banks depending on mutual business make otherwise inefficient decisions to reduce the incentive constraint is interesting but will not be addressed here.

Part b) of the proposition follows naturally. A lower number of foreign importers requiring guarantees lowers the IC constraint of the importer and reduces the number of importers that the home bank can guarantee from n^M to $n^{M'}$. The intuition follows directly from (16): if the foreign bank guarantees fewer foreign importers importing from home, the netting effect is smaller, and the outstanding amount for the home bank is larger. This outstanding amount must be lowered by reducing the number of importers that are offered a guarantee.

Part c of the proposition emphasizes an additional effect of the confirming letter of credit: the more bargaining power the foreign bank holds (lower γ), the less rent the home bank can obtain, and the incentive to renege increases.

In the theory presented in this section banks' only role is the provision of letters of credit. In reality banks engage with each other in a number of ways besides these letter of credit, often with amounts outstanding between them that are order of magnitude higher than those of letters of credit (derivatives, currency trading etc.), This makes the amount outstanding on letters of credit a small fraction of a bank's total gross outstandings. This suggests an additional reason for why banks and not specialized institutions handle the majority of letters of credit: the cost of renegeing on a letter of credit is not just being cut off from the letter of credit market, but also the cost of being cut off from other international activities crucial for the well-functioning of most modern banks.

Netting is naturally not isolated to the present setting. Bliss and Kaufman (2006) discuss the legal foundations of netting and argue that the concept is legally most cemented in the UK (where most legal disputes of letters of credit are resolved). Netting is an important feature of some payment systems as discussed in Rochet and Tirole (1996). They discuss existing real time gross systems, such as Fedwire operated by the Federal reserve system, where payments are executed one after the other in real time and deferred net settlement systems, such as CHIPS, where payments are netted at discrete time intervals (typically the end of the day). They argue that central banks tend to favor real time gross systems to facilitate monitoring, but that a netting system need only transfer the net amounts between parties and both liquidity need and risk can be substantially reduced; an effect closely related to the netting effect presented here. There is a crucial difference, however, in that there is no distinction between types of payments in Rochet and Tirole, whereas the distinction between international and domestic liabilities is crucial in the current model and drives the results. Rochet and Tirole (1996) hold the number of parties constant and vary the payment system. A netting system always (weakly) reduces the number of payments necessary. In the present model the possibility of netting is held at a constant and the number of parties is allowed to vary. Introducing an additional party always increases the total liabilities of the system, but reduces the international liabilities.

The possible introduction of an additional agent relates the present paper to an emerging literature on Central Clearing Partners (CCPs) for the trading of financial derivatives. Duffie

and Zhu (2010) discuss the tradeoff between “bilateral netting between pairs of counterparties across different underlying assets, versus multilateral netting among many clearing participants [through a CCP] across a single class of underlying assets”. They show that the introduction of a CCP for a single class of assets might increase counterparty exposure as the possibility of netting across assets is reduced.

5.1 Bundling of liquidity and guarantee in the letter of credit

Mutually confirmed guarantees partially transform the international obligations of banks towards overseas exporters into domestic obligations towards domestic exporters. Naturally, this works only if these domestic contracts can be better enforced. This is the underlying assumption of the paper but naturally there might be situations in which this is not true. This relates naturally to the bundling of liquidity and guarantee in the letter of credit: Consider an exporter engaged in international trade. He seeks the assistance of banks both to obtain liquidity and to obtain guarantees through a confirmed letter of credit. If he seeks the services from two separate banks, there exists two agency problems: the bank providing liquidity needs to ensure repayment from the exporter, and the exporter needs to ensure that he is paid by the confirming bank. If, however, the same bank provides both roles, these two agency problems cancel out: the bank will initially pay the exporter in full and only has to collect from the issuing bank. The exporter, having already secured his payment, faces no risk.²³

6 Extensions

In the main model the focus is on banks’ role in guaranteeing that the exporter receives payment. The role of reputation and banks’ ability to extract profits in establishing credibility of bank guarantees are emphasized by assuming the existence of a monopolist bank. In the following, I explicitly analyze local competition between banks and demonstrate that competition reduces rent and thereby trade. I then consider the choice between pre-payment and open account and argue that whereas bank guarantees are a natural alternative to open account where the concern is non-payment, intermediaries arise as a natural alternative to pre-payment where the concern is poor performance on quality.

6.1 Competition of banks

The theory presented here naturally relies on positive profits to sustain an incentive for honest behavior.²⁴ This, along with the fact that the industry is usually rather concentrated, begs

²³More specifically, the foreign exporter takes on debt of $D = c^*q^G$ from the bank providing the liquidity (ignore interest rates), and the bank guarantees the payment of $T^G q^G = c^*q^G$, such that the net outstanding from exporter to bank is $D - T^G q^G = c^*q^G - c^*q^G = 0$.

²⁴Klein and Leffler (1981) show a similar result in the context of a “brand” producer where rents are necessary for the producer not to shirk on quality.

the question: how would increased competition affect the market outcomes? The question is analyzed in a setting of duopoly in the market for issuance of guarantees.

There are two banks, bank A and bank B , both offering letters of credit to home importers. For simplicity I consider only unconfirmed letters of credit (so assumption 2 no longer holds). Although banks offer a homogenous product (a contract offering to guarantee as shipment q at a fee F), they differ in their ability to monitor importers. In a slight deviation from the setup above, bank $j \in \{A, B\}$ can monitor importer i at cost $m_j(i)$. Importers are located along a line segment of length 1 (with density 2), and the two banks are located at 0 and 1, respectively, as originally analyzed in Hotelling (1929). Again, half of these importers will be active every period. But whereas the original model was about transportation costs or more generally horizontal differentiation, the distance to the bank of a given importer i is proportional to the monitoring costs of that bank. This is meant to capture the notion that banks have varying familiarity with importers. The monitoring costs are:

$$m_A(i) = \hat{m}i,$$

$$m_B(i) = \hat{m}(1 - i),$$

where the parameter \hat{m} is an inverse measure of the level of competition: with high \hat{m} , there are large cost differences in monitoring, and banks can have larger market power with importers.

The banks are engaged in Bertrand competition. The only difference from the game in section 4 is that banks now simultaneously offer a letter of credit contract $(q^A(i), T^A(i), F^A(i))$ and $(q^B(i), T^B(i), F^B(i))$, $i \in [0, 1]$, respectively to all importers, and importers choose between these two and open account. The game then proceeds as described for unconfirmed letters of credit above.

I consider strategies of the following form: All banks offer contracts to all importers. If a bank has not previously deviated, the contract is taken to be credible. If it has, no contract is accepted. The importer chooses the credible contract that maximizes profits from open account and the two banks' offered letters of credit contracts. The IC constraint are:

$$\frac{\delta}{1 - \delta} \int_0^{x_A} (F^A(i) - m_i) q^A(i) di = (1 - \phi) c^* \int_0^{x_A} q^A(i) di, \quad (18)$$

$$\frac{\delta}{1 - \delta} \int_{x_B}^1 (F^B(i) - (1 - m_i)) q^B(i) di = (1 - \phi) c^* \int_{x_B}^1 q^B(i) di, \quad (19)$$

where bank A guarantees $[0, x_A]$ and bank B guarantees $[x_B, 1]$, and $x_A \leq x_B$. A candidate for a subgame perfect equilibrium of this type must have contracts $(q^A(i), T^A(i), F^A(i))$ and $(q^B(i), T^B(i), F^B(i))$ that are immune to the following undercutting in price (a full formal description of the game is available on the author's website):

Consider bank A . For a binding IC constraint (18), bank A can "steal" a client $i' \in [x_B, 1]$ from bank B (technically, it will steal two, one from each alternating period) if it offers a better

contract that does not tighten the IC constraint, which requires $\frac{\delta}{1-\delta} [F^A(i') - m(i')] q^A(i') \geq (1-\phi) c^* q^A(i')$. As importer profits are $\Pi(q^A(i'), F^A(i')) = [p(q^A(i')) - (c^* + F^A(i'))] q^A(i')$, the highest profits that bank A can offer importer i' without tightening its own IC is:

$$\hat{\Pi}(m_A(i')) = p(\hat{q}) \hat{q} - c^* \eta - m_A(i'),$$

with $p(\hat{q}) = \sigma/(\sigma-1)\eta$ and $\eta \equiv (1-\phi)(1-\delta)/\delta + 1$. Bank A can profitably do this for any equilibrium where bank B offers importer i' less than $\hat{\Pi}(m_A(i'))$. For simplicity consider the case where $\min\{\hat{\Pi}(m_A(i)), \hat{\Pi}(m_B(i))\} \geq \Pi^O$ such that both banks can offer a contract superior to open account, and an Importer IR constraint like (11) is non-binding. Symmetry then leads to an IC constraint of bank B of:²⁵

$$\frac{\delta}{1-\delta} \int_{1/2}^1 [p(q^B(i)) q^B(i) - \hat{\Pi}(m_A(i)) - m_B(i)] di \geq (1-\phi) \int_{1/2}^1 q^B(i) di,$$

which is a direct parallel to equation 12 in section 4.1, but with the outside option for the importer being the other bank, and not open account shipment. Consider a binding IC constraint, and differentiate the left hand side wrt \hat{m} :

$$-\frac{\delta}{1-\delta} \int_{1/2}^1 \left[\frac{\partial \hat{\Pi}(m_A(i))}{\partial \hat{m}} + \frac{\partial m_B(i)}{\partial \hat{m}} \right] di. \quad (20)$$

With $\partial \hat{\Pi}(m_A(i))/\partial \hat{m} = -i$ and $\partial m_B(i)/\partial \hat{m} = (1-i)$ and the integral running from 1/2 to 1, the derivative is positive: an increase in \hat{m} loosens the IC constraint and allows for higher shipment. Consequently, more competition – a drop in \hat{m} – tightens the IC constraint and reduces the ability of banks to guarantee shipments. There are two opposite effects: on the one hand, a decrease in \hat{m} reduces the monitoring cost and increases rent and thereby credibility. On the other hand, a decrease in \hat{m} improves the ability of bank A to poach the clients of bank B , which reduces profitability and thereby credibility. That the second effect dominates is particular to the present setting, but the existence of two opposite effects is more general.

The question of whether competition between banks is welfare improving is widely discussed in the literature (Allen and Gale, 2001, chapter 8 provide a review). Although the primary focus of the authors is on how too much competition might lead to excessive risk taking, they argue that branch banking (few large players with many branches) can be Pareto superior because it allows banks to build reputations for honest behavior. Although similar to the argument presented here, what is crucial for equation (20) is that the lower profits that follow from tighter competition undermine the credibility of the banks and allow them to provide fewer guarantees.

²⁵One can show that the quantity $q^B(i)$ will be the same for all importers guaranteed, though this is not relevant for the argument that follows.

6.2 Open account versus pre-payment

The main text focused on the choice between open account and bank guarantees. This section analyzes the case of pre-payment and argues that intermediaries can serve a role analogous to the banks above in guaranteeing high quality shipment. Change the game such that the payment T^P (P for pre-payment) is due before the shipment is made. This has two implications: First, as it is now the importer who bears the liquidity cost, it is necessary to be explicit about the different liquidity cost in the two countries. Let the interest rate in home be r and the foreign interest rate be r^* such that the cost of production using open account is $\hat{c}^* = (1 + r^*) c^*$, whereas if the importer bears the liquidity cost she will pay an interest rate of r . Second, as the exporter receives the money up-front, the hold-up problem changes from the short run incentive of the importer reneging on payment to the exporter either not delivering or making goods of lower quality. If the importer receives low quality goods after having paid, she can sue in the foreign courts and with a probability $\rho^* > 0$ the courts will rule in her favor, in which case she is returned the payment T^P .²⁶ If they do not, the exporter can keep the payment. Again, one can demonstrate that no strategies can support a contract better than the simple trigger strategies of reverting to no trade forever.

To simplify the analysis, assume that a foreign court can perfectly verify if the exporter sent a high quality shipment, so there is no IC constraint to prevent the importer from dishonestly claiming low quality. The contract (T^P, q^P) that maximizes profits under the condition of being supportable by a subgame perfect equilibrium is given by:

$$\hat{V}^I = \max_{q, T} p(q)q - (1 + r)Tq + \delta^2 \hat{V}^I, \quad (21)$$

subject to:

$$\text{Producer IC: } \hat{V}^X \equiv \frac{1}{1 - \delta^2} [T - c^*]q \geq (1 - \rho^*)Tq, \quad (22)$$

where \hat{V}^I and \hat{V}^X are the value functions using pre-payment and now the importer bears the liquidity cost. The left hand side of the exporter IC is the total discounted value of future trade, whereas the right hand side is the expected gain from deviating. There is no cost of producing low quality goods, but there is a probability ρ^* that the importer wins the case and

²⁶This assumption is not inconsistent with the home court's ability to perfectly verify a good to be of low quality. Once the payment has been made, the importer must seek repayment from the producer in a *foreign* court for goods that have already arrived in the home country, which increases the burden of proof (since the goods are in a different country) and exposes the importer to the complexities and possible biases of a foreign court system. Only the assumption that the importer stands a better chance in the legal system of the importing country than in the exporting country is necessary.

T is lost.²⁷ A binding IC constraint gives a result analogous to proposition 1.²⁸

$$p(q^P) = \frac{\sigma}{\sigma - 1} \frac{(1 + r) c^*}{1 - (1 - \delta^2)(1 - \rho^*)}. \quad (23)$$

Naturally, the optimal shipment is increasing in, ρ^* , the importer's ability to win in court should the exporter ship low quality. Let profits from using pre-payment be $\Pi^P = p(q^P) q^P - T^P q^P$, where T^P is given by a binding (22). Continuing to focus on the SPE that maximizes importer profits, the question of form of shipment is made by comparing Π^O and Π^P . This leads to the following proposition:

Proposition 4 *Comparing the SPEs that maximize importer profits under open account and pre-payment, there is a cut-off value $\bar{\beta}$ for which the importer is indifferent between open account and pre-payment. It is defined by*

$$\Pi^P(r, \delta, \rho^*) = \Pi^O(r^*, \delta, \phi, \bar{\beta}) \quad (24)$$

All importers with $\beta \geq \bar{\beta}(r, \rho^, \phi, r^*, \delta)$ will choose open account, and all $\beta < \bar{\beta}$ will choose pre-payment. $\bar{\beta}$ is decreasing in importer legal quality ϕ , and the importer's interest rate, r^* . It is increasing in the quality of the foreign legal environment ρ^* , and the interest rate of the importer.*

Proof. Follows directly from implicit differentiation of equation (24). ■

The first parts of the proposition follow naturally from the discussion above: the better is the relative contract enforcement in the jurisdiction of the potential reneging party – importer for open account and exporter for pre-payment – the more likely a contract that leaves the incentive to cheat on this party. Similarly, the liquidity cost should be shifted to the party with the lowest cost. The outside value of the good, β , only affects the open account transaction, so higher outside option, which increases the relative bargaining situation of the exporter in case of dispute, will increase profits from open account. This suggests that goods that are easily resold or sales to markets that are closer should more often be served by open account. The last finding is in line with Antràs and Foley (2010).

The crucial difference between the agency problems of open account and pre-payment make it clear why letters of credit are better substitutes for open account: banks have little expertise in enforcing quality from the exporter. A theory of intermediaries, however, could be

²⁷One could introduce additional costs for breach of contract (expectation damages in fact would allow the importer to claim $p(q)$ from the producer). Yet, with a wealth constraint, no more than T can be recouped from the producer.

²⁸Again, the choice of a particular Pareto-optimal subgame perfect equilibrium is not essential. Letting $\gamma \in [0, 1]$ be the weight on the importer's utility function, the quantities shipped for the full set of equilibria of the trigger type is described by: $p(q) = \frac{\sigma}{\sigma - \gamma} \frac{R^2}{1 - (1 - \rho^*)(1 - \delta^2)}$. A higher weight on the importer's utility (higher γ) implies a higher incentive for cheating on quality for the exporter and a lower shipment can be supported.

constructed along the lines here to serve that role. Intermediaries, would be large – consistent with the findings in Ahn *et al.* (2010) – so as to be able to credibly guarantee the shipment of high quality goods, and they would be specialized in a few markets (and located in the country of the exporters) so as to be better able to enforce proper quality from the exporters. These facts are consistent with the role of many intermediaries facilitating exports from developing countries.

7 Conclusion

Weak contract enforcement is an important aspect of international trade. I argue that guaranteeing banks, large intermediaries, and ECAs can be seen as mechanisms for establishing reputation for firms unable to do so themselves. The specific focus of the paper is on banks' role in guaranteeing payment by importers. The paper proceeds in three steps: First, it is demonstrated that firms themselves can overcome limited enforcement issues if they are a part of networks or interact sufficiently often. Second, for firms where this is not possible a bank more frequently interacting can improve matters *if* it can extract sufficient profits and exporters can collectively punish it by withdrawing business if it reneges on one of them. Third, a confirming bank of the exporters is shown to overcome the assumption of collective punishment and further mutually confirmed guarantees further introduces “netting”: when banks have mutual outstandings on each other they can only renege on the net amount and sustaining honest behavior is easier. The analysis suggests a concentrated industry in which banks interact repeatedly with the same parties internationally in line with observed patterns.

The paper offers additional empirical predictions and policy implications. It predicts that networks and letters of credit are most important for countries with weak contracts and for trade in specialized goods in line with limited empirical results. Future studies using micro data of the choice of contracts will shed further light on the importance of weak contract enforcement and reputations for international trade. The theory further predicts that contracts in international trade should in general be designed such that the larger player has the biggest incentive to deviate; its larger size will make deviation more costly.

The theory separates the roles of banks as providers of liquidity and guarantees and argues that the health of the financial system can affect trade through both channels. The liquidity channel depends critically on the length of the transaction, whereas the guaranteeing aspect depends crucially on the type of good and the contract enforcement of the importing country. In principle it should be possible to distinguish between the two empirically. Naturally, a more direct empirical analysis with bank-firm data would be valuable.

The result that small changes to parameters can have discontinuous effects on banks' ability to guarantee has two implications: First, in times of crisis offering government guarantees can help sustain credibility and support trade. Second, changes in the competitive structure or the

regulatory environment – such as a possible increase in capital requirement on trade finance in the Basel III accord – can decrease profits and have adverse effects on banks’ ability and willingness to offer guarantees.

Finally, to focus on banks’ role in facilitating reputations the analysis here is limited to firms exogenously locked into relationships and banks are the only intermediaries considered. Examining the choice of trade partners and the role of large intermediaries in the light of reputations is an interesting topic for future research.

References

8 Appendix

8.1 The letter of credit contract

This appendix gives a more detailed description of the legal details of a letter of credit and how the execution is often done. See McCullough (1987) for a comprehensive description of letters of credit or del Busto (1994) for a practical user's guide. Figure 8 below illustrates a typical version of the transactions in an unconfirmed letter of credit. The importer originally negotiates a sales contract and agrees upon the use of a letter of credit. The letter of credit is a legal document separated from the underlying sales contract in that it deals solely in documents and not the underlying transfer of goods. Once the letter of credit and the sales contract have been agreed upon by all parties the actual shipment of goods can take place. When the exporter ships the goods from his port he obtains documents from the shipping company necessary to claim the goods from the port of the importer. The exporter sends these documents to the issuing bank and the letter of credit requires payment, typically at the time of receipt (on sight), but occasionally later. The issuing bank then forwards these documents to the importer who needs them to claim the goods when they arrive. Whether the bank requires immediate payment from the importer depends on the specific details of the letter of credit. Once the importer has received the documents she can claim the goods from the shipping company.

Figure 8. The documents of a letter of credit

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8.2 Open account. Definition and subgame perfection

This appendix formally states the open account game between the exporter and the importer, demonstrate that the proposed strategies in the main text are subgame perfect. The full game is the following stage game repeated every other period, $t = 0, 2, 4, \dots$

1. Definition of stage game. The stage game at t has two players: exporter and importer. I split the stage game into 4 substages, where each corresponds to a decision node. Substage t^0 : both importer and exporter decide whether to engage in trade ($m_t^s = 1$, $s = I, X$) or not ($m_t^s = 0$, $s = I, X$). The stage game continues only if $m_t^I m_t^X = 1$. Substage t^1 : importer offers a contract $C_t^O = (q_t, T_t) \in \mathbb{R}_+ \times [0, p(q_t)]$, where T_t is payment per unit and importer is wealth-constrained, $T_t \leq p(q_t)$. Substage t^2 : Producer ships $q_t^X \in \{0, q_t\}$ (where $q_t^X = 0$ is not accepting). If the exporter ships $q_t^X = q_t$ the game proceeds to substage t^3 . Substage t^3 : importer either pays ($T_t^I = T_t$ per unit) or not ($T_t^I = 0$). (q_t, T_t) is thereby the contract, and q_t^X and T_t^I the corresponding decision by the exporter and importer, respectively, to adhere to it.

2. Payoffs

If no shipment has been made, pay-off is zero for both parties. If shipment has been made, and the importer pays the pay-offs for this period are $(p(q_t) - T_t) q_t$ and $(T_t - c^*) q_t$ for importer and exporter, respectively. If importer does not pay, the case goes to court, and expected payment from importer to exporter is $\phi T_t + (1 - \phi) \beta$ per unit, and expected profits are $p(q_t) q_t - [\phi T_t + (1 - \phi) \beta] q_t$ and $[\phi T_t + (1 - \phi) \beta] q_t$, respectively. Players discount the pay-offs between games with δ^2 .

3. Outcomes

Let an outcome of subgame t be $a_t = \{(m_t^I, m_t^X), (q_t, T_t), q_t^X, T_t^I\}$ for $t = 0, 2, 4, \dots$. Using this, I define a type of history for each type of substage, respectively:

$$h(t^0) = (\dots, a_{t-4}, a_{t-2})$$

$$h(t^1) = h(t^0) \cup \{(m_t^I, m_t^X)\}$$

$$h(t^2) = h(t^1) \cup \{(q_t, T_t)\}$$

$$h(t^3) = h(t^2) \cup \{q_t^X\},$$

with the set of possible histories correspondingly defined as $H(t^i)$ for $i = 0, 1, 2, 3$. Consider a given contract (q^O, T^O) and define the corresponding outcome in stage game t $a_t^*(q^O, T^O) = \{(1, 1), (q^O, T^O), q^O, T^O\}$ as the outcome of a game for which the contract (q^O, T^O) is proposed and adhered to by both parties. Let $h^*(t^i; (q^O, T^O))$, $i = 0, 1, 2, 3$ as a history were the contract was proposed and adhered to in all previous periods, with $H^*(t^i; (q^O, T^O))$, $i = 0, 1, 2, 3$ as the corresponding set of histories.

4. Strategies

I misuse notation slightly by defining strategy functions $m_t^I(h(t^0)) : h(t^0) \rightarrow \{0, 1\}$ and $m_t^X(h(t^0)) : h(t^0) \rightarrow \{0, 1\}$ as the strategy function for whether the importer and exporter participates in stage game t , $C_t^O(h(t^1)) : h(t^1) \rightarrow \mathbb{R}_+ \times [0, p(q_t^O)]$ as the strategy function of the importer when proposing a contract, and correspondingly $q_t^X(h(t^2)) : h(t^2) \rightarrow \{0, q_t\}$ and $T_t^I(h(t^3)) : h(t^3) \rightarrow \{0, T_t\}$ as the strategy function of the exporter when deciding whether to make the shipment, and the strategy function of the importer determining whether she will pay.

5. Contracts supportable by trigger strategies.

I find the set of contracts, (q^O, T^O) , for which there exists subgame perfect equilibria with simple trigger strategies as described below, that will support both parties adhering to the contract (that is where $a_t^*(q^O, T^O) = \{(1, 1), (q^O, T^O), q^O, T^O\}$ will be the outcome every period). For a given candidate contract (q^O, T^O) consider the following trigger strategies, with the understanding that the set of histories $H^*(t^i)$, $i = 0, 1, 2, 3$ correspond to the set of histories where everybody has adhered to this contract ($H^*(t^i; (q^O, T^O))$, $i = 0, 1, 2, 3$):

$$\begin{aligned}
m_t^s(h(t^0)) &= \begin{cases} 1 & \text{if } h(t^0) \in H^*(t^0) \\ 0 & \text{else} \end{cases}, \text{ for } s = I, X, \\
C_t^O(h(t^1)) &= \begin{cases} (q^O, T^O) & \text{if } h(t^1) \in H^*(t^1) \\ (\hat{q}, p(\hat{q})) & \text{else} \end{cases}, \\
q_t(h(t^2)) &= \begin{cases} q^O & \text{if } h(t^2) \in H^*(t^2) \\ q_t & \text{if } h(t^2) \notin H^*(t^2) \text{ and } \phi T_t + (1 - \phi)\beta \geq c \\ 0 & \text{else} \end{cases}, \\
T_t(h(t^3)) &= \begin{cases} T^O & \text{if } h(t^3) \in H^*(t^3) \\ T_t & \text{if } h(t^3) \notin H^*(t^3) \text{ and } T_t \leq \beta \\ 0 & \text{if } h(t^3) \notin H^*(t^3) \text{ and } T_t > \beta \end{cases},
\end{aligned}$$

where \hat{q} is the optimal shipment in a one shot game (as defined in equation (1)):

$$\phi(p(q) - c^*) \geq (1 - \phi)(c^* - \beta).$$

To show that these strategies are subgame perfect, I exploit the one-shot deviation principle, and examine the different subgames in order. Consider first the optimality of $T_t^I(h(t^3))$. For $h(t^3) \in H^*(t^3)$ the condition is:

$$\delta^2 / (1 - \delta^2) (p(q^O) - T^O) \geq (1 - \phi)(T^O - \beta), \quad (25)$$

which is condition 4 in the main text. For $h(t^3) \notin H^*(t^3)$ the condition for payment:

$$(\phi T^O + (1 - \phi)\beta) \geq T^O,$$

which gives the strategy function $T_t(h(t^3))$. Consider the optimality of $q_t^X(h(t^2))$. For $h(t^2) \in H^*(t^2)$ the condition is: $(T^O - c^*)q^O + \delta^2 / (1 - \delta^2) (T^O - c^*) \geq 0$, which requires:

$$T^O \geq c^*. \quad (26)$$

For $h(t^2) \notin H^*(t^2)$ the optimality follows from the discussion in section 3.1. Consider the optimality of $C_t(h(t^1))$. For $h(t^1) \in H^*(t^1)$ adhering to the contract returns: $(1 - \delta^2)^{-1} (p(q^O) - T^O)q^O$, whereas offering $(\hat{q}, p(\hat{q}))$ is the best alternative which yields $(p(\hat{q}) - c)\hat{q}$. (q^O, T^O) is optimal if:

$$(1 - \delta^2)^{-1} (p(q^O) - T^O)q^O \geq (p(\hat{q}) - c)\hat{q}. \quad (27)$$

Finally for $m_t^s(h(t^0))$, $s = I, X$. For $h(t^0) \in H^*(t^0)$, the conditions are, respectively:

$$\frac{1}{1 - \delta^2} [p(q^O) - T^O] q^O \geq 0,$$

$$[T^O - c^*] q^O \geq 0,$$

whereas for $h(t^0) \notin H^*(t^0)$, the optimality of $m_t^s(h(t^0)) = 0$ follows from the fact that the other player is not participating. The equations in the main text refer to the case where the importer has all the bargaining power so $T^O = c^*$ and condition (25) reduces to:

$$\delta^2 / (1 - \delta^2) (p(q^O) - c^*) \geq (1 - \phi) (c^* - \beta),$$

and the condition for the one-shot strategy not to be optimal is:

$$(1 - \delta^2)^{-1} (p(q^O) - c^*) q^O \geq (1 - \phi) (p(\hat{q}) - c) \hat{q},$$

which is satisfied by assumption (1).

8.3 The set of profiles supportable by trigger strategies

This section describes the set of pareto-optimal equilibria supportable by trigger strategies as described above. It can be found by maximizing a weighted sum of utility:

$$\max_{q, T} q (p(q) - T)^\gamma (T - c^*)^{1-\gamma},$$

subject to the conditions described above: (25) and (26) and (27). Consider the case where trade is constrained ($p(q) > \sigma / (\sigma - 1) c^*$), such that equation (27) must be binding. Substituting and maximizing gives:

$$\zeta(\sigma, \gamma) \frac{\delta^2}{1 - \delta^2} [p(q) - c^*] = (1 - \phi) (c^* - \beta),$$

where $\zeta(\sigma, \gamma) = \frac{[p(q) - \beta - \gamma / \sigma p(q) - (1 - \gamma) / \sigma p(q)]}{[p(q) - \beta - \gamma / \sigma p(q) + p(q) (1 - \gamma) \delta^2 / \sigma (1 - \phi) (1 - \delta^2)]} \leq 1$ and $\zeta(\sigma, 1) = 1$, which reduces to equation (6) in the main text. Any weight to the exporter reduces profits to the importer, and thereby the highest possible shipment.

8.4 The strategies considered in the main text are pareto-optimal

I seek to prove that there exists no subgame perfect equilibrium which yields higher profits for the importer than the (q^O, c^*) considered in the text. Consider candidate strategies (σ_I, σ_X) , for the importer and exporter, respectively, with corresponding outcome $(q_t, T_t)_{t=0}^\infty$ (where for notational reasons I let the game be repeated every period with discount factor δ^2 , where the strategy profile is required to satisfy the IR constraint for the exporter and yield higher discounted profits for the importer: $\sum_{t=0}^\infty \delta^{2s} (T_t - c^*) q_t \geq 0$ and $\sum \delta^{2t} [p(q_t) - T_t] q_t > \frac{1}{1 - \delta^2} [p(q^O) - c^*] q^O$).

Consider first a strategy that requires for honest payment by the importer in all periods:

$$\sum_{s=1} \delta^{2s} (p(q_{t+s}) - T_{t+s}) q_{t+s} \geq (1 - \phi) (T_t - \beta) q_t + \delta^2 \hat{v}_{t+1}(\sigma_I, \sigma_X), \text{ for all } t \geq 0,$$

where \hat{v}_{t+1} is the punishment described from the following period for the importer should she not honor the payment. Since nonparticipation is possible $\hat{v}_{t+1} \geq 0$ for all t . Clearly prescribing $\hat{v}_{t+1} = 0$ for all t is possible and optimal, and a Pareto optimal strategy profile must have this characteristic. Since there is no IC constraint for the exporter, it is optimal to set $\sum_{s=0}^{\infty} \delta^{2s} (T_{t+s} - c^*) q_s = 0$ for all t , such that $T_t = c^*$ which gives:

$$\sum_{s=1} \delta^{2s} (p(q_{t+s}) - c^*) q_s \geq (1 - \phi) (c^* - \beta) q_t, \text{ for all } t \geq 0,$$

Now consider the quantities $(q_s)_{s=0}^{\infty}$ and some t and t' for which:

$$\sum_{s=0} \delta^{2s} (p(q_{t+s}) - c^*) q_{t+s} > \sum_{s=0} \delta^{2s} (p(q_{t'+s}) - c^*) q_{t'+s}. \quad (28)$$

Consider the case where $t > t'$, and the alternative quantities of $(q_1, q_2, \dots, q_{t'-1}, q_t, q_{t+1}, \dots)$. The IC constraints from t onwards obviously still hold, and from equation (28) the IC constraint for $t' - 1$ will be loser and $q_{t'-1}$ can be increased. A similar argument can be made if $t < t'$, and only a profile of constant q is possible. Hence, there exists no subgame perfect equilibrium where the importer adheres to the contract every period that dominates the one found in the appendix. Similar logic can be applied to show that there exists no subgame perfect equilibrium in which the importer never adheres to the contract, nor does so in some periods.

8.5 Appendix unconfirmed bank

This appendix formally states the unconfirmed letter of credit game between the exporters, importers, and the bank. The set of players in the full game is $\{(I_i)_{i=0}^{\alpha}, (X_i)_{i=0}^{\alpha}, B\}$, where I_i and X_i correspond to the importer and exporter of pair i , respectively, and b is the bank. I first define the partial game i , as the game consisting of just $\{I_i, X_i, B\}$ for some i , and show that the bank cannot serve a role for such a game.

1. Definition of stage game for the partial game i (suppress the subscript i in the following). The stage game has three players: importer i , exporter i , and a bank. I split the stage game into 5 substages, where each correspond to a decision note. Since a part of the stage game corresponds to the stage game in the open account, I distinguish between substages t^i as described in the appendix above, and t_b^0 corresponding to the additional substages of the letter of credit. Substage t_b^0 : Bank offers open letter contract $C_t^b = (q_t, T_t, P_t)$. Substage t_b^1 : Importer chooses open account contract ($n_t^I = \{OA\}$) in which case the stage game proceeds as described for the open account, so substages t^0, t^1, t^2 and t^3 take place. Alternatively, she chooses the letter of credit contract ($n_t^I = \{LC\}$) in which case the game proceeds to substage t_b^2 . Substage t_b^2 : Importer decides whether to continue ($\tilde{m}_t^I = 1$) or not ($\tilde{m}_t^I = 0$). Simultaneously, exporter makes the same decision (with corresponding $\tilde{m}_t^X \in \{0, 1\}$). Game continues only if $\tilde{m}_t^I \tilde{m}_t^X = 1$. Substage t_b^3 : Substage t_b^3 : exporter decides on quantity $q_t^X \in \{0, q_t\}$. Substage t_b^4 : Importer

decides whether to pay ($T_t^I = T_t + P_t$) or not ($T_t^I = 0$). Bank simultaneously decides whether to pay ($T_t^b = T_t$) or not ($T_t^b = 0$).

2. Stage game pay-offs

If shipment is not made, payoff is zero for all three players. If open account is chosen, pay-off is as described above. If letter of credit is chosen, and shipment is made: if both bank and importer pays, pay-offs are: $[p(q_t) - (T_t + P_t)]q_t$, $(T_t - c^*)q_t$, and P_tq_t , for importer, exporter, and bank, respectively. If importer does not pay, but bank does so, expected return is $p(q_t)q_t - \hat{\phi}(T_t + P_t)q_t$ and $(\hat{\phi}(P_t + T_t) - T_t)q_t$ for importer and bank. If importer pays, but bank does not, expected return is $((P_t + T_t) - \phi T_t)q_t$ and $(\phi T_t - c^*)q_t$ for bank and exporter, and if neither of them pay, returns are: $p(q_t)q_t - \hat{\phi}(T_t + P_t)q_t$, $(\hat{\phi}(P_t + T_t) - \phi T_t)q_t$ and $(\phi T_t - c^*)q_t$.

3. Outcomes

Using this, I can define an outcome of the stage game as $\tilde{a}_t = ((q_t, T_t, P_t), n_t^I, a_t, (\tilde{m}_t^I, \tilde{m}_t^X), q_t^X, (T_t^I, T_t^b))$, where a_t is the history of the open account stage game as it was described above. From this I can define histories as:

$$\begin{aligned}\tilde{h}(t_b^0) &= (\dots, \tilde{a}_{t-4}, \tilde{a}_{t-2}) \\ \tilde{h}(t_b^1) &= \tilde{h}(t_b^0) \cup \{(q_\tau^G, T_\tau^G, P_\tau^G)\} \\ \tilde{h}(t_b^2) &= \tilde{h}(t_b^1) \cup \{LC, a_t\} \\ \tilde{h}(t_b^3) &= \tilde{h}(t_b^2) \cup \{(\tilde{m}_\tau^d, \tilde{m}_\tau^p)\} \\ \tilde{h}(t_b^4) &= \tilde{h}(t_b^3) \cup \{q_\tau\},\end{aligned}$$

with the set of possible histories correspondingly defined as $\tilde{H}(t_b^i)$, for $i = 0, 1, 2, 3, 4$. Consider a given contract (q^G, T^G, P^G) , and define the outcome $\tilde{a}^*(q^G, T^G, P^G) = \{(q^G, T^G, P^G), n^I, a^*, (1, 1), q^G, (T^G + P^G, T^G)\}$, $n^I \in \{OA, LC\}$ as outcome of the stage game for which all adhere to the letter of contract *or* the importer chooses the open account transaction and everybody adheres to that, with the open account stage game is the best outcome for the importer achievable as a subgame perfect outcome described in the main text: $a^* = \{1, 1, (q^O, c^*), q^O, c^*\}$. That is, the importer choosing open account is not considered as a deviation. Note, that I can then define a history for which all have adhered to the contract $\tilde{h}^*(t_b^i)$, $i = 0, 1, 2, 3, 4$, with a corresponding set of all histories of $\tilde{H}^*(t_b^i)$, $i = 0, 1, 2, 3, 4$.

4. Strategies

In a manner similar to above, I define strategy functions of $C_t^b : \tilde{h}(\tau^0) \rightarrow \mathbb{R}_+^3$, as the strategy function of the proposed contract by the bank, $n_t^I : \tilde{h}(t_b^1) \rightarrow \{OA, LC\}$, as the strategy function of whether to accept the letter of credit or instead propose open account, $m_t^I : \tilde{h}(t_b^2) \rightarrow \{0, 1\}$, $m_t^X : \tilde{h}(t_b^2) \rightarrow \{0, 1\}$, as the participation function of the importer and exporter, respectively, $q_t^X : \tilde{h}(t_b^3) \rightarrow \{0, q_t\}$, as the strategy function of whether to make the shipment, and $T_t^b : \tilde{h}(t_b^3) \rightarrow \{0, T_t\}$ and $T_t^I : \tilde{h}(t_b^3) \rightarrow \{0, T_t + P_t\}$ as the strategy function for

whether to honor payment for the bank and the importer. This concludes the description of the strategies.

5. Subgame perfect of trigger strategies.

Consider a given candidate letter of credit contract (q^G, T^G, P^G) with the understanding that $\tilde{H}^*(t_b^i)$, $i = 0, 1, 2, 3, 4$ correspond to histories where this contract has been honored in all previous stages. Consider the strategies:

$$\begin{aligned}
C_t^b(\tilde{h}(t_b^0)) &= \begin{cases} (q^G, T^G, P^G) & \text{if } \tilde{h}(t_b^0) \in \tilde{H}^*(t_b^0) \\ (0, 0, 0) & \text{else} \end{cases}, \\
n_t^I(\tilde{h}(t_b^1)) &= \begin{cases} \{LC\} & \text{if } \tilde{h}(t_b^1) \in \tilde{H}^*(t_b^1) \\ \{OA\} & \text{else} \end{cases}, \\
m_t^s(\tilde{h}(t_b^2)) &= \begin{cases} 1 & \text{if } \tilde{h}(t_b^2) \in \tilde{H}^*(t_b^2) \\ 0 & \text{else} \end{cases} \text{ for } s = I, X, \\
q_t^X(\tilde{h}(t_b^3)) &= \begin{cases} q^G & \text{if } \tilde{h}(t_b^3) \in \tilde{H}^*(t_b^3) \\ q_t & \text{if } \tilde{h}(t_b^3) \notin \tilde{H}^*(t_b^3) \text{ and } \phi T_t \geq c^* \\ 0 & \text{else} \end{cases}, \\
T_t^I(\tilde{h}(t_b^4)) &= \begin{cases} P^G + T^G & \text{if } \tilde{h}(t_b^4) \in \tilde{H}^*(t_b^4) \\ 0 & \text{else} \end{cases}, \\
T_t^b(\tilde{h}(t_b^4)) &= \begin{cases} T^G & \text{if } \tilde{h}(t_b^4) \in \tilde{H}^*(t_b^4) \\ 0 & \text{else} \end{cases},
\end{aligned}$$

and the open account strategies as described above, in particular a deviation from the bank implies reversion to open account strategies, but a deviation from an importer or an exporter implies no trade forever. Note first, that given this strategy, the open account strategies will be optimal in all substages t^0, t^1, t^2 and t^3 . I check the optimality of the strategies. Consider first a history of $\tilde{h}(t_b^4)$. For $T_t^b(t_b^4)$, optimality for $\tilde{h}(t_b^4) \in \tilde{H}^*(t_b^4)$ requires:

$$\frac{\delta^2}{1 - \delta^2} P^G \geq (1 - \phi) T^G, \quad (29)$$

and it is easy to see that not paying is optimal for $\tilde{h}(t_b^4) \notin \tilde{H}^*(t_b^4)$. For $T_t^b(\tilde{h}(t_b^4))$ optimality requires for $\tilde{h}(t_b^4) \in \tilde{H}^*(t_b^4)$:

$$\frac{\delta^2}{1 - \delta^2} [p(q^G) - (P^G + T^G)] \geq (1 - \hat{\phi})(P^G + T^G), \quad (30)$$

and this history can only have been reached by at least one deviation by the exporter or the importer, so not paying is optimal.

For optimality of $q_t^X(\tilde{h}(t_b^3))$ and $\tilde{h}(t_b^3) \in \tilde{H}^*(t_b^3)$ the requirement is

$$T^G \geq c^*, \quad (31)$$

Whereas, for $\tilde{h}(t_b^3) \notin \tilde{H}^*(t_b^3)$ can only be reached by a deviation by the importer, so the prescribed strategy is optimal.

For a history of $\tilde{h}(t_b^2)$, the optimality of $m_t^I(\tilde{h}(t_b^2))$ and $m_t^X(\tilde{h}(t_b^2))$ requires $T^G \geq c^*$ and $p(q^G) \geq (P^G + T^G)$. Off-path, is optimal by construction.

Consider $C_t^b(\tilde{h}(t_b^0))$ and $n_t^I(\tilde{h}(t_b^1))$. The condition for on path is, respectively::

$$\begin{aligned} [p(q^G) - (P^G + T^G)] q^G &\geq \Pi^O, \\ P^G &\geq 0, \end{aligned} \tag{32}$$

and off-path follows easily.

Combining equations (29), (31), and (32) returns:

$$\frac{\delta^2}{1 - \delta^2} [p^G(q^G) - T^G] q^G - \Pi^O \geq (1 - \phi) q^G,$$

which is more restrictive than equation 8. This establishes part *ii*) of proposition 2; by just guaranteeing the shipment of one importer-exporter pair, the bank can be of no use.

The full game

Now, consider the full game with players $\{(I_i)_{i=0}^2, (X_i)_{i=0}^2, b\}$, where the outcome of each partial game is given by \tilde{a}_{it} , with $i \in [0, 2]$, with $(\tilde{a}_{i,\tau})_{i=0}^2$ being the outcome of the entire game.²⁹ Then a history $\tilde{h}_F^*(t_b^0) = (\dots, (\tilde{a}_{i,t-2})_i^2, (\tilde{a}_{i,t-1})_i^2)$ for the full game can be defined (with $\tilde{h}_F^*(\tau^i)$, $i = 1, 2, 3, 4$ correspondingly defined from this). It is then straightforward to substitute $\tilde{h}_F^*(t_b^i)$ for $\tilde{h}^*(t_b^i)$ in the description of strategies above, and find that the only thing that changes is the IC constraint of the bank, which becomes:

$$\frac{\delta}{1 - \delta} [p^G(q^G) - T^G] q^G - \Pi^O \geq (1 - \phi) q^G,$$

which returns equations (12) in the main text.

The case in which the IR constraint is not binding

If the IR constraint is not binding (equation (30) binds before equation (32)), the importer IC must bind, and substituting gives:

$$\max_{q,P} \frac{1}{1 - \delta} \left(\frac{1}{\hat{\eta} + 1} p(q) - c^* \right) q,$$

subject to:

$$\text{Importer IC: } \frac{\delta^2}{1 - \delta^2} (p(q) - (c^* + P)) q = (1 - \hat{\phi}) (c^* + P) q,$$

$$\text{Bank IC: } \frac{\delta}{1 - \delta} \left(\frac{1}{\hat{\eta} + 1} p(q) - c^* \right) q \geq (1 - \phi) (c^* + P) q,$$

where $\hat{\eta} \equiv (1 - \hat{\phi}) (1 - \delta^2) \delta^{-2} > 0$, and it is clear that the qualitative conclusions carry through: The importer IC constrains is tighter from $P > 0$, and the bank can only serve a role if $\hat{\phi} > \phi$, and the bank IC is tighter, as $\hat{\eta} > 0$, and the bank can only serve a role through more frequent interaction.

²⁹Since each importer-exporter pair is only active every other period, the outcome is $\tilde{a}_{it} = \emptyset$ for the remaining periods.

8.6 Appendix Mutually confirmed letters of credit

The problem is:

$$\max_{n, n^*, q^M, q^{M^*}, \Lambda} (U)^\gamma (U^*)^{1-\gamma}, \quad (33)$$

subject to $n \leq 1$, $n^* \leq \alpha$ and:

$$\frac{\delta}{1-\delta} U \geq (1-\phi) \Lambda, \quad (34)$$

where U and U^* are defined as in the text:

$$U = n [p(q^M) q^M - \Pi^O] - n^* c q^{M^*} - \Lambda, \quad (35)$$

$$U^* = n^* [p(q^{M^*}) q^{M^*} - \Pi^{O^*}] - n c^* q^M + \Lambda. \quad (36)$$

It is easily demonstrated that first order conditions for n and q^M return:

$$p(q^M) q^M = \sigma \Pi^O,$$

and since the net outstanding is from home bank to foreign $n^* = \alpha$. Imposing $q^{M^*} = q^{F^*}$ this returns a problem of choosing n and Λ so as to maximize 33 wrt. to condition (34). It follows that the IC constraint is linear in (Λ, n) space with slope:

$$\frac{(1-\phi) \frac{1-\delta}{\delta} + 1}{(\sigma-1) \Pi^O},$$

and the slope of the iso-value function $k = U^\gamma (U^*)^{1-\gamma}$ is given by:

$$\frac{dn}{d\Lambda} = \frac{\gamma}{1-\gamma} \frac{(\sigma-1) \Pi^O - x c^* q^{F^*}}{1-x},$$

with $x = U/U^*$, which is positively sloped with $\frac{d^2 n}{d\Lambda^2} < 0$ for parameters with interior solution ($n < 1$). Consider first an increase in γ . This will leave the IC constraint unchanged, but increases the slope of the iso-value function and both n and Λ increase. This establishes part *c* of proposition (3). Part *b* is most easily demonstrated by substituting for (34) in (33) such that the problem is an unconstrained problem of maximizing wrt n . First order condition is:

$$\gamma(1-\beta)(\sigma-1)\Pi^O x(n)^{\gamma-1} + (1-\gamma)[\beta(\sigma-1)\Pi^O - c^* q^M] x(n)^\gamma = 0,$$

with $\beta \equiv \left(1 + \frac{\delta}{1-\delta} \frac{1}{1-\phi}\right)^{-1} < 1$, implying that $\beta(\sigma-1)\Pi^O < c^* q^M$. Using the envelope theorem and differentiating wrt α demonstrates that $dn/d\alpha > 0$, which establishes part *b*.