

Understanding Trade Finance: Theory and Evidence from Transaction-level Data*

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Abstract

This paper provides a portrait of the pattern of payment methods in international trade at the national level, by employing the universe of Colombian and Chilean import transactions data. The data reveal a striking predominance of the post-shipment payment system: the post-shipment term accounts for 80~90 percent of total import transactions in Colombia and Chile. Further, a substantial level of variation across source countries is mostly explained by Asian countries with which the post-shipment payment term is used significantly less by around 10~20 percentage points. Alternative model of trade finance that features the self-liquidating and recourse nature of account receivables financing is introduced to explain the observed empirical patterns of payment methods. A subsequent econometric analysis strongly supports the validity of the model.

JEL classification: F1, F4, G2, G3

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1. Introduction

Exchange takes time. For example, when a seller receives a purchase order that stipulates payment after delivery, the seller has to produce and ship a product before the buyer pays. This requires financing over short horizons because the seller may need to borrow working capital to complete the order or may purchase credit insurance to protect against counterparty defaults. That is the essence of trade finance. It is often described as the lifeline of business transactions because more than 90 percent of transactions involves some form of credit, insurance or guarantee (International Trade Center, 2009). Despite its importance in international trade, however, it was not until the recent great trade collapse that trade finance came to the attention of academic researchers.¹

This study aims to broaden understanding of trade finance, in particular, the pattern of payment methods—pre-shipment payment, post-shipment payment, or letter of credit. One of the most fundamental questions in trade finance is what determines the pattern of payment methods because it essentially tells who is responsible for financing transactions, and thus who would most need liquidity support. This is particularly relevant in developing countries where the lack of trade finance supply is often cited as the main hindrance to trade, or in times of financial crisis when the overall drying up of trade finance supply could lead to the global collapse in trade. The lack of understanding on the topic thus far stems largely from the unavailability of sufficiently detailed data.

The main contributions of this paper are two folds—empirical and theoretical. First, I provide a portrait of the pattern of payment methods in international trade at the national level, by exploring the universe of Colombian and Chilean import transactions data, and document three main stylized facts.² Second, I develop a theoretical model that can explain

¹The 2008-09 great trade collapse has been the motivation for a variety of theoretical and empirical exercises seeking to account for the much more dramatic collapse in trade relative to GDP. The role of trade finance in the great trade collapse has been discussed in Ahn (2013), Ahn, Amiti, and Weinstein (2011), Amiti and Weinstein (2011), Aboin (2009), Berman, de Sousa, Martin, and Mayer (2012), Berman and Martin (2012), Bricongne, Fontagné, Gaulier, Taglioni, and Vicard (2012), Chor and Manova (2012), Niepmann and Schmidt-Eisenlohr (2013b), and Paravisini, Rappoport, Schnabl, and Wolfenzon (forthcoming). Other hypotheses on the great trade collapse includes product composition effects (Levchenko, Lewis, and Tesar, 2010), inventory adjustment (Alessandria, Kaboski, and Midrigan, 2010), vertical integration effects (Bems, Johnson, and Yi, 2010), and other demand factors (Eaton, Kortum, Neiman, and Romalis, 2011).

²Given that the choice of payment methods is made between the importer and the exporter, it is critical to consider the characteristics of both sides involved in the transaction, which requires importer- and/or exporter-level transaction data with payment method information. The unique feature of these datasets—which identify the payment method used in each transaction, in addition to the fact that the majority of importers or exporters transact with multiple trading partners from different countries—enhances the quality of econometric analysis because it allows for exploiting within-firm variations, effectively controlling for firm-level characteristics such as nonpayment risks or financing conditions (Section 2). Rare exceptions with buyer-seller matched transactions data include Antras and Foley (2011) using data from a single U.S. food exporter and Klapper, Laeven, and Rajan (2012) using data from a factoring company. Other sources for the information on patterns of payment methods include the bank-level trade finance survey, which collect first-hand information from commercial banks on market conditions for trade finance (Asmundson et al., 2011; IMF- BAFT, 2009; ICC, 2010).

these empirical findings, and take the model to the data to test the main prediction of the model.

A comprehensive look at the data reveals that the post-shipment payment term is the predominant payment method in Colombian and Chilean imports. It accounts for as much as 90 percent of total import transactions in Colombia, and around 80 percent of import transactions in Chile, while letters-of-credit transactions covering only 5 percent of Colombian imports and around 10 percent of Chilean imports. It further shows that a substantial level of variation across source countries is mostly explained by, in addition to exchange controls on payment methods, Asian countries—the share of transactions covered by the post-shipment payment term declines to around 75 percent for Colombian imports from Asia and to around 50 percent for Chilean imports from Asia. Controlling for goods- and firm-level fixed effects as well as other country-level characteristics, econometric analysis confirms that imports from an Asian exporter tends to use the post-shipment payment term significantly less by around 5~20 percentage points. Such a high prevalence of the post-shipment payment terms in general as well as the lack thereof in trade with Asian countries is at odds with existing theory models of trade finance or trade credit (Section 3).

This paper proposes alternative model of trade finance by explicitly considering the peculiar feature of account receivables financing. According to the model, the predominance of the post-shipment payment term can be explained by the self-liquidating and recourse nature of account receivables financing—when a trade finance loan is made with account receivables (i.e., trade credits) as collateral, it becomes self-liquidating and the lender retains recourse to the borrower. In practice, account receivables further offer a broader range of financing options such as factoring and securitization, all of which make trade financing cost cheaper than otherwise. To the extent that account receivables financing markets are less developed or their advantages are diluted by other implicit or explicit state policies on trade payment controls, it also explains why the post-payment term is less frequently used in Asia (Section 4).

The model is further developed to derive the implication of the relationship between trading partners on the pattern of payment methods, which is used as the unique hypothesis to test the validity of the model. Colombian imports data with trading partner relationship information strongly support the model prediction: controlling for importer- and exporter-level characteristics, the post-shipment payment term is more likely to be chosen for a transaction between trading partners with stronger relationship in general, but such tendency disappears for transactions with Asian countries or countries with explicit policy requiring to use letters of credit, where the account receivables financing mechanism is expected to be weaker. Chilean data with the importer-country level relationship information yield qualitatively identical results (Section 5).

Main findings of this study are expected to complement a growing literature that studies

the pattern of an optimal payment system in international trade. Schmidt-Eisenlohr (2013) shows that firms in a country with relatively lower financing costs or weaker enforcement of contracts offer trade credit to counterparty firms in a country with relatively higher financing costs or stronger enforcement of contracts. Olsen (2013) considers the optimal payment system in the presence of imperfect contract enforcement, and shows how bank intermediation mitigates such problems in international trade. Antràs and Foley (forthcoming) also offer a prediction on the pattern of an optimal payment system based on an imperfect contract approach, and test the prediction using international transactions data from a single U.S. food exporter. Demir and Javorcik (2014) find supporting evidence for the imperfect contract approach using the Turkish industry-country level export data. Niepmann and Schmidt-Eisenlohr (2013a) investigate the use of letters of credit in exports by employing banking data from the U.S.³

This paper also contributes to the trade credit literature, which offers various theory models that explain why trade credits exist. This includes transaction costs motive (Ferris, 1981), suppliers' informational advantage on buyers (Biais and Gollier, 1997; Smith, 1987) or better ability in monitoring buyers' moral hazard (Burkart and Ellingsen, 2004). Empirical evidence on these theories is provided in Petersen and Rajan (1997), Love, Preve, and Sarria-Allende (2007), and Klapper, Laeven, and Rajan (2012) among others.

Other closely related literatures include studies on credit constraints and international trade. In the presence of fixed costs for exporting, credit constrained firms find it difficult to finance such fixed costs, and are discouraged from participating in exporting (Chaney, 2013). This can alter the patterns of trade, depending on industry level financial vulnerability as well as the financial development of the countries (Manova, 2013), and thus financial development can become a source of comparative advantage (Kletzer and Bardhan, 1987; Ju and Wei, 2011). Empirical studies find that financial development leads to a greater level of exports (Beck, 2002; Hur, Riyanto, and Raj, 2006), and credit constrained firms are less likely to become exporters (Mûuls, 2008).⁴ Although the literature focuses on the comparison between non-exporting and exporting firms in terms of long-term fixed costs financing, the current paper studies the difference between short-term domestic and export financing even for a single exporter.

1.1. Methods of Payment in International Trade

There are three major types of payment methods—post-shipment payment terms, pre-shipment payment terms, and letters of credit—in international trade, each of which is

³There is a newly emerging literature employing various types of trade finance data. This includes Auboin and Engemann (forthcoming) and Van der Veer (forthcoming) for export credit insurance, and Felbermayr and Yalcin (2013) for export guarantees.

⁴Greenaway, Guariglia, and Kneller (2007) find that the strong correlation between firms' financial health and exporting status rather comes from the reverse causality, i.e., exporting improves firms' financial health.

illustrated in <Figure 1>. The post-shipment payment (i.e., open account system) refers to when suppliers extend trade credit to buyers such that the intermediate goods are produced and shipped to buyers first and the payment is made later. The exact opposite is true for the pre-shipment payment (i.e., cash-in-advance system) in that the payment by buyers is made to suppliers prior to the production or delivery of the intermediate goods. Therefore, it is the supplier that is responsible for financing the post-shipment payment transaction and thus is exposed to non-payment risk from the buyer, while it is the buyer that is responsible for financing the pre-shipment payment transaction and is subject to non-delivery risk from the supplier.

In contrast to these, a letter of credit system involves a buyer's bank and a supplier's bank in such a way that the former guarantees the payment to the latter on behalf of buyers. By accepting the agreement, the supplier's bank becomes obliged to pay the supplier whether the buyer's bank actually pays or not.⁵ As a result, the supplier's bank is exposed to non-payment risk from the buyer's bank.

2. Data

2.1. Colombia Transaction-level Import Data

One of primary datasets for this study comes from the import transaction database of the Colombian National Customs and Taxes Authority (DIAN) over the period 2008-11.⁶ The value of import transactions in the data adds up to nearly 100 percent of the official import value reported by the Central Bank of Colombia. The unique feature of the data, even when compared to other countries' micro-level customs data, is that every observation is recorded at the transaction level with extremely detailed information. This includes the name of importers and foreign exporters *both* at the firm level and payment methods in addition to other routine items such as CIF value, quantity, 10-digit product codes, country of exports, dates, etc.⁷

Small transactions with CIF value below US\$ 100, which total .04 percent of the official import value, are excluded in the main analysis so as to remove noisy transactions. The sample is further restricted to import transactions from those countries that are covered by other main country-level variables (see below), which account for 97 percent of the official import value in 2011.

Regarding the payment methods item, there are 11 different types of payment methods, most of which can be broadly re-classified into three major payment methods (i.e., post-

⁵This corresponds to the irrevocable confirmed letters of credit. Detailed descriptions on various kinds of letters of credit can be found, for example, in Venedikian and Warfield (2000).

⁶The main analysis of this paper will be based on the single year's data in 2011, and the previous 3 years' data will be used to provide the importer-exporter specific past transactions history.

⁷This dataset is also used in Ahn (2013) that focus on letters-of-credit transactions during the 2008-09 financial crisis period.

shipment payment, pre-shipment payment, and letters of credit). Transactions with few types of payment methods that cannot fall into these three major payment methods, which account for 17 percent of the official import value in 2011, are excluded in the main analysis.⁸ The consequent final dataset covers 80 percent of the official import value in 2011.

2.2. Chile Transaction-level Import Data

The other part of primary datasets for this study includes the import transaction database of the Chilean National Customs Service over the period 2008-11.⁹ The value of import transactions in the data adds up to 89.5 percent of the official import value reported by the Central Bank of Chile in 2011. Unlike the Colombian data, this dataset cannot identify the counterparty of the transaction—foreign exporters—, but the data provide the same level of information in all other dimensions, such as the Chilean importer, payment methods, CIF value, quantity, 10-digit product codes, country of exports, dates, etc.

Small transactions with CIF value below US\$ 100, which total less than .02 percent of the official import are excluded in the main analysis so as to remove noisy transactions. The sample is further restricted to import transactions from those countries that are covered by other main country-level variables (see below), which account for 87 percent of the official import value in 2011.

Regarding the payment methods item, there are 7 different types of payment methods, most of which can be broadly re-classified into three major payment methods (i.e., pre-shipment payment, post-shipment payment, and letters of credit). Transactions with few types of payment methods that cannot fall into these three major payment methods, which account for 2.7 percent of the official import in 2011, are excluded in the main analysis.¹⁰ The resulting final dataset covers 84.3 percent of the official import value in 2011.

⁸11 types of payment methods are in Spanish: (i) "PAGOS ANTICIPADOS", (ii) "CARTA DE CREDITO SOBRE EL EXTERIOR", (iii) "GIRO DIRECTO", (iv) "MECANISMO DE COMPENSACION O CUENTA DE COMPENSACION EN EL EXT", (v) "FINANCIACION DEL INTERMEDIARIO DEL MERCADO CAMBIARIO", (vi) "FINANCIACION DIRECTA DEL PROVEEDOR", (vii) "CREDITO EXTERNO DE MEDIANO Y LARGO PLAZO", (viii) "ARRENDAMIENTO FINANCIERO - LEASING -", (ix) "INVERSION EXTRANJERA DIRECTA", (x) "COMBINACION DE ALGUNAS DE LAS ANTERIORES FORMAS DE PAGO", (xi) "IMPORTACION QUE NO GENERA PAGO AL EXTERIOR". Cross-checking between Colombian imports and Chilean exports data—by Chilean exporter name, HS codes, value, and quantity— assigns (i), (ii), and (iii)-(vii) to pre-shipment payment, a letter of credit, post-shipment payment, respectively, and drops (viii)-(xi) in the analysis.

⁹The main analysis of this paper will be based on the single year's data in 2011, and the previous 3 years' data will be used to provide the importer-exporting country specific past transactions history.

¹⁰7 types of payment methods are in Spanish: (i) "ANTICIPO", (ii) "ACREDITIVO"/"CREDITO BANCO 1 A 2 ANOS" , (iii) "COBRANZA HASTA 1 AÑO"/"COBRANZA ENTRE 1 Y 2 ANOS", (iv) "ANT/CRED"/"ANT/COB", (v) "CBIM"/"CBOFU"/"CBOFA", (vi) "OTRAS", (vii) SIN PAGO COBERTURA. Cross-checking between Colombian imports and Chilean exports data—by Chilean exporter name, HS codes, value, and quantity— assigns (i), (ii), and (iii) to pre-shipment payment, a letter of credit, post-shipment payment, respectively, and drops (iv)-(vii) in the analysis.

2.3. *Other Country-level Data*

Additional country-level data are merged to the primary transaction-level data. The first set of the country-level data comes from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREXER) database, which provides a description of the foreign exchange arrangements, exchange and trade systems, and capital controls of all IMF member countries. This has been the original source of the widely-used capital control measures such as Chinn-Ito Index (Chinn and Ito, 2008) and Quinn Index (Quinn, 1997), and also used in Wei and Zhang (2007) to construct the measure of controls on trade payment. Of particular interest to this paper is the item that records whether a member country imposes any policy measure that requires letters of credit for certain export transactions, which are expected to have first-order effects on the pattern of payment system across countries. Other country-level data include GDP data in 2010 from the World Development Indicators (WDI) database, bilateral distance data from CEPII (Mayer and Zignago, 2011), and legal origins data are from LaPorta, Lopez-de-Silanes, Shleifer, and Vishny (1999).

3. Empirical Findings and Discussion

3.1. *Stylized Facts on Patterns of Payment Methods*

This section documents empirical findings on the pattern of payment system in import transactions in Colombia and Chile. Beginning with the aggregate level, <Figure 2> summarizes the share of international transactions financed by each payment system—pre-shipment, letter of credit, post-shipment—in Colombian and Chilean imports, both measured in terms of total import values in 2011. It reveals a striking predominance of the post-shipment payment system: the post-shipment terms account for 90 percent of total import transactions in Colombia, and 79 percent of total import transactions in Chile. On the other hand, letters of credit and pre-shipment payments are used to finance only about half the remaining transaction values, respectively.

Fact 1 *The post-shipment term is the predominant payment method in import transactions in Chile and Colombia.*

Turning to the country-level, the first thing to consider is whether a country imposes any policy measure that restricts the choice of payment methods for international transactions because such policy will have first-order effects on the country's pattern of payment system. According to the AREXER by the IMF, there were 28 countries that required letters of credit for certain export transactions in 2011.¹¹ <Figure 3> summarizes the share of import

¹¹Countries have different conditions under which international transactions are required to be settled by letters of credit; there are few countries that require all transactions to use letters of credit, while other countries require certain products, trade with certain countries, or transactions over certain values to be settled by letters of credit.

transactions financed by each payment system, separately for countries with an explicit policy requiring letters of credit and for countries without any such policy. Unsurprisingly, those countries with such policy tend to use post-shipment terms much less in their exports to Colombia and Chile, in favor of letters of credit.

Fact 2 *The share of Colombian and Chilean imports paid by the post-shipment term is significantly lower for imports from countries with payment control policies requiring letters of credit.*

Even after excluding those countries with the explicit policy measure requiring letters of credit, there is a substantial level of variation in the use of each payment method across trading partner countries. <Figure 4> plots the share of transactions by post-shipment terms in Colombian imports (y-axis) and Chilean imports (x-axis) from each exporting country. A closer look at the figure further reveals that countries are concentrated in the northeast region, but that Asian countries—marked as a triangle—are mostly located outside the northeast region. That is, the post-payment term is the predominant payment method in transactions with Chile and Colombia for most countries, but its predominance is much weaker for Asian countries. <Figure 5> shows stark contrast between Asian and non-Asian countries in the share of transactions financed by each payment system. The predominance of the post-payment term in import transactions reported in <Figure 2> becomes even more pronounced in imports from non-Asian countries, accounting for as much as 93 percent and 86 percent of import transactions in Colombia and Chile, respectively, whereas it accounts for only 74 percent and 50 percent of total Colombian and Chilean import transactions from Asian countries, respectively.¹²

One possible factor behind such regional level variation may be the difference in the composition of product types by regions. There are theories suggesting that the pattern of payment methods may differ by product types (e.g., Hoefele, Schmidt-Eisenlohr, and Yu, 2013; Demir and Javorcik, 2014). Excluding those countries with the explicit policy measure requiring letters of credit, <Figure 6> and <Figure 7> check this possibility by comparing the share of transactions by each payment method between Asian and non Asian countries across 15 broadly defined sectors in Colombian imports and Chilean imports, respectively.¹³ They all unambiguously show that such regional level variation in the pattern of payment

¹²This appears largely consistent with South Korean data reported in Shin (2005) and Hong (2011) that the share of South Korean trade covered by letters credit is one of the highest in trade with other Asian countries.

¹³Industry classification is based on 2 digit HS codes. 1:01-05 Animal & Animal Products;2:06-15 Vegetable Products; 3:16-24 Foodstuffs; 4:25-27 Mineral Products; 5:28-38 Chemicals & Allied Industries; 6:39-40 Plastics / Rubbers; 7:41-43 Raw Hides, Skins, Leather, & Furs; 8:44-49 Wood & Wood Products; 9:50-63 Textiles; 10:64-67 Footwear / Headgear; 11:68-71 Stone / Glass; 12:72-83 Metals; 13:84-85 Machinery / Electrical; 14:86-89 Transportation; 15:90-97 Miscellaneous.

methods holds across all sectors, confirming that it is not simply driven by the composition of product types by regions.

Fact 3 *The predominance of the post-shipment payment system is particularly pronounced in imports from non-Asian countries, and much weaker for imports from Asian countries.*

3.2. Econometric Evidence

This section performs econometric analysis to check the robustness of the second and third stylized facts reported above, by controlling for country- and firm-level characteristics. For example, it would be interesting to know whether the third stylized fact merely reflects some country-level characteristics common to Asian countries. Similarly, it could simply be the result of the composition of firm-level characteristics; it is possible that Chilean or Colombian importers that prefer the post-shipment payment terms for whatever reasons happened to transact mostly with non-Asian countries.

<Table 1> summarizes regression results from the firm-country-6 digit HS product level Colombian and Chilean imports data. The dependent variable is the share of transactions paid by the post-shipment term in total transactions at the firm-country-6 digit HS product level, and defined between 0 and 1. Independent variables include country-level variables such as GDP in 2010 and distance, both in log. Common law dummy variable is also included to capture contract enforceability in exporting countries *a la* Antràs and Foley (forthcoming). Firm-HS6 level fixed effects in all columns absorb any firm- and product-specific characteristics. As a result, all specifications explore country-level variation within a given importer-HS6 pair, and thus actual samples are restricted to importers that imported a certain HS6-level product from multiple countries. Of particular interest in this analysis are dummy variables for countries with letter-of-credit requirement policy and for Asian countries. The dummy variable for letter-of-credit requirement policy has the straightforward interpretation and checks the second stylized fact, while the dummy variable for Asian countries corresponds to the third stylized fact and will show if there is indeed anything special in Asian countries other than typical country-level characteristics.

As expected, the policy dummy variable shows negative and statistically significant coefficient estimates for both Colombia (column 2) and Chile (column 6). Any given importer in Colombia and Chile tends to have the same product paid in post-shipment term by 11 and 18 percentage points lower when exporting country imposes an explicit policy requiring letters of credit. This highlights potential omitted variable bias in other studies that overlook the role of payment control policies in investigating country-level determinants of payment methods.

More interestingly, the dummy variable for Asian countries confirms the stark contrast between Asian and non-Asian countries for any given importer-HS6 product pair, suggesting that there exists something special in Asian countries that weakens the incentive to use the

post-shipment payment terms. The share of Colombian imports paid by the post-shipment terms is on average 5.5 percentage point lower for imports from Asian countries compared to imports from non-Asian countries (column 3). The number is even bigger—21 percentage point—for Chilean imports (column 7).

Overall, only the policy dummy and Asian countries dummy variables show robust signs and significance levels across all columns, while other country-level variables often change signs and significance levels depending on specifications and countries considered. In sum, once firm-level and product-level characteristics are effectively wiped out, the Asia dummy variable as well as the letter-of-credit policy dummy variable remains to be highly significant, both economically and statistically, after controlling for other country-level key characteristics. We take this as evidence confirming the robustness of the second and third stylized facts reported above.

3.3. Discussion

The first stylized fact that the post-shipment payment term predominates in Colombian and Chilean import transactions is not as expected from previous theoretical models that study the pattern of payment systems in international trade. In particular, the sheer size of the share of transactions covered by the post-shipment terms—80~90 percent in countries like Chile and Colombia— is by all means rather striking. For example, recent theory models based on incomplete contracts such as Antràs and Foley (forthcoming) and Schmidt-Eisenlohr (2013) predict that country-level contract enforceability would be the main determinant of optimal payment choice. According to these models, the post-shipment term is more likely to be chosen when, other things being equal, an importing country has a relatively stronger contract enforceability than an exporting country. To the extent that Chile or Colombia does not have one of the strongest contract enforceability in the world, the observed share of import transactions paid by the post-shipment terms in Chile and Colombia is not readily reconciled with these models.

Neither an extensive set of theory models in the trade credit literature squares well with such a high prevalence of the post-shipment payment terms in international transactions, not least because the literature tended to focus implicitly on domestic transactions. The main question in the literature has been why buyers borrow from suppliers instead of banks, or to put it differently, why trade credit exists at all. Trade credit theories have offered answers based on the idea that suppliers have advantage over banks in monitoring or liquidating collateral—thanks partly to input illiquidity—, which may not be easily extended to international transactions because it is questionable if foreign suppliers would have such advantage over domestic banks, given the weaker cross-border contract enforceability and/or stronger cross-border informational friction. Alternative theories based on firm-level determinants such as market power or financing conditions do not seem to be able to explain the

observed pattern well either, because it would require an implausibly skewed distribution of market power or financial conditions between importers and exporters.

With all that being said, all of the above theories have merit and are believed to operate in practice, but none of them can reasonably explain the degree of predominance of the post-shipment payment terms in import transactions observed in Chile and Colombia; there must be something missing that makes the post-shipment payment term overwhelmingly prevalent in overall international transactions, but at the same time that makes it less so in trade with Asian countries.

This paper proposes, namely, the account receivables financing mechanism as the missing element, by carefully considering how trade credit is used for trade financing in practice. An interesting feature of trade financing in the post-shipment payment term is that suppliers can pledge trade credit as collateral.¹⁴ That is, trade finance loan is backed by self-liquidating trade credits (i.e., account receivables): the payment from the buyer is made directly to the lending bank, whereby the trade finance loan is automatically deducted before being transferred to the supplier's account. It is also subject to recourse: when the buyer fails to make the payment (i.e., trade credit defaults), the supplier is responsible for the repayment to the lending bank. Therefore, the lending bank will fail to collect loan repayment only if both supplier and buyer default. This is why trade finance loan is often referred as safer than other types of loans (e.g., IMF, 2003). This self-liquidating and recourse nature of account receivables financing makes, this paper argues, trade financing cost of the post-shipment payment transaction cheaper than that of other payment methods. In addition, account receivables offer a broader range of financing options such as factoring and securitization, and hence, the post-shipment payment term becomes more appealing to both buyers and suppliers.

To the extent that account receivables financing mechanism is weaker in Asia, this can explain not only the predominance of the post-shipment payment terms in general, but also lack thereof in trade with Asian countries. The weaker account receivables financing mechanism could stem from several reasons; it could simply be the reflection of the fact that many Asian countries are actively engaged in subsidizing trade finance, often targeted at letter of credit owing to its non-fungibility.¹⁵ It could also be the legacy of past foreign exchange control policies not captured in the present AREAER database. For instance, China regulated the ratio of the trade credit balance and payment periods for exporters and importers until recently under the State Administration of Foreign Exchange (SAFE). In South Korea, it was not until 1998 that the choice of payment methods in international trade

¹⁴Burkart and Ellingsen (2004) considers the implication of trade credits as pledgeable assets on drawing additional loans.

¹⁵The recent drop in metal prices precipitated by China's credit tightening, as widely covered by the media (e.g., Financial Times (2014)), stems from the implicit policy targeted at letters of credit in China; imported metals have become popular forms of collateral mainly because import letters of credit are cheaper and easier to get than other types of credit.

is fully liberalized under the Foreign Exchange Management Act. <Figure 8> describes the evolution of the share of South Korean trade financed by letters of credit since 1990, revealing two interesting facts. First, foreign exchange control policies were binding in that the relaxation of the payment methods regulation toward pre- and post-shipment payment terms coincides with the declining share of letters-of-credit transactions. Second, even a decade after the full liberalization, letters-of-credit transactions account for around 20 percent of international trade, which seems relatively high compared to present data from Colombia and Chile. This could be due to the fact South Korean exporters, importers, and banks are so accustomed to using letters of credit from their long experience under the regulation. In any case, such present and past credit policies and foreign exchange regulations, which tend to have been more popular in Asian countries, would have dampened the incentive to use trade credits, and thus in turn hindered the development in the account receivables financing market. As an example, Factoring Chain International (FCI), a global network of factoring companies, reports that the size of factoring market in Asia (25 percent of world total) relative to the total export value (37 percent of world total) is, although having risen recently, one of the lowest in 2011(<Figure 9>). Given that factoring is one particular type of account receivables financing, this indicates the under-developed account receivables financing market in Asia.¹⁶

4. A Model

This section presents a model of trade finance, with a particular attention to actual practices of each payment method. The main element of the model that distinguishes itself from previous theory models is the explicit consideration of the self-liquidating and recourse nature of account receivables financing, which enables to predict empirical findings reported above while preserving most of the properties from other theory models. The model also features firm-level heterogeneity in default probability, and hence that in borrowing costs, to replicate the co-existence of multiple payment systems in bilateral trade. In addition, the model allows for other country-level variables in reduced forms to incorporate insightful properties from other theory models such as imperfect contract enforcement. This greatly helps to make the current model comparable to others.

4.1. Environment

A random matching process provides a unique supplier-buyer relationship between producers of intermediate goods and final goods. Once a random match is made between a supplier and a buyer, the supplier has the exclusive right to provide the inputs to the corresponding buyer, who in turn produces and sells final goods to domestic consumers.

¹⁶Factoring can be either recourse or non-recourse. Recourse factoring shares the property stated above. Non-recourse factoring is another example of broader financing options offered by account receivables.

Both suppliers and buyers are assumed to be risk neutral such that suppliers set the price for intermediate goods to maximize their own expected profit, and similarly final goods producers set the final goods price to maximize their expected profit.¹⁷

Each transaction can be domestic (D) or international (F) transaction, depending on the geographical location of each matched buyer and supplier. International transactions incur variable trade costs that take the form of an iceberg-type cost ($\tau_F > 1$), whereas domestic transactions are free of such trade costs ($\tau_D = 1$). This captures various sources of possible trade costs such as transportation costs.

A final goods producer transforms a unit of intermediate goods into final goods without any additional cost. Accordingly, the demand for intermediate inputs (q_s) follows exactly the demand for final goods (q_b):

$$q_s = q_b = q = Ap_b^{-\sigma}, \quad (1)$$

where A denotes the demand level for final goods, $\sigma = \frac{1}{1-\rho} > 1$ is the constant elasticity of substitution across varieties, and p_b is the price of final goods. Intermediate goods are produced with a unit working capital requirement technology such that one unit of working capital (with unit cost w) is required to produce one unit of intermediate goods.

Firms are heterogeneous in the level of default probability: when a firm defaults, it fails to fulfill any commitment and is assumed to get zero payoff. The probability that a firm does not default throughout the transaction cycle is defined as $0 \leq \chi \leq 1$.¹⁸ The country-level contract enforceability $0 \leq \phi_C \leq 1$ is introduced *a la* Antras and Foley (2011) and Schmidt-Eisenlohr (2013) such that when a firm in country C defaults, the counterparty firm can recover ϕ_C fraction of claims.¹⁹ For notational simplicity, no internal financing is assumed and the only available financing in this model will be external, namely borrowing from banks. This assumption makes the default probability as the only source of borrowing cost heterogeneity across firms in this model.²⁰

¹⁷The main discussion of the model can be readily extended to other types of trade finance facilities (e.g., export credit insurance) by introducing risk averse agents.

¹⁸The default probability is assumed as exogenous and publicly known in the baseline model, but this assumption is relaxed later when trading partner relationship is considered. See Ahn (2011) for a model with endogenous default probability based on informational friction between counterparty banks and firms in a transaction.

¹⁹For inter-bank claims, a constant contract enforceability of ϕ_{BB} is assumed. On the other hand, lending banks are assumed to recover none of claims when borrowing firms default (i.e., $\phi = 0$). As long as $\phi_C > 0$, the model, therefore, allows foreign suppliers as well as foreign buyers to have the advantage over domestic lenders in terms of recovery. This is for the sake of simplicity, and is not critical for the main results.

²⁰Additional sources of borrowing cost heterogeneity could be introduced by considering firm-specific collateral assets or borrowing needs, which will basically reflect financial health of each firm. For instance, Ahn (2011) introduces a fraction of working capital that can be used as collateral. A direct implication is that firms may have different values of collateralizable assets or use different technology in terms of tangible input usage, but this can be more broadly interpreted as any other firm characteristic that leads to different borrowing cost across firms.

One of the novel features of the model is the introduction of the three main modes of payment system—post-shipment payment (OA), pre-shipment payment (CA), and a letter of credit (LC). The subsequent sections will go over each payment system step by step, and provide conditions under which each mode is chosen as the optimal payment system by either party in the transaction.

In terms of specific timing of events, the transaction cycle of the post-shipment payment system begins with the delivery of intermediate goods at $t = 0$, and ends with the payment from the buyer to the supplier (hence, with loan repayment by borrowers) at $t = 1$. Similarly, a letter of credit transaction begins with the delivery of intermediate goods at $t = 0$, and ends with the payment from the buyer's bank to the supplier's bank (and the subsequent loan repayment from the buyer) at $t = 1$, whereas the transaction cycle of the pre-shipment payment system begins with the buyer's advance payment to the supplier at $t = 0$, and ends with the delivery of intermediate goods (and the subsequent final goods sale and loan repayments) at $t = 1$.^{21,22}

4.2. Post-shipment Payment (OA)

Buyer's Problem On receiving the intermediate goods from a supplier, a buyer transforms them into the final goods, which are then sold to domestic consumers. As long as the buyer does not default until the end of the transaction cycle (with probability χ_b), the buyer receives revenue from sales of final goods, and then makes the payment (i.e., account payable) to the supplier. Since the revenue from sales of final goods is enough to cover the inputs payment, the buyer does not need to borrow from a bank. Taking an input price p_s as given, the buyer solves the simple expected profit maximization problem:

$$\max_{p_b} E(\Pi_b^{OA} | \chi_b) = p_b q - p_s q \quad (2)$$

to set the optimal price for the final goods as a markup over marginal cost:

$$p_b = \frac{1}{\rho} p_s \quad (3)$$

Supplier's Problem A supplier providing q units of intermediate goods needs $q\tau w$ value of working capital. Since, by extending trade credits to the buyer, the payment from the buyer will be made to the supplier only after the delivery, the supplier has to finance the working capital from a bank at the interest rate r_s^{OA} , hence the cost function becomes $q\tau w r_s^{OA}$. If the buyer defaults and cannot fulfill the payment, the supplier can recover only

²¹The length of transaction cycles (t) can be allowed to vary across country pairs or shipping modes *a la* Ahn et al. (2011) and Berman et al. (2012).

²²Note that the price of final goods as well as that of intermediate goods, hence the sales quantity is optimally determined at the very beginning of each transaction, and a buyer will have no incentive to change final goods price after the intermediate goods are delivered as ordered.

the fraction of the account receivable, depending on the degree of contract enforceability in the buyer's country, $0 \leq \phi_{bC} \leq 1$. Consequently, taking the interest rate as a given, the supplier maximizes the expected profit conditional on his/her own non-default (with probability χ_s) as in:

$$\max_{p_s} E(\Pi_s^{OA} | \chi_s) = \chi_b p_s q + (1 - \chi_b) p_s q \phi_{bC} - q \tau w r_s^{OA} \quad (4)$$

The optimal price for the intermediate goods is, taking into account the probability of the non-payment from the buyer, set as a markup over marginal cost:

$$p_s = \frac{1}{\rho} \tau w r_s^{OA} \left[\frac{1}{\chi_b + (1 - \chi_b) \phi_{bC}} \right] \quad (5)$$

A risk-neutral supplier charges a higher price to a buyer with a higher default probability to compensate expected losses from the non-payment, which also depends on the recovery ratio (i.e., ϕ_{bC}).

Bank's Problem A bank lends working capital ($q\tau w$) to a supplier and expects to receive gross repayment ($q\tau w r_s^{OA}$) from the supplier. An interesting feature of trade financing in the post-shipment payment system is that it is backed by account receivables and thus self-liquidating, and the lending bank retains the recourse to the supplier. Therefore, the lending bank fails to receive loan repayment only if both supplier and buyer default during the transaction cycle (with probability $(1 - \chi_s)(1 - \chi_b)$).

The banking sector is assumed to be competitive such that the bank sets the lending rate by equalizing the expected profit with the opportunity cost of lending (or cost of funding):

$$[1 - (1 - \chi_s)(1 - \chi_b)] q \tau w r_s^{OA} = q \tau w i_{sC} \quad (6)$$

where i_{sC} is the risk-free gross return rate such as the deposit rate at the central bank in the supplier's country. The interest rate is then set as:

$$r_s^{OA} = \frac{i_{sC}}{[1 - (1 - \chi_s)(1 - \chi_b)]} \quad (7)$$

It is intuitive that the borrowing cost is increasing in the bank's funding cost (i_{sC}) and supplier's default probability ($\frac{\partial r_s^{OA}}{\partial \chi_s} < 0$). More interestingly, it is also increasing in the buyer's default probability because the value of collateral (i.e., account receivable) declines as the buyer is more likely to default. Overall, the self-liquidating and recourse nature of trade financing loan backed by account receivables will be, other things being equal and unless the default probability is perfectly correlated, cheaper than other type's general loans solely dependent on the borrower's repayment probability.

To sum up, the borrowing cost in equation (7) enters the intermediate goods price in equation (5), which in turn determines the final goods price in equation (3) as:

$$p_b^{OA}(\varphi_s) = \frac{1}{\rho^2} \tau w r_s^{OA} \left[\frac{1}{\chi_b + (1 - \chi_b) \phi_{bC}} \right], \quad (8)$$

4.3. Pre-shipment payment (CA)

Buyer's Problem A buyer needs to pay a supplier before the intermediate goods are shipped and delivered. If the supplier defaults and cannot complete the shipment, the buyer can recover only the fraction of the scheduled shipment, depending on the degree of contract enforceability in the supplier's country, $0 \leq \phi_{sC} \leq 1$. To finance the advance payment, the buyer needs to borrow from a bank at the interest rate r_b^{CA} . The cost function for the buyer is thus $p_s q r_b^{CA}$, and taking the interest rate and the intermediate goods price as given, the buyer maximizes expected profit:

$$\max_{p_b} E(\Pi_b^{CA} | \chi_b) = \chi_s p_b q + (1 - \chi_s) p_b q \phi_{sC} - p_s q r_b^{CA}$$

to set the optimal price for the final goods, taking into account the probability of non-delivery from the supplier, as a markup over marginal cost:

$$p_b = \frac{1}{\rho} \frac{p_s r_b^{CA}}{[\chi_s + (1 - \chi_s) \phi_{sC}]} \quad (9)$$

A risk-neutral buyer charges a higher price for the final goods as non-delivery risk from a supplier is higher, but relatively less so when a recovery ratio (ϕ_{sC}) is higher.

Bank's Problem A bank supports the transaction by lending to a buyer so that the buyer can make advance payment to a supplier. The bank will be able to collect the full loan repayment from the buyer only if the buyer does not default (with probability χ_b). The bank equates the expected profit with the opportunity cost of lending in a following way:

$$\chi_b p_s q r_b^{CA} = p_s q i_{bC} \quad (10)$$

to set the optimal interest rate charged to a buyer with non-default probability χ_b as:

$$r_b^{CA} = \frac{i_{bC}}{\chi_b} \quad (11)$$

The borrowing cost for a buyer increases with the bank's cost of funding in a buyer's country (i_{bC}), and decreases with the non-default probability (χ_b).

Supplier's Problem Since the advance payment made by the buyer can be used for working capital financing, a supplier does not need to borrow from a bank. More interestingly, a buyer's default after the payment no longer affects the supplier's profit. The corresponding expected profit for a supplier becomes:

$$\max_{p_s} E(\Pi_s^{CA} | \chi_s) = p_s q - q \tau w$$

yielding the optimal price for the intermediate goods as:

$$p_s = \frac{1}{\rho} \tau w \quad (12)$$

Plugging the input price expressed in equation (12) and the borrowing cost expressed in equation (11) into the final goods price in equation (9), the final goods price is expressed as:

$$p_b^{CA} = \frac{1}{\rho^2} \tau w r_b^{CA} \left[\frac{1}{\chi_s + (1 - \chi_s) \phi_{sC}} \right] \quad (13)$$

4.4. A Letter of Credit (LC)

Buyer's Problem By issuing a letter of credit, a buyer's bank obligates itself to pay a supplier's bank on behalf of a buyer. From the bank's perspective, the letter of credit issuance essentially amounts to providing a loan to the buyer because the buyer's bank makes a payment to the supplier's bank first and gets reimbursement from the buyer later. The letter of credit fee for the buyer is thus similarly set as the interest rate for a loan, and the cost function for a buyer is expressed as $p_s q r_b^{LC}$. Taking the fee as a given, the buyer maximizes the expected profit as:

$$\max_{p_b} E(\Pi_b^{LC} | \chi_b) = p_b q - p_s q r_b^{LC}$$

that yields the optimal final goods price as:

$$p_b = \frac{1}{\rho} p_s r_b^{LC} \quad (14)$$

Issuing Bank's Problem (Buyer's Bank) Once the agreement to use a letter of credit is made and the intermediate goods are shipped, the buyer's bank has to meet the obligation to pay the supplier's bank. Unless the buyer defaults, the bank receives the repayment at the gross interest rate r_b^{LC} (i.e, a letter of credit fee). The expected profit of the buyer's bank is then equated with the opportunity cost:

$$\chi_b p_s q r_b^{LC} = p_s q i_{bC} \quad (15)$$

and the corresponding optimal interest rate (a letter of credit fee) is exactly the same to the lending rate to a buyer in the pre-shipment payment case above:

$$r_b^{LC} = \frac{i_b C}{\chi_b} \quad (16)$$

Supplier's Problem The supplier's bank is promised to receive the payment from the buyer's bank on behalf of the buyer, but at the same time guarantees to pay the supplier whether the buyer's bank actually pays or not. Since the supplier receives the payment only after the delivery of the inputs, the supplier still faces the working capital financing problem. A supplier borrows the total working capital from the bank using the letter of credit proceeds as collateral, which also features self-liquidating property but non-recourse in this case. In practice, a supplier receives the proceeds in advance with discount rate δ , from the supplier's bank. Taking the discount rate as a given, the supplier's expected profit function becomes:

$$\max_{p_s} E(\Pi_s^{LC} | \chi_s) = p_s q (1 - \delta) - q \tau w$$

and the optimal price for the intermediate goods is set as:

$$p_s = \frac{1}{\rho} \frac{1}{(1 - \delta)} \tau w \quad (17)$$

The higher the discount rate charged, the higher the price of the intermediate goods.

Confirming Bank's Problem (Supplier's Bank) The supplier's bank would receive the payment from the buyer's bank only if the buyer's bank does not default (with probability χ_{BB}), while the guaranteed payment is made to the supplier irrespective of the buyer's bank default. As discussed above, the supplier's bank disburses the proceeds in advance with discount rate δ , to the supplier. The supplier's bank equates the following expected profit with the opportunity cost:

$$\chi_{BB} p_s q + (1 - \chi_{BB}) p_s q \phi_{BB} = (1 - \delta) p_s q i_{sC} \quad (18)$$

where χ_{BB} and ϕ_{BB} denote the buyer's bank's non-default probability and the contract enforceability between banks. This yields the discount rate charged to a supplier for a letter of credit issued by a bank with the non-default rate χ_{BB} as:

$$\frac{1}{(1 - \delta)} = \frac{i_{sC}}{[\chi_{BB} + (1 - \chi_{BB}) \phi_{BB}]} \quad (19)$$

It is intuitive that the discount rate will be higher as the buyer's bank is more likely to default or the cost of fund is higher.

Substituting the supplier bank's optimal discount rate from equation (19) into equation (17), which in turn enters equation (14) together with equation (16), the final goods price is expressed as:

$$p_b^{LC} = \frac{1}{\rho^2} \tau w \frac{i_{bC}}{\chi_b} \frac{i_{sC}}{[\chi_{BB} + (1 - \chi_{BB}) \phi_{BB}]} \quad (20)$$

4.5. *Optimal Payment System*

Depending on who has control over the choice of payment systems, the payment system that gives the highest expected profit for the corresponding entity will be chosen as an optimal payment system for a transaction between a given buyer-supplier pair (χ_b, χ_s) . The overall pattern of optimal payment system in this model depends on country-, buyer-, and supplier-level characteristics as well as the joint distribution of buyers and suppliers and the matching process between them. This section compares key variables across payment systems as summarized in <Table 2>, and performs simple comparative statics analysis to discuss conditions under which each payment system is optimally chosen for a transaction. The key property of the model will be that country-level determinants of the pattern of the payment system play a limited role in the presence of the account receivables financing mechanism that strongly favors the post-shipment payment term.

Symmetric case First consider the choice between the post-shipment term and pre-shipment payment term for a symmetric case in which $\chi_b = \chi_s$, $\phi_{bC} = \phi_{sC}$, and $i_{bC} = i_{sC}$. Comparing the intermediate goods price (p_s) in two payment systems, it is clear that a supplier always charges a higher price for the intermediate goods under the post-shipment payment system, by the amount of trade financing cost (r) and the (effective) probability of successful payment from the buyer ($1/[\chi_b + (1 - \chi_b) \phi_{bC}]$). The former reflects that the supplier is responsible for financing the transaction, which therefore enters the supplier's marginal cost. The latter stems from the risk-neutral supplier's optimal pricing behavior to take into account the non-payment probability from the buyer's side: a lower intermediate goods price is charged to a buyer with lower default probability (i.e., higher χ_b). This offers a unique explanation for the stylized fact in the trade credit literature that the price offered via trade credits (implied by the discount rate in the early payment option) is often more expensive than the general bank-borrowing rate, which gives rise to the long-standing puzzle—why trade credits are widely used despite such high prices.

On the contrary, the final goods price (p_b) will be always lower when a transaction is supported by the post-shipment payment system than when it is done by the pre-shipment payment system. The final goods price between two payment systems differs only by trade financing cost (r). This is because risk-neutral buyer also factors in the non-delivery risk from the seller's side when setting an optimal final goods price in the pre-shipment payment

system. As for the difference in the cost of trade financing, it is easy to see that, in the symmetric case, the cost of financing the post-shipment payment system is always lower than that of financing the pre-shipment payment system (i.e., $r_b^{CA} > r_b^{OA}$), precisely because of the self-liquidating and recourse nature of the financing backed by account receivables, consistent with the general notion among practitioners that trade finance loan is safer than other types of loans (i.e., $1 - (1 - \chi_s)(1 - \chi_b) > \chi_b$).

Since the final goods demand is decreasing with the final goods price from equation (1) (i.e., $\partial q/\partial p_b < 0$), the expected profit for a supplier will be always greater in the post-shipment payment system (i.e., $r_s^{OA}q^{OA} > q^{CA}$), and thus a supplier will always prefer the post-shipment payment system to the pre-shipment payment system. Similarly, a buyer also finds the post-shipment payment system always more profitable than the pre-shipment payment system (i.e., $(p_b^{OA})^{1-\sigma} > [\chi_s + (1 - \chi_s)\phi_{sC}](p_b^{CA})^{1-\sigma}$).

The important difference from other trade finance models is that unlike their prediction that firms will be indifferent between the post-shipment payment and pre-shipment payment system when countries (as well as firms in an implicit manner) are symmetric, this model suggests that both buyers and suppliers will prefer the post-shipment payment system. This also offers a unique explanation for wide use of trade credits in domestic transactions—account receivables financing mechanism—, which has not been discussed in the trade credit literature.

Comparative statics Considering a deviation from the country-level symmetry condition (i.e., $i_{bC} \neq i_{sC}$ or $\phi_{bC} \neq \phi_{sC}$), holding the firm-level symmetry condition fixed (i.e., $\chi_b = \chi_s$), gives qualitatively similar predictions from previous studies (Antràs and Foley, forthcoming); Schmidt-Eisenlohr, 2013): as the bank's funding cost in the supplier's country is relatively higher than that in the buyer's country, the pre-shipment payment system becomes more attractive for both suppliers and buyers, and the same is true as the contract enforceability in the supplier's country is relatively stronger than the contract enforceability in the buyer's country. However, this model predicts that the sensitivity of the choice in the optimal payment system to variations in country-level parameters will be relatively limited because of the presence of the account receivables financing mechanism discussed above that unambiguously works toward the post-shipment payment system under the symmetric condition. In other words, it requires sufficiently large asymmetries in country-level determinants for the pre-shipment payment system to be chosen as an optimal payment method in this model.

A firm-level heterogeneity in the default probability allows a richer prediction on the within-country share of each payment system. Considering a deviation from the firm-level symmetry condition (i.e., $\chi_b \neq \chi_s$), holding country-level parameters fixed at the symmetric case, shows that as a buyer's default probability is lower, final goods prices for both

the post-shipment payment and pre-shipment payment system decline because it reduces the cost of trade financing in both cases as well as the intermediate goods price charged by a supplier in the post-shipment payment system. Which payment system becomes relatively more attractive depends on model parameter values. Intuitively, it will make the pre-shipment payment system more attractive when the contract enforceability in a buyer's country is sufficiently strong because the marginal impact of a decrease in the buyer's default probability on the supplier's expected payoff rate is decreasing with the degree of contract enforceability in a buyer's country (i.e., $\partial^2 [\chi_b + (1 - \chi_b) \phi_{bC}] / \partial \chi_b \partial \phi_{bC} < 0$). The opposite will be true when the contract enforceability in a buyer's country is sufficiently weak. Similarly, as a supplier's default probability declines, the pre-shipment payment system can become either more attractive or less attractive depending on parameter values. The intuition will be that it makes the pre-shipment payment system more attractive when the contract enforceability in a supplier's country is sufficiently weak because the marginal impact of a decrease in the supplier's default probability on the buyer's expected payoff rate is decreasing with the degree of contract enforceability in a supplier's country (i.e., $\partial^2 [\chi_s + (1 - \chi_s) \phi_{sC}] / \partial \chi_s \partial \phi_{sC} < 0$). The opposite will be true when the contract enforceability in a supplier's country is sufficiently strong.

Letter of credit Now consider the letter of credit system for an symmetric case in which $\chi_b = \chi_s = \chi_{BB}$, $\phi_{bC} = \phi_{sC} = \phi_{BB}$, and $i_{bC} = i_{sC}$. The final goods price will be always the highest under the letter-of-credit system, mainly due to the fact that the letter of credit requires both sides of the transaction, supplier and buyer, to bear the financing costs. This highlights that trade financing costs for the letter of credit will be more expensive than other types' trade financing costs when everything else is equal. Given this, both a supplier and a buyer will always find it optimal to choose the post-shipment payment system over the letter of credit.

Deviating from the symmetry condition (e.g., $\chi_b = \chi_s \neq \chi_{BB}$ or $\phi_{bC} = \phi_{sC} \neq \phi_{BB}$), it becomes clear when and why the letter of credit is used for transactions. As the bank-level default probability declines relative to the firm-level default probability (i.e., higher χ_{BB}) or the contract enforceability between banks is higher than the one between firms (i.e., higher ϕ_{BB}), a letter of credit can become significantly more attractive for both buyers and suppliers. Intuitively, a letter of credit will be an optimal choice when, for example, gains from replacing risks from buyers with the lower bank-level default risk are greater than costs of a letter of credit. Trade finance subsidies towards letters of credit can be expressed as lower i_{bC} or i_{sC} , banks' effective costs for issuing letters of credit.

4.6. Relationship Between Trading Partners

Thus far, firm-level default probability has been assumed as exogenously given and publicly known. However, when it is endogenous or private information, the relationship between trading partners could affect subjective or estimated default probability of the counterparty significantly. For example, repeated transactions between a trading partner allow for collecting more information on the counterparty or gives rise to stronger incentive to fulfill the commitment. The former can be formalized into a model via the improved screening channel (Ahn, 2011) or Bayesian updates (Antràs and Foley, forthcoming), while the latter can take a form of the reputation mechanism (Schmidt-Eisenlohr, 2010; Olsen, 2013). This paper is apathetic to the exact form, and leaves the micro-foundation of the endogenous default probability to abovementioned papers. It is sufficient for this study to take the common reduced form property, $\frac{\partial \chi(I)}{\partial I} > 0$, where I denotes the intensity of the relationship between trading partners.

Specifically, the model distinguishes two types of default probability, one assessed by the direct lender (borrower's own bank), and the other assessed by counterparty as well as counterparty's bank. The former is independent of the intensity of the relationship between trading partners, whereas the latter is decreasing in the intensity of the relationship between trading partners. <Table 3> modifies <Table 2>, by explicitly denoting endogenous parts of default probability as $\chi(I)$.

The main question is which payment method becomes more preferred as the relationship between trading partners develops. According to the model, the question reduces to:

$$\begin{aligned} & \frac{\partial \ln [E(\Pi_b^{OA}|\chi_b) / E(\Pi_b^{CA}|\chi_b)]}{\partial I} \\ &= \overbrace{(1-\sigma) \frac{\partial \ln r_s^{OA}}{\partial I}}^{ARF>0} + \sigma \left[\kappa_{bC} \frac{\partial \chi_b(I)}{\partial I} - \kappa_{sC} \frac{\partial \chi_s(I)}{\partial I} \right] - \kappa_{bC} \frac{\partial \chi_b(I)}{\partial I} \geq 0 \end{aligned} \quad (21)$$

for buyers, and

$$\begin{aligned} & \frac{\partial \ln [E(\Pi_s^{OA}|\chi_s) / E(\Pi_s^{CA}|\chi_s)]}{\partial I} \\ &= \overbrace{(1-\sigma) \frac{\partial \ln r_s^{OA}}{\partial I}}^{ARF>0} + \sigma \left[\kappa_{bC} \frac{\partial \chi_b(I)}{\partial I} - \kappa_{sC} \frac{\partial \chi_s(I)}{\partial I} \right] \geq 0 \end{aligned} \quad (22)$$

for suppliers, where $\kappa_{sC} = \frac{(1-\phi_{sC})}{[\chi_s(I)+(1-\chi_s(I))\phi_{sC}]}$ and $\kappa_{bC} = \frac{(1-\phi_{bC})}{[\chi_b(I)+(1-\chi_b(I))\phi_{bC}]}$ with $\frac{\partial \ln r_s^{OA}}{\partial I} = -\frac{(1-\chi_s)}{[\chi_b(I)+\chi_s-\chi_s\chi_b(I)]} \frac{\partial \chi_b(I)}{\partial I} < 0$.

Overall, the direction of inequalities depends on model parameter values. For example, when the contract enforceability in the buyer's country is perfect (i.e., $\phi_{bC} = 1$), it becomes more likely that pre-shipment payment terms become more attractive as transactions repeat over time between trading partners. On the other hand, if the contract enforceability in the supplier's country is perfect (i.e., $\phi_{sC} = 1$), it will be only the post-shipment payment terms that become more preferred as the relationship develops. The same is true when the supplier's default probability does not depend on the intensity of the relationship (i.e., $\frac{\partial \chi_s(I)}{\partial I} = 0$), which is indeed the ad hoc assumption made in Antràs and Foley (forthcoming) that led to the prediction that the post-shipment payment terms would become more likely to be chosen for trading partners with previous transactions.

Irrespective of parameter values, however, the presence of the account receivables financing mechanism unambiguously makes the post-shipment payment term more likely to be used as the transaction repeat over time. This is captured by the first term in each inequality, which is always positive (denoted as ARF). The default probability of a buyer having stronger relationship with a given supplier is assessed as lower due either to less incentive for the buyer to renege on payment or to more information on the buyer collected over time, which raises the value of the collateral (i.e., account receivables) and hence lowers the cost of financing post-shipment term transactions. Therefore, the stronger the account receivables financing mechanism is, the stronger the tendency for the post-shipment transaction to be chosen for repeated transactions is.

5. Evidence on the Validity of the Model

The model developed in the previous section showed how the account receivables financing mechanism can explain the predominance of the post-shipment payment terms in international transactions. According to the model, the less intensive use of the post-shipment terms in transactions with Asian countries could reflect the weaker account receivables financing mechanism in these countries, stemming from under-developed account receivables financing markets owing to implicit and explicit trade financing subsidy targeted at letters of credit or foreign exchange control policies that restrict the choice of payment methods.

One way to check the validity of the model based on the account receivables financing mechanism is to test the hypothesis concerning repeated transactions. If the observed difference in the use of the post-shipment payment term is indeed due to the difference in the degree of account receivables financing mechanism, the likelihood for the post-shipment transaction to be chosen for repeated transactions should be also different across these two distinct sets of countries. This idea leads to the following hypothesis:

Hypothesis 1 *The model of trade finance based on the account receivables financing mechanism predicts that transactions between trading partners with stronger relationship will use*

the post-shipment payment term more, but such tendency will be less pronounced for transactions with Asian countries or countries with explicit policy requiring to use letters of credit, where the account receivables financing mechanism is thought to be weaker.

A rigorous test of the hypothesis requires the importer-exporter-level matched data with the history of past transactions, which are available only for Colombian import transactions data. For Chilean imports, it is instead checked at the importer-exporting country level. The idea is that any given importer's credit information from past transactions will be partially passed on and shared within a country. <Figure 10> provides descriptive comparisons of the share of payment methods in total imports across relationship intensities. In Colombia, a larger share of transactions is paid in the post-shipment payment term as an importer has previously imported from a given exporter from non Asian countries or countries without any policy requiring letters of credit, but this is not true when exporters reside in Asia or countries with an explicit policy requiring letters of credit. Similarly, Chilean importers paid a larger share of transactions in the post-shipment payment term when importing from countries with previous transactions history, but this is not as evident for imports from Asian countries or countries with explicit payment control policies.

<Table 4> reports econometric tests of the hypothesis for Colombian imports. The dependent variable in <Table 4> is the share of transactions covered by the post-shipment terms defined at the importer-exporter-product level. The intensity of the relationship between an importer and an exporter is measured by the number of years in which the two transacted in the past three years during 2008-10. Comparing the effect of the relationship on the payment method across two distinct sets of countries can be done by interacting the relationship intensity measure with the country-level dummy variable. Lastly, various kinds of different model parameter values will be controlled by importer- as well as exporter-level fixed effects.

The first two columns in <Table 4> include importer-HS6 product level fixed effects and country-level variables, whereas the last two columns include both importer-HS6 product level fixed effects and exporter-level fixed effects with the latter basically absorb all other country-level variables. Column (2) and (4) include the interaction term that compares the effect of the relationship on the choice of the payment method across two distinct sets of countries. The results confirm that the post-shipment transaction is more likely to be chosen for a transaction between trading partners with longer relationship in general, but such tendency disappears for transactions with Asian countries or countries with explicit policy requiring letters of credit.

Likewise, <Table 5> reports econometric tests of the hypothesis for Chilean imports. The only difference is that the dependent variable in <Table 5> is defined at the importer-exporting country-product level, and the intensity of the relationship is measured between an importer and an exporting country. As in <Table 4>, the first two columns in <Table

5> include importer-HS6 product level fixed effects and country-level variables, whereas the last two columns include both importer-HS6 product level fixed effects and exporting country-level fixed effects. The results are qualitatively very similar to those in <Table 4>, confirming the validity of the model prediction.

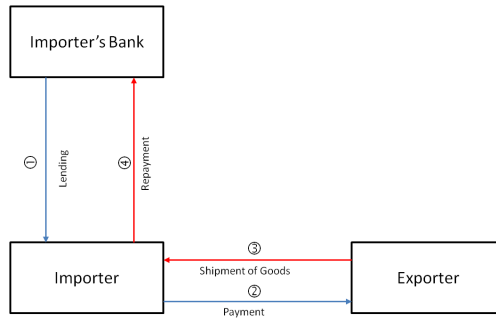
6. Conclusion

This study is one of recent efforts in the literature to broaden understanding of trade finance. In particular, this paper deals with one of the most fundamental questions in trade finance: what determines the pattern of payment methods?

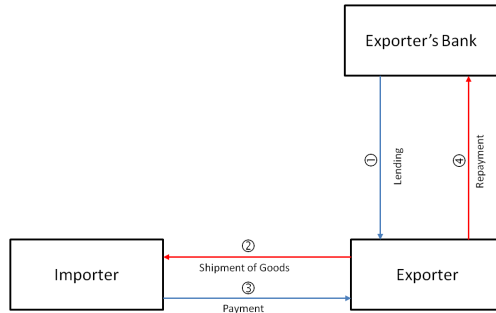
A portrait of the pattern of payment methods in international trade at the national level—Colombian and Chilean imports— uncovers a strikingly high prevalence of the post-shipment payment terms in general as well as the lack thereof in trade with Asian countries, which is not easily reconciled with existing theory models of trade finance or trade credit. As an attempt to explain those observed patterns of payment methods, this paper proposes alternative model of trade finance that features the self-liquidating and recourse nature of account receivables financing, which makes trade financing cost for transactions with the post-shipment payment term cheaper than that with other payment terms. To the extent that account receivables financing markets are less developed or their advantages are diluted by other implicit or explicit state policies on trade payment controls, it also explains why the post-payment term is less frequently used in Asia.

Main findings of this study are expected to complement a growing literature that studies the pattern of an optimal payment system for international trade as well as the broad trade credit literature that studies the use of trade credits. Future studies on this topic with other countries' data will help determine the generalizability of empirical findings from this paper. The model of trade finance proposed in the paper can be a useful tool in analyzing cyclical property of trade finance and its impact on trade such as the great trade collapse.

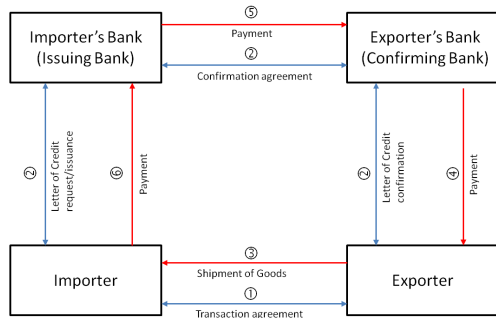
Figures



(a) Pre-shipment payment system (i.e., cash-in-advance)



(b) Post-shipment payment system (i.e., open account)



(c) Letter of credit system (i.e., bank-intermediated)

Figure 1: Description of Major Payment Systems

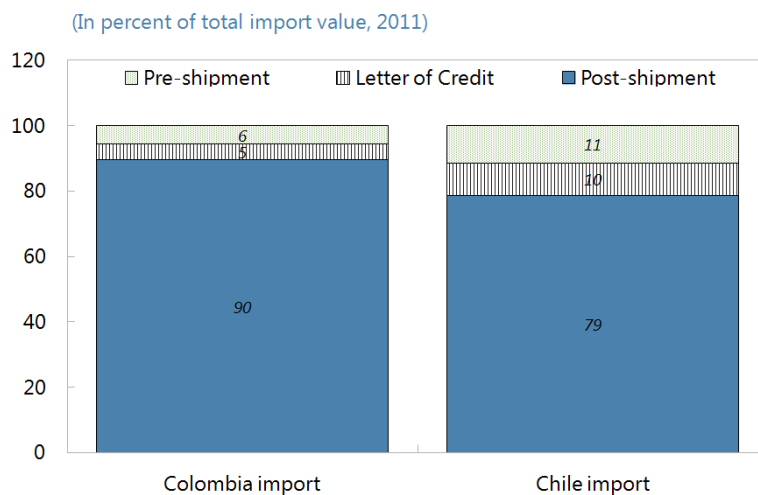


Figure 2: Patterns of Payment Methods: Aggregate

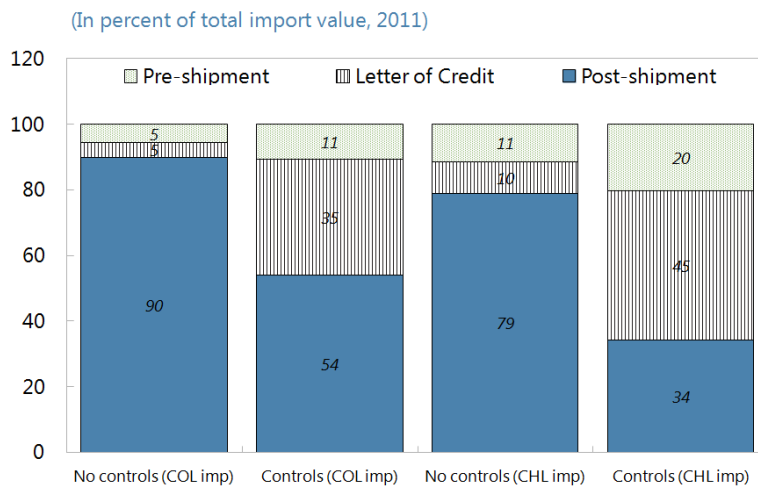


Figure 3: Patterns of Payment Methods by Payment Control Policy

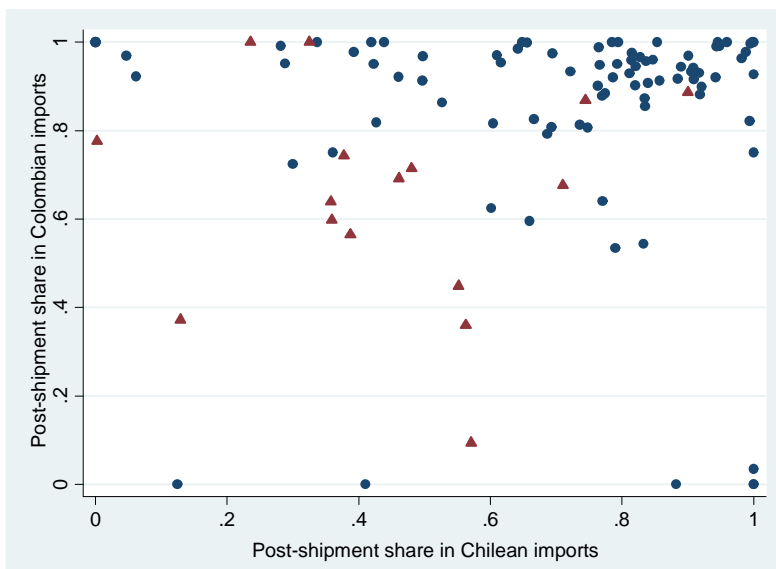


Figure 4: Pattern of Payment Methods: Country-level Scatterplot

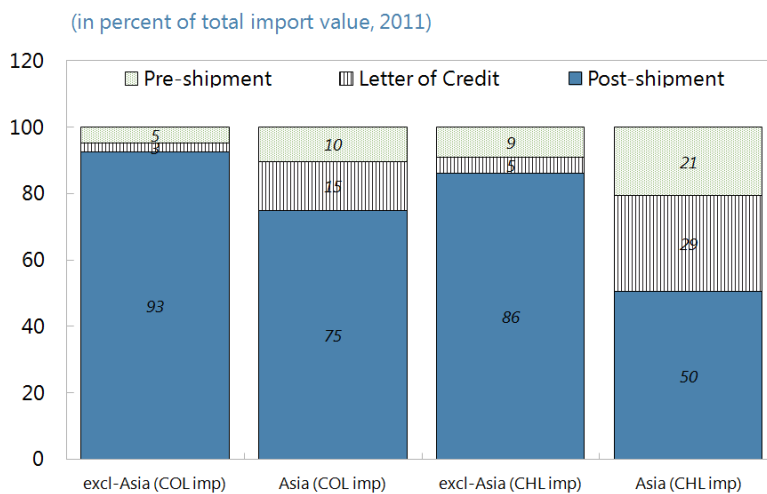


Figure 5: Pattern of Payment Methods by Regions

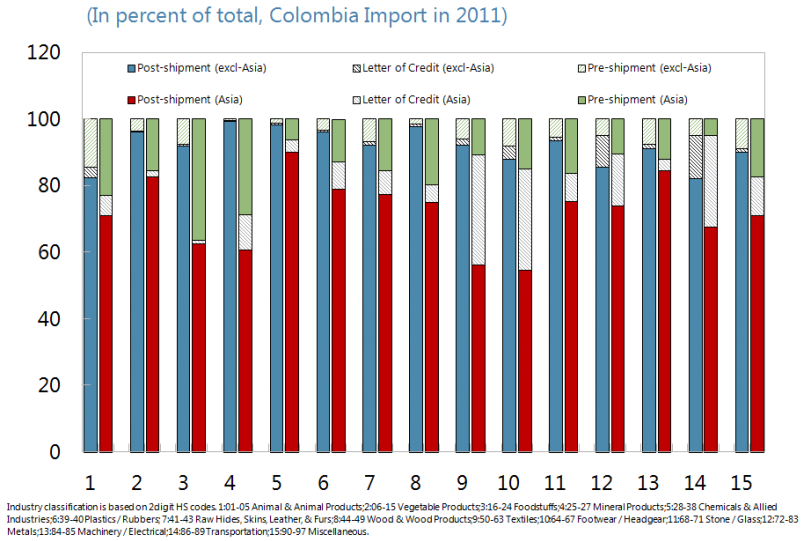


Figure 6: Pattern of Payment Methods by Sectors: Colombia Import

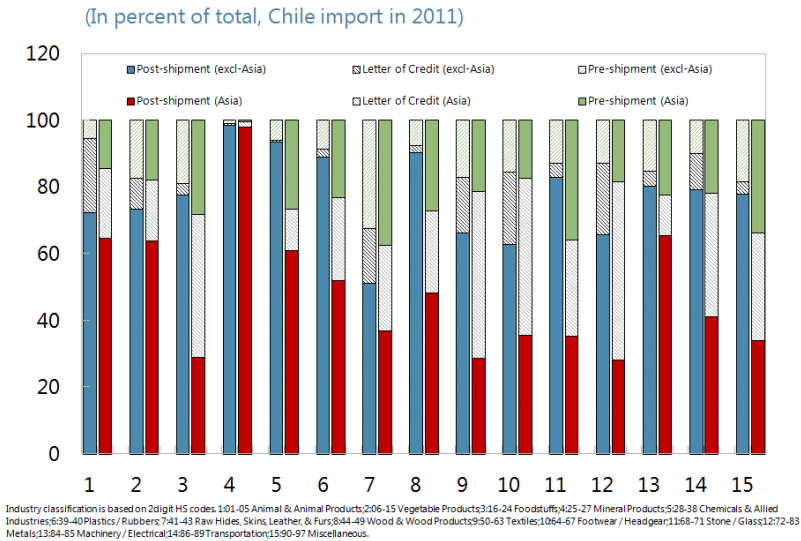
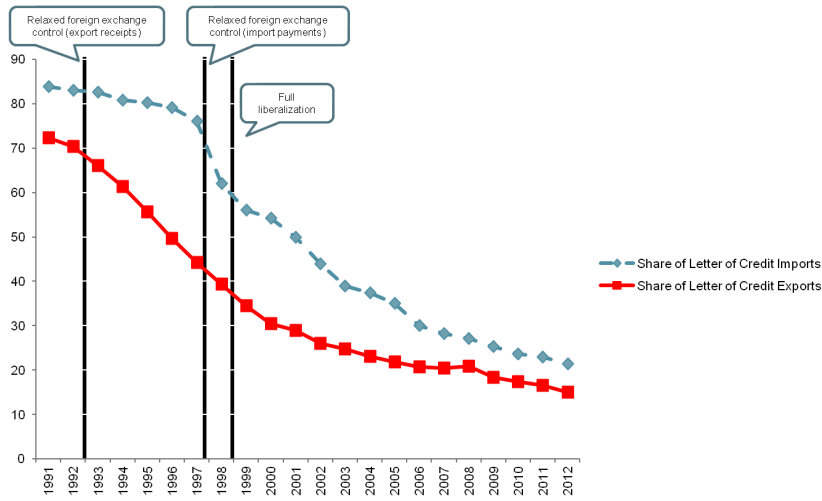
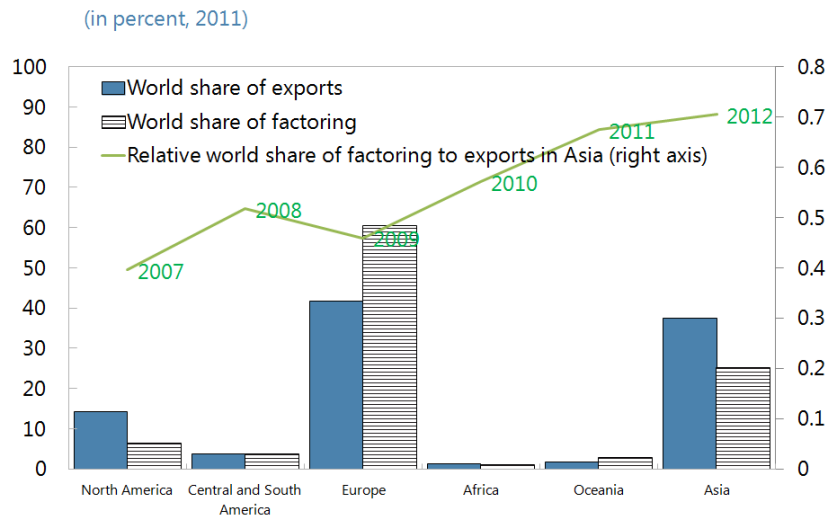


Figure 7: Pattern of Payment Methods by Sectors: Chile Import



Source: Korea Customs Service. Data are available at the website of The Korea International Trade Association (http://www.kita.net/statistic/index_eng.jsp); Foreign Exchange Management Act of the Republic of Korea

Figure 8: Evolution of LC Share in South Korean Trade



Sources: Factors Chain International; UNComtrade

Figure 9: World Share of Exports and Factoring

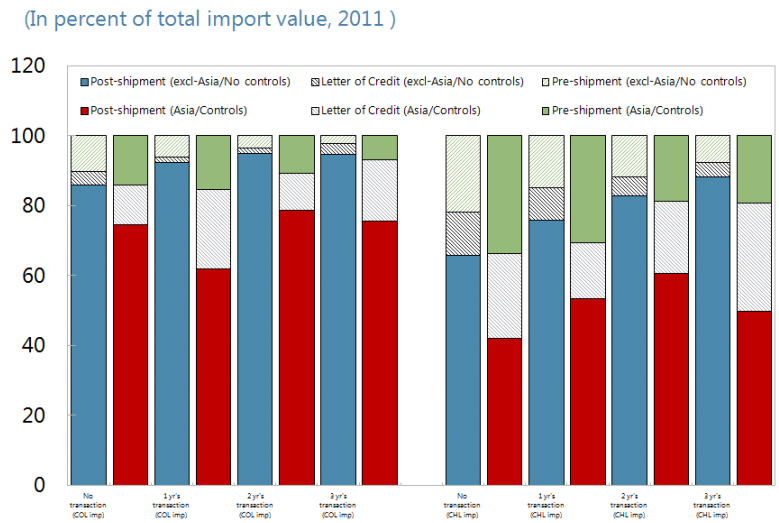


Figure 10: Pattern of Payment Methods by Relationship Intensity

Tables

Dependent variable: Post-shipment payment share (Importer-Country-HS6 level)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Colombia Import				Chile Import			
In_GDP	0.008 *** (0.001)	0.007 *** (0.001)	0.007 *** (0.001)	0.006 *** (0.001)	0.004 *** (0.001)	0.002 ** (0.001)	0.001 (0.001)	0.000 (0.001)
In_Distance	-0.050 *** (0.002)	-0.047 *** (0.002)	-0.031 *** (0.002)	-0.031 *** (0.002)	-0.074 *** (0.003)	-0.070 *** (0.003)	0.009 ** (0.003)	0.008 ** (0.003)
Common law	-0.002 (0.003)	0.006 * (0.003)	-0.003 (0.003)	0.004 (0.003)	0.026 *** (0.003)	0.037 ** (0.003)	0.014 *** (0.003)	0.019 *** (0.003)
LC controls		-0.112 *** (0.012)		-0.094 *** (0.012)		-0.175 *** (0.012)		-0.081 *** (0.006)
Asia			-0.055 *** (0.005)	-0.049 *** (0.005)			-0.210 *** (0.006)	-0.204 *** (0.012)
Firm-HS6 FE	Y	Y	Y	Y	Y	Y	Y	Y
Adj-R2	0.386	0.388	0.388	0.389	0.472	0.474	0.474	0.492
OBS	119,666	119,666	119,666	119,666	128,234	128,234	128,234	128,234

Note: The dependent variable in columns (1) - (4) is the importer-country-HS6-level share of post-shipment payment transactions in total import values in Colombia in 2011, in columns (5) - (8) is the importer-country-HS6-level share of post-shipment payment transactions in total import values in Chile in 2011. Independent variables includes nominal GDP in 2010 in log, bilateral distance in log, dummy variables for Asian countries, countries with common law, and countries that imposed the explicit policy promoting the use of letter of credits in exports in 2011. All columns include importer-HS6 pair fixed effects. Standard errors in parentheses are clustered at the importer-HS6 level. Significance: * 10 percent; ** 5 percent; *** 1 percent.

Table 1: Firm-Country-HS6 Level Regression: Firm-HS6 Fixed Effects

	Post-shipment (OA)	Pre-shipment (CA)	Letter of Credit (LC)
p_s	$\frac{1}{\rho} \tau w r \left[\frac{1}{\chi_b + (1-\chi_b)\phi_{bC}} \right]$	$\frac{1}{\rho} \tau w$	$\frac{1}{\rho} \frac{1}{(1-\delta)} \tau w$
p_b	$\frac{1}{\rho^2} \tau w r \left[\frac{1}{\chi_b + (1-\chi_b)\phi_{bC}} \right]$	$\frac{1}{\rho^2} \tau w r \left[\frac{1}{\chi_s + (1-\chi_s)\phi_{sC}} \right]$	$\frac{1}{\rho^2} \tau w r \frac{1}{(1-\delta)}$
r	$\frac{i_{sC}}{[1-(1-\chi_s)(1-\chi_b)]}$	$\frac{i_{bC}}{\chi_b}$	$\frac{i_{bC}}{\chi_b}$
$\frac{1}{(1-\delta)}$	<i>N.A.</i>	<i>N.A.</i>	$\frac{i_{sC}}{[\chi_{BB} + (1-\chi_{BB})\phi_{BB}]}$
$E(\Pi_s \chi_s)$	$(1-\rho) \frac{1}{\rho} \tau w r q$	$(1-\rho) \frac{1}{\rho} \tau w q$	$(1-\rho) \frac{1}{\rho} \tau w q$
$E(\Pi_b \chi_b)$	$(1-\rho) p_b^{1-\sigma}$	$\frac{(1-\rho) p_b^{1-\sigma}}{[\chi_s + (1-\chi_s)\phi_{sC}]^{-1}}$	$(1-\rho) p_b^{1-\sigma}$

Table 2: Summary of Key Variables—Baseline Model

	Post-shipment (OA)	Pre-shipment (CA)
p_b	$\frac{1}{\rho^2} \tau w r \left[\frac{1}{\chi_b(I) + (1 - \chi_b(I)) \phi_{bC}} \right]$	$\frac{1}{\rho^2} \tau w r \left[\frac{1}{\chi_s(I) + (1 - \chi_s(I)) \phi_{sC}} \right]$
r	$\frac{i_{sC}}{[1 - (1 - \chi_s)(1 - \chi_b(I))]}$	$\frac{i_{bC}}{\chi_b}$
$E(\Pi_s \chi_s)$	$(1 - \rho) \frac{1}{\rho} \tau w r q$	$(1 - \rho) \frac{1}{\rho} \tau w q$
$E(\Pi_b \chi_b)$	$(1 - \rho) p_b^{1 - \sigma}$	$\frac{(1 - \rho) p_b^{1 - \sigma}}{[\chi_s(I) + (1 - \chi_s(I)) \phi_{sC}]^{-1}}$

Table 3: Summary of Key Variables—Endogenous Default Probability Model

	Dependent variable: Post-shipment payment share (Imp-Exp-HS6 level)			
	(1)	(2)	(3)	(4)
In_GDP	0.004 *** (0.001)	0.004 *** (0.001)		
In_Distance	-0.030 *** (0.002)	-0.031 *** (0.002)		
Common law	-0.001 (0.002)	0.000 (0.002)		
Asia	-0.048 *** (0.004)	-0.022 *** (0.005)		
LC controls	-0.085 *** (0.009)	-0.087 *** (0.009)		
Years	0.019 *** (0.001)	0.023 *** (0.001)	0.014 *** (0.001)	0.016 *** (0.002)
Asia/LC *Years		-0.021 *** (0.002)		-0.013 ** (0.005)
Firm-HS6 FE	Y	Y	Y	Y
Exp FE	N	N	Y	Y
Adj-R2	0.473	0.474	0.859	0.859
OBS	254,989	254,989	168,531	168,531

Note: The dependent variable in columns (1)-(4) is the importer-exporter-HS6-level share of post-shipment payment transactions in total import values in Colombia in 2011. Independent variables includes nominal GDP in 2010 in log, bilateral distance in log, number of years each importer and exporter transacted during 2008-10, dummy variables for Asian countries, countries with common law, and countries that imposed the explicit policy promoting the use of letter of credits in exports in 2011. Asia/LC*Years is the interaction variable between number of years each importer and exporter transacted during 2008-10 and the dummy variable for source countries in Asia or with policies promoting the use of letter of credits in exports in 2011. Columns (1) and (2) include importer-HS6 pair fixed effects, and columns (3) and (4) include importer-HS6 pair fixed effects and exporter fixed effects. Standard errors in parentheses are clustered at the importer-HS6 level. Significance: * 10 percent; ** 5 percent; *** 1 percent.

Table 4: Importer-Exporter-HS6 Level Regression: Colombia Imports

Dependent variable: Post-shipment payment share (Imp-Country-HS6 level)

	(1)	(2)	(3)	(4)
ln_GDP	-0.005 *** (0.001)	-0.005 *** (0.001)		
ln_Distance	0.012 *** (0.003)	0.013 *** (0.003)		
Common law	0.020 *** (0.003)	0.016 *** (0.003)		
Asia	-0.205 *** (0.006)	-0.054 *** (0.012)		
LC controls	-0.072 *** (0.012)	-0.078 *** (0.012)		
Years	0.035 *** (0.002)	0.052 *** (0.003)	0.033 *** (0.002)	0.048 *** (0.003)
Asia/LC *Years		-0.062 *** (0.004)		-0.056 *** (0.004)
Firm-HS6 FE	Y	Y	Y	Y
Country FE	N	N	Y	Y
Adj-R2	0.495	0.498	0.5022	0.859
OBS	128,234	128,234	128,224	128,234

Note: The dependent variable in columns (1)-(4) is the importer-country-HS6-level share of post-shipment payment transactions in total import values in Chile in 2011. Independent variables includes nominal GDP in 2010 in log, bilateral distance in log, number of years each importer-country pair transacted during 2008-10, dummy variables for Asian countries, countries with common law, and countries that imposed the explicit policy promoting the use of letter of credits in exports in 2011. Asia/LC*Years is the interaction variable between number of years each importer and country transacted during 2008-10 and the dummy variable for source countries in Asia or with policies promoting the use of letter of credits in exports in 2011. Columns (1) and (2) include importer-HS6 pair fixed effects, and columns (3) and (4) include importer-HS6 pair fixed effects and exporting country fixed effects. Standard errors in parentheses are clustered at the importer-HS6 level. Significance: * 10 percent; ** 5 percent; *** 1 percent.

Table 5: Importer-Country-HS6 Level Regression: Chile Imports

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