Estimating the Direct Impact of Bank Liquidity Shocks on the Real Economy: Evidence from Imports by Letters of Credit in Colombia*

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Abstract

This study identifies, and provides the precise estimate of, the direct impact of bank liquidity shocks on real economic activity, exploring letter of credit import transactions in Colombia during the 2008-2009 global financial crisis. The extremely detailed dataset on letter of credit transactions enables us to exploit within importer-exporter variations across issuing banks. We find substantial impacts of bank liquidity shocks on import transactions by letters of credit: an 1 percentage point decline in bank deposits growth led to a 4.5 percentage point decline in imports in intensive margins, and to a 5 percent increase in the exit probability in extensive margins. Further, our estimate suggests that adverse bank liquidity shocks can explain at least 38% ~47% of the collapse in import transactions by letters of credit in Colombia.

JEL classification: F1, F4, G2, G3

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1. Introduction

This study identifies, and provides the precise estimate of, the direct impact of bank liquidity shocks on real economic activity, exploring letter of credit import transactions in Colombia during the 2008-2009 global financial crisis.

For the past several years since the global financial crisis, academic research has been actively centered on two main transmission channels through which financial crisis led to the global great recession. One of them is the global transmission of financial shocks across countries, and the other is the subsequent transmission of financial shocks to the real economy. This paper aims to identify the second transmission channel, taking bank liquidity shocks transmitted by the first channel as given. Specifically, we estimate the direct impact of bank liquidity shocks on imports transactions via one particular channel, namely the letter of credit channel. We find a substantial impact of bank liquidity shocks on letter of credit import transactions: an 1 percentage point decline in bank deposits growth led to a 4.5 percentage point decline in intensive margins, and to a 5 percent increase in the exit probability in extensive margins. Further, our estimate suggests that adverse bank liquidity shocks can explain at least 38% ~47% of the collapse in import transactions by letters of credit in Colombia.

This paper contributes to two strands of literature. First, we build on the literature that studies the bank lending channel through which financial shocks affect the real economy. Although it has long been one of the most sought-after tasks, identifying the real transmission of financial shocks has often been elusive not least because of difficulty in separating out demand shocks from supply shocks. We tackle the problem by employing, and improving, the novel methodology developed in Khwaja and Mian (2008) that use extensive sets of fixed effects to control for demand shocks. Our contribution to the literature stems mainly from the extremely detailed nature of the import transactions data as well as the unique characteristics of letters of credit. Our dataset that identifies the name of importers, exporters, and banks for each letter of credit transaction, together with the fact that there are many importer-exporter pairs that use multiple issuing banks for letter of credit transactions, allows us to control for importer-exporter specific shocks. Hence, our estimation process exploits borrower-project (importer-exporter) level variations across lenders (issuing banks) for a particular type of loan (letter of credit), which is a much finer level of disaggregation compared to those in previous studies that examined borrower level variations across lenders. We claim that our disaggregation level in the estimation process corrects potential biases, and demonstrate that the failure to control for importer-exporter level shocks would have underestimated the impact of bank liquidity shocks substantially.

Another edge over previous studies comes from the unique feature of a letter of credit that connects the financial sector with the real sector by exactly one-to-one level. Its sole purpose to pay for import transactions ensures that our estimated impact of bank liquidity

shocks on letters of credit supply is directly translated to the impact on the real economy. This is a stark contrast to other general loans that are not always entirely used for real activities and thus are expected to deliver a noisier interpretation.

The exactly same reasons bring an important contribution to the trade finance literature. Despite the active research on the issue, the lack of direct trade finance data at micro level has made it hard to evaluate the independent role of trade finance in the great trade collapse. Our unique dataset allows us to achieve the goal by exploring one particular trade finance product (a letter of credit), and by separating out its demand shocks from its supply shocks effectively at importer-exporter-bank level.

It is important to note that our estimation results, which rely on importer-exporter level variations across issuing banks, reflect only *relative* changes in letters of credit supply across banks for a given importer-exporter pair. It is perfectly plausible that the results were mainly driven by switching across issuing banks within an importer-exporter pair, without any significant effect on total imports by the importer-exporter pair. Similarly, it is conceivable that importer-exporter pairs switched to alternative payment methods in response to reduced supply in letters of credit, without resulting in overall reductions in import transactions. We undergo further examinations to check these possibilities, and confirm that there is no evidence of such switching across banks or payment methods, and that our estimated impacts of bank liquidity shocks on letters of credit supply are directly passed on to the aggregate reductions in import transactions.

Related Literature: ***[to be added]***

2. Background

2.1. A Letter of Credit

Although it is hard to come up with an exact number without any representative data, there are several sources of data from which we can infer an approximate share of international transactions covered by letters of credit in world trade. Despite differing estimates across data sources, they mostly confirm that a letter of credit is one of the major payment methods used in international transactions.

One such data comes from a bank survey conducted by the IMF and Bankers' Association for Finance and Trade (BAFT). The survey asked participating banks for an estimated share of each payment method. According to the survey, letters of credit are estimated to account for, on average, around 40% of international transactions worldwide (Asmundson, Dorsey, Khachatryan, Niculcea, and Saito, 2011). Another survey report by International Chamber of Commerce (ICC) indicates that a letter of credit accounts for about half the traditional trade finance, which is used for around 20% of total international transactions.

Instead of survey data, we can also consult few countries' customs data that provide payment methods information for the universe of export and/or import transactions. Albeit specific to the source country, customs data are expected to deliver the most accurate figure. To my knowledge, there are at least three countries that require importers and exporters to report the payment method used for each cross-border transaction: Chile, Colombia, and South Korea. Our own calculation from the Chilean National Customs Service data tells that letters of credit financed around 10% of total imports and exports during the period 2008-2009.[1] The Colombian data, our main data introduced in the next section with more details, shows that letters of credit are responsible for around 4% of total imports in 2008 and 2009.

South Korean customs data offer a useful time-series picture of the changing role of letters of credit in total trade during the period 1991-2012.[2] This is drawn in <Figure 1>. It is a rather striking to observe the rapidly declining role of letters of credit in South Korean trade. For both imports and exports, a letter of credit is used for most of international transactions in early 1990's, but its share started falling in mid 1990's, and its rapid decline appears to have occurred during the Asian financial crisis. Having continued falling, a letter of credit now accounts for around 20% of total trade as of 2012.[3]

<Figure 2> describes how international transactions are conducted under a letter of credit. Instead of a direct transaction between an importer and an exporter, a letter of credit involves banks intermediating the transaction on behalf them. An importer's bank (i.e., issuing bank) promises to pay to an exporter's bank (i.e., confirming bank) on behalf of an importer, and the exporter's bank guarantees the payment to an exporter whether the importer's bank actually pays or not. The whole transaction ends by the payment from the importer to the importer's bank. This implies that, from the exporter's viewpoint, nonpayment risk from the importer is replaced by nonpayment risk from the importer's bank, and the exporter's bank assumes the nonpayment risk that would been borne by the exporter otherwise. For this reason, it is critical for the importer's bank to assess the importer's credit risk correctly, while the exporter's bank needs a proper evaluation of the importer's creditworthiness.

The way it works in letter of credit transactions makes it quite interesting to study how letter of credit transactions can be disturbed during financial crises. The inherent nature of inter-bank transactions in letters of credit resembles that of inter-bank lending markets. As

[1] Transaction level Chilean exports and imports data do not provide information on the identity of trading partners (at the firm level) nor that of banks for each transaction. Given the crucial role of this information in our estimation strategy (as discussed in section 4), we prefer using the Colombian import transactions data.

[2] This is publicly available at the website of the Korea International Trade Association.

[3] Although it is tempting to investigate reasons behind the declining share of letters of credit, it is beyond the scope of this paper. A more thorough discussion on the choice of payment methods is provided in Ahn (2013).

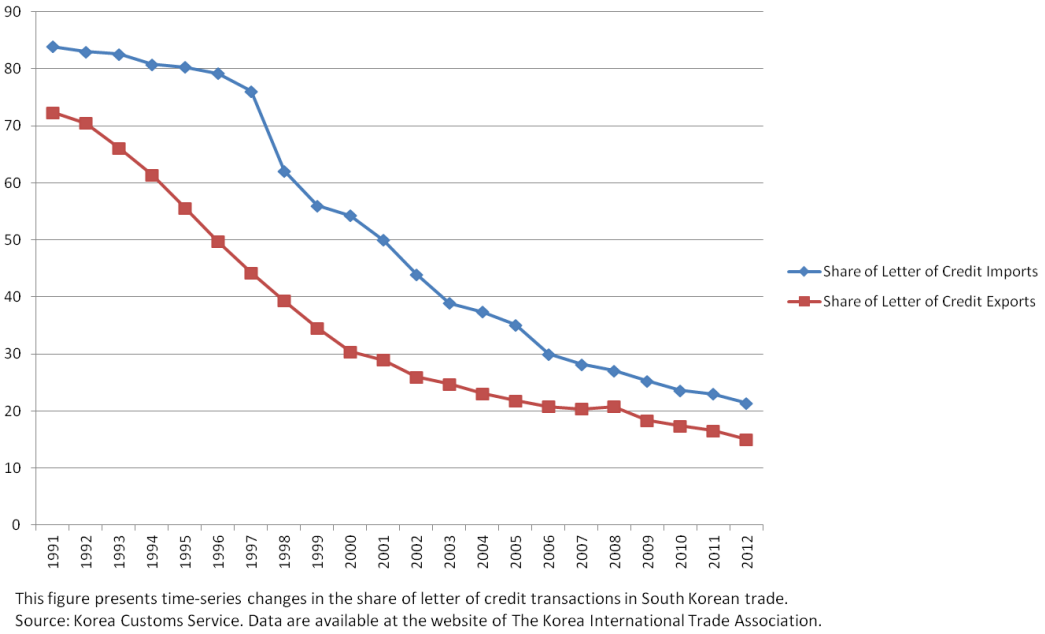


Figure 1: The Share of Letter of Credit Transactions in South Korean Trade over the period 1991-2012.

the evidence suggests that inter-bank lending markets almost collapsed during the recent global financial crisis, we can infer that the same could have happened for letter of credit transactions. Exporter's bank must have been very reluctant to be exposed to hightened default risk of importer's bank. At the same time, adverse liquidity shocks must have led an importer's bank to reduce letters of credit issuance to an importer, just like other types of loans. These mechanisms provide basic grounds on which the main analysis of this paper stands.

Colombia during the global financial crisis Financial shocks from the epicenter of the crisis rapidly diffused to emerging countries. It is by now well known that in the aftermath of the Lehman bankruptcy, banks stopped lending to one another and started pulling out their deposits from other institutions both within and across borders, and both from subsidiaries and arm's length institutions. The international spillover from the financial crisis was not limited to the banking sector. The impact on the real economy was almost immediate. The most notable of the real consequences was an unprecedented collapse in trade, which far exceeded GDP drops worldwide.

Colombia was neither immune from the international transmission of shocks, nor was an exception for what is by now known as the great trade collapse. As described in <Figure 3>, after several years of rapid growth, total deposits in Colombia decelerated substantially in 2009 (solid line, left axis). This is in part precipitated by huge reductions in foreign

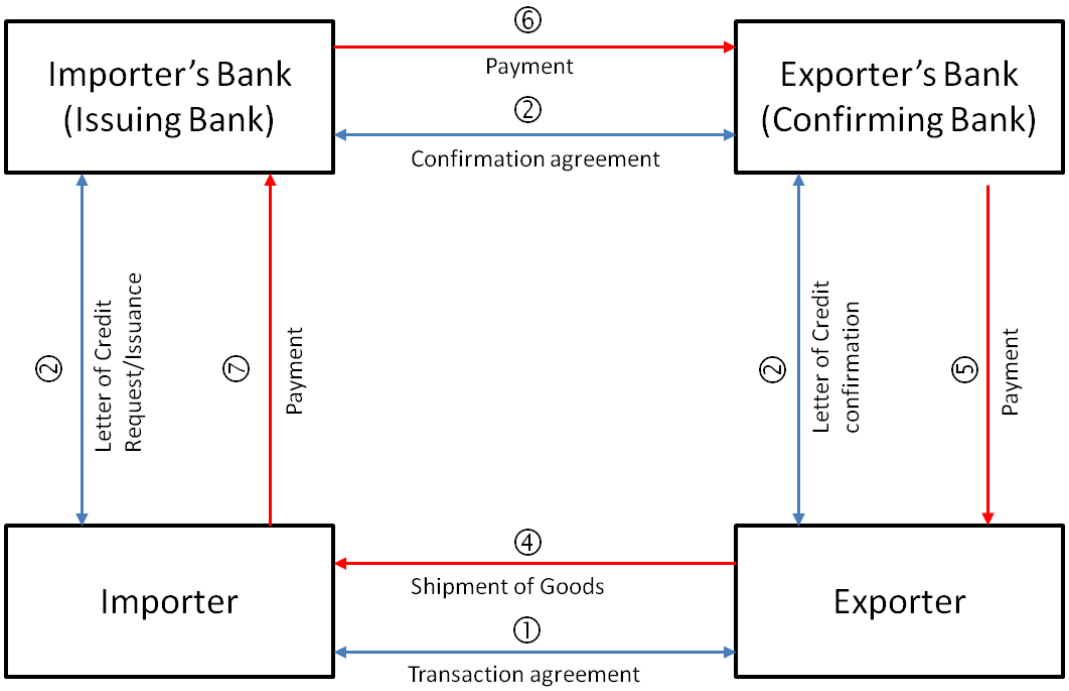


Figure 2: An Illustration of a Letter of Credit Transaction

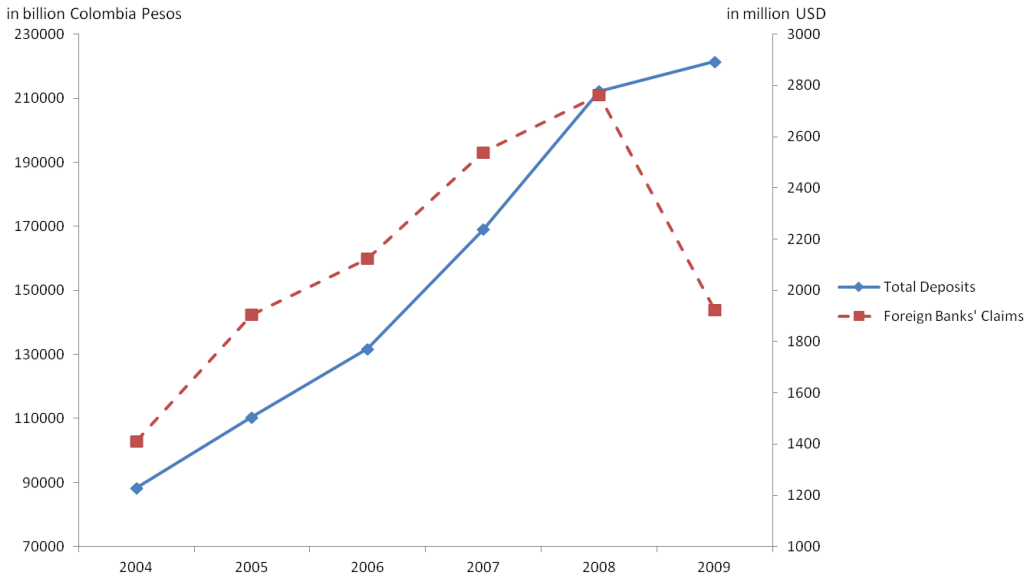
banks' claims on Colombian banks (dashed line, right axis), which consist of large parts of bank-to-bank deposits in Colombia.

<Figure 4> plots quarterly imports in Colombia (solid line, left axis) that dropped by more than 30% during the subsequent three quarters after the onset of the financial crisis. Colombian imports financed by letters of credit (dashed line, right axis) showed similar patterns, albeit more severe. The rest of the paper will explore these letters of credit import transactions in Colombia to identify, and estimate the economic size of, the direct transmission channel through which bank liquidity shocks affected the collapse in trade.

3. Data

Our primary data come from the import transactions database collected by Colombian National Customs and Taxes Authority (DIAN). The value of import transactions in the data adds up to 99.99% of the official import value reported by the Central Bank of Colombia.[4] The unique feature of the data, even compared to other countries' micro-level Customs data, is that every single observation is recorded literally at the transaction level with extremely detailed information. This includes the name of importers and foreign exporters both at the firm level, payment methods, and banks in addition to other usual items such

[4] drop small transactions....covers 99.2%



This figure depicts annual total deposits at financial institutions in Colombia (solid line, left axis), and foreign banks' claims on Colombian banks (dashed line, right axis). Total deposits are summed over financial institutions listed in the Bankscope database, and foreign banks' claims data are from the BIS database.

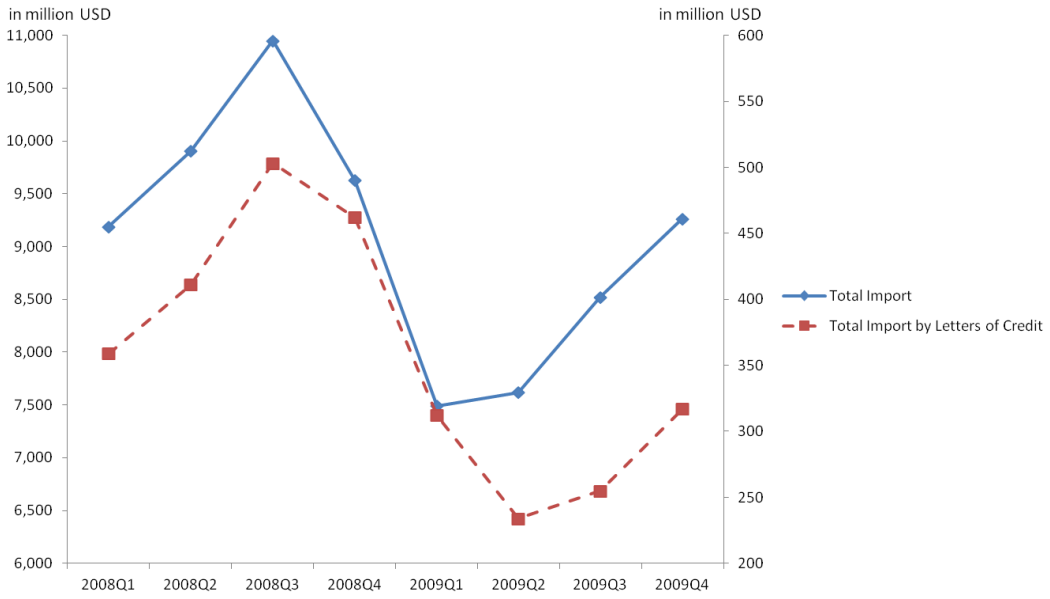
Figure 3: Total Deposits and Foreign Banks' Claims in Colombia

as cif value, quantity, 10 digit product codes, country of exports, dates, etc.

Regarding the payment methods item, there are three major payment methods (i.e., open account, cash-in-advance, and letter of credit) that cover nearly all of the transactions. Given the focus of the paper, we will explore only letter of credit transactions throughout the paper.[5] <Table 1> shows total value and number of transactions paid by letters of credit in 2008 and 2009, and their share in total import transactions. In 2008, letter of credit transactions accounted for about 4.4% of total import transactions in value, and about 2.4% in number. In 2009, the share of letter of credit transactions declined to 3.4% and 2.1% in value and number, respectively. Although its share in Colombia is remarkably low relative to other countries or sources, it is nonetheless these letter of credit transactions that are expected to most clearly identify the transmission of shocks from financial sector to real sector because the loans made by each bank (i.e., letter of credit) have a direct one-to-one relationship with the real activity by each borrower (i.e., import transaction supported by the letter of credit).

Detailed information on importers, exporters, and banks enables us to identify each importer-exporter with an issuing bank for every letter of credit transaction. Noting that imports started collapsing in the fourth quarter of 2008 through the second quarter of 2009 in <Figure 4>, we classify the first three quarters of 2008 as the pre-crisis period, and

[5] General discussion in Ahn (2013)



This figure depicts quarterly total imports (solid line, left axis), and total imports by letters of credit (dashed line, right axis) in Colombia.

Figure 4: Quarterly Total Imports and Quarterly Total Imports by Letters of Credit

	2008	2009
Value (million USD)	1,736	1,116
Percentage of total	4.41%	3.42%
Transactions	42,179	34,253
Percentage of total	2.39%	2.10%

This table provides the share of letter of credit transactions in total Colombian imports in terms of value and number of transactions.

Table 1: The Share of Letter of Credit Transactions in Total Imports

the subsequent three quarters as the post-crisis period, and aggregate the observations to importer-exporter-bank level in each period. Our main strategy will be to track each letter of credit transaction by an importer-exporter-bank triplet that was present in the pre-crisis period. Restricting our focus to such observations, panel A in <Table 2> provides mean and median value of letter of credit transactions in the sample. There are total 4,706 unique importer-exporter-bank triplets that conducted import transactions using letters of credit in the pre-crisis period. Among them, 1,189 importer-exporter-bank triplets continued letters of credit transactions in the post-crisis period, while 3,517 of them stopped letters of credit transactions in the post-crisis period. Those that continued tend to have had larger transaction values on average compared to those that stopped the relation. The most interesting feature of letter of credit transactions is that there are many importer-exporter pairs that used letters of credit issued by multiple banks in a given period. These

importer-exporter pairs with multiple issuing banks in the pre-crisis period constitute total 1,823 observations. They will form our baseline sample with the idea that we can effectively control for demand shocks by looking at variations across banks within an importer-exporter pair. Again, among those 1,823 observations, 670 observations survived in the post-crisis period, while 1,153 observations dropped in the post-crisis period.

Panel A	All		Coninue		Exit	
	All	Bank>1	All	Bank>1	All	Bank>1
Mean (1000 USD)	269	446	591	892	161	187
Median (1000 USD)	54	75	93	130	47	58
Obs	4,706	1,823	1,189	670	3,517	1,153

Panel B	Importer			Importer-Country			Importer-Exporter	
	All	Bank>1	Exporter>1	All	Bank>1	Exporter>1	All	Bank>1
Mean (1000 USD)	1,058	2,937	2,330	596	1,690	1,246	349	1,090
Median (1000 USD)	82	420	359	78	325	288	58	213
Number	1,197	351	436	2,125	542	496	3,629	746
Obs	4,706	3,498	3,838	4,706	2,769	2,744	4,706	1,823

Panel A provides summary statistics at importer-exporter-bank level. The sample includes all importer-exporter-bank triplets that appear in the pre-crisis period. The sample is classified as Continue if an importer-exporter pair used letter of credit from an issuing bank in both the pre- and the post-crisis periods. The sample is classified as Exit if an importer-exporter pair used letter of credit from an issuing bank in the pre-crisis period but not in the post-crisis periods. Bank>1 denotes observations by importer-exporter pairs that used multiple issuing banks in the pre-crisis period. Panel B provides summary statistics for the same sample but at differing levels: importer, importer-country, and importer-exporter level. Bank>1 at the importer-level section refers to observations by importers that used multiple issuing banks in the pre-crisis period. Exporter>1 are observations by importers that transacted with multiple exporters in the pre-crisis period. Definitions hold similarly for importer-country level and importer-exporter level sections.

Table 2: Summary Statistics for Letter of Credit Transactions

Panel B in <Table 2> breaks down the sample at three different levels: by importer, by importer-country pairs, and by importer-exporter pairs. In our sample, there are total 1,197 unique importers, of which 351 importers used multiple issuing banks and 436 importers imported from multiple exporters in the pre-crisis period. Similarly, there are 2,125 unique importer-country pairs, and 542 of them used multiple issuing banks. The fact that there are more importer-country pairs than importers reflects that there are some importers importing from multiple countries. One potential strength of the current data that provides exporter information at firm level is highlighted in the third column of the importer-country level section. There are 496 importer-country pairs that have multiple exporters within the country. This captures the fact that an importer A, for example, imports from multiple exporters in country B. Unlike other existing datasets that would aggregate such transactions to the importer-country level, our dataset correctly records the transaction at the actual importer-exporter level. To the extent that imports demand varies at each importer-exporter level, it will help correctly control for imports demand shocks. Consequently, there are 3,629 unique importer-exporters, far exceeding the number of importer-country pairs due to the presence of multiple exporters per importer within a country. Among them, 746 importer-exporter pairs used multiple issuing banks, which constitute out baseline sample of 1,823 observations.

Given that we are going to explore those importer-exporter pairs that used multiple issuing banks, it is imperative to ask why they ever use multiple issuing banks in a given period. <Table 3> gives a rough idea on the pattern of the issuing bank choice for each letter of credit transaction by an importer-exporter pair. Each row in the table represents the average share of letters of credit issued by the nth most used bank for each importer-exporter pair, and each column corresponds to those importer-exporter pairs that used n issuing banks. The first cell on the diagonal is 100% because there is only bank for these importer-exporter pairs. The second column shows that those importer-exporter pairs that had letters of credit issued by two different banks tend to get 70% of total transactions covered by the major bank, and the remaining 30% by the secondary bank. Likewise, the third column shows that when an importer-exporter pair uses three different issuing banks, on average, 62% of total transaction is supported by the first bank, 26% by the second bank, and the remaining 11% by the third bank. One pattern that arises through columns is that letters of credit issuance is not evenly distributed across banks within each importer-exporter pair.[6] The first few banks support the most of transactions, while the least used banks cover only small part of transactions. One rationale behind the pattern is that each bank imposes a credit line for each transaction, just as it does for other types of loans. If the total value of transaction to be covered by letters of credit exceeds a credit limit at the first bank, the importer-exporter pair will apply the remainder to the second bank, and repeat until they get the transaction fully covered by letters of credit. Accordingly, the pair will use the first $n-1$ banks until the value covered by a letter of credit reaches the maximum available at each bank, and the last nth bank will take whatever remains with the share far below $1/n$. Other things being equal, this would also imply that as the value of transaction is larger, an importer-exporter pair would more likely to receive letters of credit from multiple issuing banks. This is consistent with <Table 2> that mean and median value of total letter of credit transactions is much larger for importer-exporter pairs using multiple issuing banks than others. The implication of this pattern of issuing bank choices will be discussed in more detail when we introduce the empirical strategy at the end of the next section.

We further incorporate annual bank level data compiled by the Bankscope database into our primary import transactions data. Among 16 banks that provided letters of credit to Colombian importers in the pre-crisis period, we exclude 3 banks of which balance sheets data are not available in the Bankscope database.[7] <Table 4> presents summary statistics

[6] Had it been the case, we would have observed the diagonal filled by (100%, 50%, 33%, 25%, 20%, 16%, 14%) instead of the current one.

[7] These 3 banks were collectively responsible for less than 1% of total letter of credit transactions during the period. The list of remaining 13 banks is: AV VILLAS, BANCO AGRARIO DE COLOMBIA, BANCO COLPATRIA - RED MULTIBAN, BANCO DAVIVIENDA, BANCO DE BOGOTA, BANCO DE CREDITO, BANCO DE OCCIDENTE, BANCO POPULAR,

	Bank=1	Bank=2	Bank=3	Bank=4	Bank=5	Bank=6	Bank=7
rank=1	100.00%	69.86%	61.87%	56.68%	54.61%	56.65%	82.65%
rank=2		29.68%	26.37%	23.12%	23.17%	25.78%	12.38%
rank=3			11.54%	12.85%	11.32%	13.82%	3.02%
rank=4				7.35%	7.06%	2.87%	1.05%
rank=5					3.84%	0.54%	0.46%
rank=6						0.34%	0.34%
rank=7							0.10%

This table describes the pattern of issuing bank choices by importer-exporter pairs. Each row corresponds to the share of letter of credit issued by the nth most used bank averaged over importer-exporter pairs. Each column restricts the sample to importer-exporter pairs that used n issuing banks.

Table 3: The Pattern of Issuing Bank Choices

for some of the key bank level variables. Banks in our sample reduced total loans, on average, by 20% during the two year period between 2007 and 2009. During the same period, although total deposits at these banks kept growing by 22% on average, it should be noted that the growth rate almost halved from preceding periods, which must have been perceived as liquidity shocks by banks. The loan reduction rate appears to be moderate compared to an average 88% decline in letters of credit issuance between the pre- and the post-crisis periods.[8]

	Mean	Median	S.D
Growtn inletter of credit issuance (post-pre)	-0.89	-0.74	0.98
Growth in Loans ('07-'09)	-0.21	-0.25	0.15
Growth in Deposits ('07-'09)	0.23	0.22	0.08
Assets in '07 (in log)	9.22	9.05	0.77
Equity/Aseets Ratio in '07	0.10	0.09	0.03
Liquid Assets/Assets Ratio in '07	0.17	0.17	0.10

This table provides summary statistics for bank level variables. The data come from the Bankscope database except for the letter of credit data calculated from the import transactions data. The sample includes 13 banks that provided letters of credit for import transactions in Colombia in the pre-crisis period and of which balance sheets data are available at the Bankscope database.

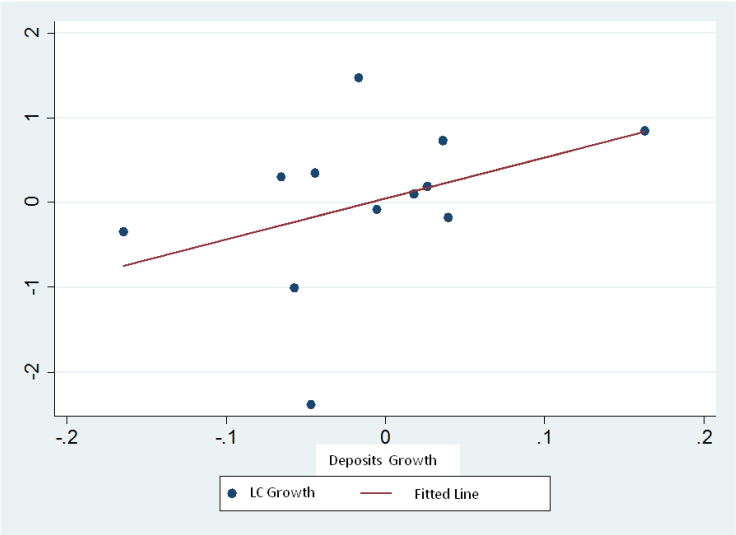
Table 4: Summary Statistics for Bank Level Variables

<Figure 5> illustrates the relationship between the growth in letters of credit issuance and the growth in total deposits. X-axis is the growth in total deposits at each bank between 2007 and 2009, and Y-axis is the growth in letters of credit issued at each bank between

BANCO SANTANDER COLOMBIA S A, BANCO SUDAMERIS COLOMBIA, BANCOLOMBIA S A, BBVA - BBVA BANCO GANADERO - B, CITIBANK.

[8] Although this may suggest that letters of credit supply is more sensitive to bank liquidity shocks than general loans supply, we do not exclude the possibility that the same is true for the demand side during financial crises.

the pre- and post-crisis periods. Both are expressed as the deviation from the mean. The figure shows weakly positive relationship between them, suggesting that banks with bigger adverse liquidity shocks reduced letters of credit supply more. The subsequent sections will be devoted to confirming the pattern and providing the precise estimate of the relationship, by carefully controlling for demand side factors.



This figure provides scatter plots between bank level deposits growth between 2007 and 2009 (X-axis), and bank level growth in letters of credit issuance between the pre- and post-crisis periods (Y-axis). Both are expressed as the deviation from the mean.

Figure 5: Bank Level Deposits Growth and Growth in Letters of Credit Issuance

4. Empirical Strategy

Every international transaction takes place between an importer and an exporter. When the transaction is backed by a letter of credit, it involves, in addition, a bank that issues a letter of credit and thereby promises to pay on behalf of an importer. Hence, the proper starting point of understanding letter of credit transactions is set at an importer-exporter-bank (ijb) level.[9]

The amount outstanding for each letter of credit will be determined by demand and supply of letter of credit issuance. Once an importer and an exporter agrees to transact a certain value using letters of credit, the importer applies for a letter of credit to a bank, and the bank decides whether to issue a letter of credit to support full or part of the transaction. An exporter's bank then decides whether to accept a letter of credit issued by the importer's bank, a choice to oblige itself to make payments to the exporter. Accordingly, just as in other general types of loans, letters of credit demand is formed in the real sector by importers

[9] exporter's bank.

and exporters, while letters of credit supply is determined in the financial sector by issuing and confirming banks. Our goal is to identify the pure supply shocks for letters of credit triggered by issuing bank's liquidity shocks, which can be achieved only if demand shocks are isolated from supply shocks.

We begin by specifying the changes in the value of letter of credit transactions for each importer (i)-exporter (j)-bank (b) triplet between the pre-crisis and the post-crisis period as:

$$\Delta LC_{ijb} = \beta_0 + \beta_1 \Delta B_b + \beta_2 \Delta V_{ijb} + \varepsilon_{ijb}, \tag{1}$$

where β_0 is a constant capturing economy-wide shocks, ΔB_b is the issuing bank's liquidity shocks, and $\Delta V_{ijb} = \Delta V_i' + \Delta V_{ij}'' + \Delta V_{ijb}'''$ is the composite of various factors at importer, importer-exporter, and importer-exporter-bank level, with β_2 being a vector of corresponding coefficients. β_1 is the coefficient of interest that measures the impacts of bank level liquidity shocks on the supply of letters of credit. This is the letter of credit channel through which financial shocks affect international trade.

Assume for now that importer-exporter-bank level shocks are not correlated with bank level liquidity shocks and thus can be absorbed into the error term (i.e., $corr(\Delta B_b, \Delta V_{ijb}''') = 0$), which will be relaxed and discussed further at the end of this section. Then, we can rewrite equation (1) as:

$$\Delta LC_{ijb} = \beta_0 + \beta_1 \Delta B_b + \beta_2 \Delta V_{ij} + \varepsilon_{ijb}, \tag{2}$$

where $\Delta V_{ij} = \Delta V_i' + \Delta V_{ij}''$ is now composed of factors at two levels, importer and importer-exporter level. The main component of the importer level shocks will be importer specific demand and credit shocks. An importer may decide to reduce overall imports by, say, 10%. Also, when importer's creditworthiness deteriorates, it will adversely affect banks' decisions to issue letters of credit on behalf of the importer. Furthermore, when an importer imports from several exporters, each of which selling different types of goods, it is very likely for demand shocks to occur at the importer-exporter level even within an importer. For example, demand for high quality goods tends to decline relatively more than demand for low quality goods during recessions. Similarly, durable goods demand tends to decline more than nondurable goods demand. Although there is no doubt that there exist various shocks at both importer and importer-exporter level, a more relevant question here is whether they are correlated with bank level liquidity shocks, ΔB_b.

Assume further that importer-exporter level shocks are not correlated with bank level liquidity shocks (i.e., $corr(\Delta B_b, \Delta V_{ij}'') = 0$). Then, one can aggregate them over exporters for each importer-bank pair:

$$\Delta LC_{ib} = \beta_0 + \beta_1 \Delta B_b + \eta_i + \varepsilon_{ib}, \tag{3}$$

where $\Delta LC_{ib} = \Sigma_j \Delta LC_{ijb}$ and η_i captures all variations collapsed into importer level. This is exactly the specification that previous studies employed in studying the impacts of bank liquidity shocks on general loans with j being replaced with loan types instead of exporters in our case (Khwaja and Mian, 2008; Schnabl, 2012). The estimate from a simple OLS will be biased when importer specific shock is correlated with bank level liquidity shocks (i.e., $corr(\Delta B_b, \eta_i) \neq 0$), which is very likely to be the case. One simple example will be that an importer tends to receive letter of credit from its main bank such that bad shocks on the importer side generate bad news on the bank, worsening liquidity shocks at the bank.[10] Since many importers receive letters of credit from multiple banks in a given period, a novel remedy to address such bias developed in the abovementioned studies can be also applied to this setting by including importer fixed effects to absorb all importer level shocks. Therefore, as long as our underlying assumption holds ($corr(\Delta B_b, \Delta V''_{ij}) = 0$), running a regression in (3) with importer fixed effects will deliver the unbiased estimate of β_1.

However, there are good reasons to believe that importer-exporter level shocks are correlated with bank level liquidity shocks (i.e., $corr(\Delta B_b, \Delta V''_{ij}) \neq 0$), which will invalidate the specification in (3) in the first place. Here is one example in which the correlation may arise from the selection process by exporters' banks. When an exporter's bank decides whether to accept a letter of credit, it will prefer a letter of credit issued by a healthier bank. To the extent that exporters' banks with relatively weaker balance sheets showed stronger preference patterns and thus were more likely to be self-selected into the relationship with healthier issuing banks, this will generate negative correlation between importer-exporter level shocks and importer's bank level liquidity shocks (i.e., $corr(\Delta B_b, \Delta V''_{ij}) < 0$). This is because exporters' banks with relatively weaker balance sheets before the crisis are more likely to have been hit harder by global financial shocks, and thus to have more actively reduced the overall exposure to letters of credit acceptance, while ex ante healthier issuing banks are more likely to have weathered the storm of liquidity shocks. In other words, since the composition of exporters' banks, and hence that of exporters at each importer-bank level matters, the aggregation process that results in equation (3) is not warranted and should be avoided.[11]

For this reason, we will go back to the importer-exporter-bank level specification in (2). Of course, working with the importer-exporter-bank level data does not automatically solve the problem. We need to control for importer-exporter specific shocks that would generate downward bias if they are negatively correlated with bank level liquidity shocks as reasoned above. One natural candidate is including importer-exporter level fixed effects, which will deliver the unbiased estimate of β_1 as long as our first assumption holds ($corr(\Delta B_b, \Delta V'''_{ijb}) =$

[10] In fact, negative correlation.. downward bias in OLS...weaker importer–>healthier bank

[11] (Khwaja and Mian Schnabl tries to address the issue by controlling for the share of each type of loans–footnote)depending on the composition of loan type...

0). This methodology, however, imposes strict restriction on the sample that only those importer-exporter pairs using letters of credit from multiple issuing banks can be included. A great advantage of the current dataset is that, as described in the previous section, it indeed includes many importer-exporter pairs using letters of credit issued by multiple banks. Had it not been for such a unique feature of the data, we might have had to rely on the secondary method of including importer-country level fixed effects. To the extent that vulnerability of exporters' banks was relatively homogeneous and thus they behaved similarly within a country, importer-country level fixed effects could alleviate the omitted variable bias to some degree, but not as much as importer-exporter level fixed effects do.

The final step is to question the validity of our first assumption that importer-exporter-bank level shocks are not correlated with bank level liquidity shocks (i.e.,$corr(\Delta B_b, \Delta V'''_{ijb}) = 0$). The answer lies in better understanding why an importer-exporter pair would ever use multiple issuing banks for their letter of credit transactions at the same time. One possible explanation is that each bank imposes a credit line for each transaction, just as it does for other types of loans. If the total value of transaction to be covered by letters of credit exceeds a credit limit at the first bank, the importer-exporter pair will apply the remainder to the second bank, and repeat until they get the transaction fully covered by letters of credit. Alternatively, exporters' banks may want to diversify thier risk exposures across issuing banks. In either case, the pair will use the first $n-1$ banks until the value covered by a letter of credit reaches the maximum available at each bank, whether it be due to the limit of credit line or exposure, and the last nth bank will take whatever remains.

This implies that it is very likely for the estimate to be seriously biased when this process is not properly accounted for. The reason is as follows. Any given importer-exporter pair will tend to approach the most creditworthy bank first, and use the least creditworthy bank last, not least because of exporter's bank's preference. At the same time, the amount of letters of credit issued by the first few banks is most likely to have reached credit limits, while they are likely to be below the credit limit at the last one. Suppose now that liquidity shocks occur across banks. Even if the ex ante healthier banks are hit less, they cannot avoid shrinking balance sheets, and will also have to lower credit limits for each line of credit just as–but less than–other banks. Since lowering credit limits will affect binding cases most (i.e., those letters of credit that have already reached credit limits) and these cases are likely to have been more prevalent in those ex ante healthier banks, this will generate bias toward zero, in particular for intensive margin analysis that looks at continuing letter of credit issuances.

The opposite will be true for extensive margin analysis that focuses on discontinuing importer-exporter-bank relationship. When import demand falls, an importer-exporter pair is most likely to drop out of the relationship with the the last nth banks because the pair no longer needs them that mostly took the the remainders from each importer-exporter pair.

To the extent that the last nth banks are the weakest banks hit most, this will overestimate the effect of bank liquidity shocks on the banks' decision to discontinue letter of credit issuances.

As an attempt to eliminate such bias, we include the pre-crisis value of letter of credit issued by a bank for each importer-exporter pair ($LC_{ijb,pre}$). This variable will capture the relative distance from credit limits across banks within an importer-exporter pair. The higher the pre-crisis value is, the lower the subsequent intensive growth and the probability of exit are during crises.[12] Consequently, the main specification that is free from any potential bias is given as:

$$\Delta LC_{ijb} = \beta_0 + \beta_1 \Delta B_b + \beta_2 LC_{ijb,pre} + \eta_i + \eta_{ij} + \varepsilon_{ijb}, \tag{4}$$

where β_0 is a constant capturing economy-wide shocks, and ΔB_b is the issuing bank's liquidity shock measured by the difference in log deposits at a bank between two periods. A lower deposits growth corresponds to larger adverse liquidity shocks. $LC_{ijb,pre}$ is importer-exporter-bank level log pre-crisis value of letter of credit, and η_i denotes importer fixed effects, which will be wiped out when η_{ij} is controlled for by importer-exporter fixed effects. The dependent variable is the difference in log value of letter of credit issued by a bank (b) for an importer-exporter pair (ij) between the pre- and the post-crisis period for intensive margin analysis, and an exit dummy variable for extensive margin analysis.

In sum, $\beta_1$is the coefficient of interest that is supposed to capture the impacts of bank level liquidity shocks on letters of credit supply. This is the letter of credit channel through which financial shocks affect international trade. $\beta_1 > 0$ (or $\beta_1 < 0$ for extensive margin analysis) will imply that each importer-exporter pair find it harder to get letters of credit issued by a bank facing bigger adverse liquidity shocks. This will be a result of both facts that (a) a bank hit harder by liquidity shocks reduces supply of letters of credit more (supply reduction by issuing banks), and (b) an exporter's bank reduces an exposure to a harder-hit bank more (supply reduction by confirming banks).

5. Results

5.1. Bank Liquidity Shocks and Letters of Credit Supply

<Table 5> presents the regression results when the dependent variable captures both intensive margin growth and extensive margin growth due to exit. In particular, the dependent variable is constructed as the change in the value of letter of credits issued by a bank b for an importer-exporter pair ij between the pre-crisis and the post-crisis period scaled by the sum of these two values. By construction, this measure is bounded between -1 and

[12] The implicit assumption is that the level of credit limit does not vary systemically across banks within an importer-exporter pair. This may or may not be true, but our results in the next section strongly support the view.

1, which makes it more appealing than the traditional growth measure scaled by the pre-crisis value that is not bounded above.[13] We restrict the sample to importer-exporter-bank triplets that appear in the pre-crisis period.[14] Column (1)-(3) report the regression results from the most preferred specification that includes importer-exporter level fixed effects. Column (1) includes the bank level deposit growth only, and column (2) adds importer-exporter-bank level pre-crisis value of letter of credit transaction. The result does not vary much as the pre-crisis value is added, perhaps because the opposing effects are offset between intensive and extensive margins. The coefficient on bank liquidity shocks is greater than 1 and statistically significant at 10% level. Given that the estimation is based on within importer-exporter pair variations, the estimate reflects pure supply effects as long as reduced demand within an importer-exporter pair is in equal proportion across banks after controlling for the pre-crisis value. Adding log total assets value as a proxy for a bank size reduces the size of the estimated coefficient on bank liquidity shocks but the qualitative interpretation remains the same (column (3)).[15] The results from column (1)-(3) reveal significant impacts of bank liquidity shocks on letters of credit supply, and thus identify one particular channel through which financial shocks are transmitted to real activity, namely the letter of credit channel.

In order to highlight the role of importer-exporter level fixed effects in eliminating potential biases, column (4)-(9) report corresponding regression results with importer-country fixed effects (column (4)-(6)) and importer-fixed effects (column (7)-(9)). When importer-country fixed effects are included instead of importer-exporter fixed effects, the estimate on bank liquidity shocks tends to be lowered across all specifications. This reflects potential downward bias caused by failure to control for the self-selection pattern of exporters' banks as discussed in the previous section in detail. Column (7)-(9) shows even lower estimates, hence implies more severe downward bias when only importer level fixed effects are included. This shows that adding importer-country level fixed effects corrects downward bias in the estimated coefficient a little bit, but cannot eliminate all.

Despite its advantage in presenting the overall impacts, the dependent variable in <Table 5> makes it hard to interpret the size of the estimated coefficient. In order to deliver a meaningful interpretation, it is useful to break it down to intensive and extensive margin impacts. <Table 6> presents the regression results when the dependent variable captures intensive margin growth only. The dependent variable is now the difference in log value of letter of credit issued by a bank b for an importer-exporter pair ij between the pre-crisis and the post-crisis period. Therefore, the sample is restricted to importer-exporter-bank

[13] Antras and Foley

[14] This is the subset of the sample with all importer-exporter pairs that received letters of credit from multiple issuing banks for which importer-exporter fixed effects regressions are justified.

[15] Including additional sets of bank level controls such as pre-crisis value of deposits and liquidity assets gives very similar results.

Dependent variable	$(LC_{ijb,post}-LC_{ijb,pre})/(LC_{ijb,post}+LC_{ijb,pre})$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δln(Deposits)$_b$	1.256 **	1.257 *	1.205 *	1.104 *	1.073 *	1.013 *	1.037 *	1.008 *	0.946
	(0.570)	(0.584)	(0.594)	(0.547)	(0.543)	(0.550)	(0.571)	(0.562)	(0.565)
ln(LC)$_{ijb,pre}$		-0.001	0.000		0.022 *	0.023 *		0.026 ***	0.027 ***
		(0.024)	(0.024)		(0.012)	(0.012)		(0.008)	(0.008)
ln(Assets)$_{b,pre}$			-0.027			-0.034			-0.037
			(0.044)			(0.045)			(0.044)
Fixed effects	imp-exp	imp-exp	imp-exp	imp-cty	imp-cty	imp-cty	importer	importer	importer
Obs	1,823	1,823	1,823	1,823	1,823	1,823	1,823	1,823	1,823
# of imp-exp pairs									
R squared	0.514	0.514	0.515	0.346	0.348	0.349	0.234	0.237	0.239

Notes: The dependent variable is the importer-exporter-bank level growth in the value of letter of credit transactions measured as the change in the value of letter of credit transactions between the pre-crisis and the post-crisis period scaled by the sum of the value of letter of credit transactions in these two periods. The sample includes all importer-exporter pairs of which letter of credit transactions were undertaken by multiple issuing banks in the pre-crisis period. Independent variables are the bank level growth in the deposits between two periods, importer-exporter-bank level pre-crisis value of letter of credit transactions in logarithm, and bank's pre-crisis asset value in logarithm. Column (1)-(3) include importer-exporter fixed effects, column (4)-(6) include importer-country fixed effects, and column (7)-(9) include importer fixed effects. Standard errors in parentheses are clustered at the bank level. Significance: * 10 percent; ** 5 percent; *** 1percent.

Table 5: Impacts of Bank Liquidity Shocks on Letter of Credit Issuance: Overview

triplets that appear in both the pre-crisis and the post-crisis period. As earlier, column (1)-(3) report the most preferred regression results with importer-exporter level fixed effects. The coefficient on bank liquidity shocks is around 3 but not statistically significant in column (1), but adding the pre-crisis level raises the size as well as the statistical significance of the coefficient estimate substantially. At the same time, the coefficient on the pre-crisis value is estimated to be negative and statistically significant. Thus, column (2) confirms our discussion in the previous section that the closer the previously issued letter of credit is to a credit limit, the larger the subsequent decline is for intensive margin growth, and that failing to control for this will cause downward bias in estimating the impacts of bank liquidity shocks on intensive margin growth of letter of credit issuance. Adding a bank size as an additional bank level control lowers the estimate a little bit (column (3)). The estimated coefficient implies that 1 percentage point decline in bank liquidity leads to a 4.5 percentage point decline in the bank's letter of credit issuances. Column (4)-(6) repeat these regressions with importer-country level fixed effects instead of importer-exporter level fixed effects. The coefficient is underestimated across all three specifications compared to the one in a corresponding column in (1)-(3). This again confirms the earlier discussion on potential downward bias that persists in the absence of importer-exporter fixed effects. Column (7)-(9) report the results with importer level fixed effects only, and it reveals even worse downward bias, further supporting the point. It is also worth noting the consistent role of adding the pre-crisis value in these alternative fixed effects regressions (column (4) vs (5) and column (7) vs (8)).

Turning to extensive margin impacts due to exit, <Table 7> presents the regression results from the linear probability model with the exit dummy as the dependent variable. The sample is the same as the one in <Table 5> that includes importer-exporter-bank triplets that appear in the pre-crisis period. Those that disappear in the post-crisis period

Dependent variable	$\Delta\ln(LC)_{ijb}$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\Delta\ln(Deposits)_b$	2.964	4.605 **	4.499 **	2.419	3.481 *	3.378 *	2.554	3.486 **	3.352 **
	(1.710)	(1.953)	(1.969)	(1.727)	(1.658)	(1.672)	(1.432)	(1.353)	(1.351)
$\ln(LC)_{ijb,pre}$		-0.472 ***	-0.473 ***		-0.431 ***	-0.431 ***		-0.420 ***	-0.421 ***
		(0.109)	(0.108)		(0.062)	(0.062)		(0.056)	(0.055)
$\ln(Assets)_{b,pre}$			-0.085			-0.100			-0.122
			(0.147)			(0.125)			(0.112)
Fixed effects	imp-exp	imp-exp	imp-exp	imp-cty	imp-cty	imp-cty	importer	importer	importer
Obs	670	670	670	670	670	670	670	670	670
# of imp-exp pairs									
R squared	0.584	0.678	0.679	0.379	0.499	0.501	0.239	0.387	0.390

Notes: The dependent variable is the importer-exporter-bank level growth in the value of letter of credit transactions measured as the change in the log value of letter of credit transactions between the pre-crisis and the post-crisis period. The sample is the subset of all importer-exporter pairs of which letter of credit transactions were undertaken by multiple issuing banks in the pre-crisis period, which is restriced to importer-exporter-bank triplets that undertook letter of credit transactions in both periods. Independent variables are the bank level growth in the deposits between two periods, importer-exporter-bank level pre-crisis value of letter of credit transactions in logarithm, and bank's pre-crisis asset value in logarithm. Column (1)-(3) include importer-exporter fixed effects, column (4)-(6) include importer-country fixed effects, and column (7)-(9) include importer fixed effects. Standard errors in parentheses are clustered at the bank level. Significance: * 10 percent; ** 5 percent; *** 1percent.

Table 6: Impacts of Bank Liquidity Shocks on Letter of Credit Issuance: Intensive Margin

have the exit dummy equal 1, and 0 otherwise. Column (1)-(3) report the regression results with importer-exporter level fixed effects. Column (1) shows the negative and statistically significant coefficient on bank liquidity shocks, implying that a bank with bigger adverse liquidity shocks is more likely to discontinue issuing a letter of credit to a given importer-exporter. Adding the pre-crisis value moves the estimate to a smaller negative value with its own coefficient being negative and statistically significant (column (2)). The lower the pre-crisis value is, the higher the probability of exit is during crises, and failing to control for this overesitmates the extensive margin impact of bank liquidity shocks. This is exactly what we have discussed in the previous section. The value of letters of credit issued by a bank is not randomly assigned within an importer-exporter pair. Adding a bank size as an additional bank level control lowers the estimate a little bit. Column (4)-(6) and column (7)-(9) are the results from importer-country level fixed effects and importer level fixed effects, respectively. As earlier, these results confirm that including importer-country level fixed effects instead of importer-exporter level fixed effects underestimates the impact of bank liquidity shocks on letters of credit supply, and that the downward bias is much worse when only importer fixed effects are included. The importance of adding the pre-crisis value is also found in these alternative cases (column (4) vs (5) and column (7) vs (8)).

Despite its clearness, the sheer size of the coefficient in <Table 7> makes it hard to deliver a reasonable interpretation. For example, column (3) suggests that a 2 percentage point decline in bank deposits leads to an increase in the exit probability by 1.9, which is nonsense given that the probability must be between 0 and 1. This is a common drawback of the linear probability model. Instead, we can employ the logit model, and the results are reported in <Table 8>. Since the logit model discards observations without any variation in the dependent variable within a group, the sample now includes only those importer-exporter pairs (importer-country pairs in column (4)-(6) and importers in column (7)-(9))

Dependent variable	EXIT=1_{ijb}								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δln(Deposits)$_b$	-1.124 **	-0.973 **	-0.955 **	-0.963 **	-0.819 **	-0.793 *	-0.805	-0.697	-0.667
	(0.425)	(0.386)	(0.389)	(0.412)	(0.374)	(0.386)	(0.458)	(0.421)	(0.427)
ln(LC)$_{ijb,pre}$		-0.090 ***	-0.090 ***		-0.102 ***	-0.102 ***		-0.100 ***	-0.100 ***
		(0.014)	(0.014)		(0.006)	(0.006)		(0.007)	(0.008)
ln(Assets)$_{b,pre}$			0.009			0.015			0.018
			(0.030)			(0.031)			(0.031)
Fixed effects	imp-exp	imp-exp	imp-exp	imp-cty	imp-cty	imp-cty	importer	importer	importer
Obs	1,823	1,823	1,823	1,823	1,823	1,823	1,823	1,823	1,823
# of imp-exp pairs									
R squared	0.545	0.575	0.575	0.370	0.422	0.423	0.256	0.316	0.317

Notes: The dependent variable is the importer-exporter-bank level dummy variable equal to 1 if an importer-exporter pair discontinued letter of credit transactions supported by a bank in the post-crisis period, and 0 otherwise. The sample includes all importer-exporter pairs of which letter of credit transactions were undertaken by multiple issuing banks in the pre-crisis period. Independent variables are the bank level growth in the deposits between two periods, importer-exporter-bank level pre-crisis value of letter of credit transactions in logarithm, and bank's pre-crisis asset value in logarithm. Column (1)-(3) include importer-exporter fixed effects, column (4)-(6) include importer-country fixed effects, and column (7)-(9) include importer fixed effects. Standard errors in parentheses are clustered at the bank level. Significance: * 10 percent; ** 5 percent; *** 1percent.

Table 7: Impacts of Bank Liquidity Shocks on Letter of Credit Issuance: Extensive Margin (Linear Probability)

that discontinued receiving letters of credit from at least one bank, but not from all.[16] The qualitative patterns in the coefficient estimate are exactly same with those found in <Table 7> from linear probability model. Our interests are in the odds ratio reported at the bottom of each column, which gives an easy interpretation addressing the drawback of the linear probability model. Column (1) shows that an 1 percentage point increase in bank liquidity shocks reduces the exit probability by 6 percent (1-0.938). Column (2) tells that controlling for the pre-crisis value can correct the overestimated value, and lowers the estimated impact on the exit probability to 5 percent (1-0.946). Importer-country fixed effects and importer fixed effects regressions report similar but underestimated results.

We end the section by presenting the regression results from the importer-bank level data as specified in equation (3). Column (1)-(3), column (4)-(6), and column (7)-(9) replicate the regression results reported in <Table 5>, <Table 6>, and <Table 7>, respectively at the importer-bank level with importer fixed effects. In all cases, the coefficient on bank level liquidity shocks is not precisely estimated, and none is statistically significant. This highlights the caution against aggregating the data over exporters to an importer-bank level, or over loan types to a borrower-lender level in more general cases.

5.2. Letters of Credit Supply and Imports Collapse

Our main results so far have confirmed that bank liquidity shocks lead to a reduction in the letter of credit issuance. However, it is important to note that the results were all in *relative* terms, and that they do not necessarily identify the presence of the transmission channel from financial shocks to the real economy. Banks hit harder by liquidity shocks

[16] IAnother change made here is that bank deposits growth is now multiplied by 100 in order to deliver a more simple and intuitive interpretaion.

Dependent variable	EXIT=1$_{ijb}$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δln(Deposit)$_{b*100}$	-0.064 ***	-0.055 ***	-0.054 ***	-0.051 ***	-0.047 ***	-0.045 ***	-0.040 ***	-0.041 ***	-0.039 ***
	(0.012)	(0.013)	(0.013)	(0.011)	(0.012)	(0.012)	(0.010)	(0.011)	(0.011)
ln(LC)$_{ijb,pre}$		-0.554 ***	-0.559 ***		-0.591 ***	-0.595 ***		-0.561 ***	-0.567 ***
		(0.078)	(0.078)		(0.061)	(0.062)		(0.054)	(0.054)
ln(Assets)$_{b,pre}$			0.089			0.107			0.139
			(0.098)			(0.090)			(0.084)
Fixed effects	imp-exp	imp-exp	imp-exp	imp-cty	imp-cty	imp-cty	imp-cty	imp-cty	imp-cty
Obs	869	869	869	1,212	1,212	1,212	1,450	1,450	1,450
Odds Ratio	0.938 ***	0.946 ***	0.948 ***	0.950 ***	0.954 ***	0.956 ***	0.960 ***	0.960 ***	0.962 ***
Δln(Deposit)$_b$	(0.011)	(0.012)	(0.012)	(0.011)	0.011	(0.011)	(0.010)	(0.011)	(0.011)

Notes: The dependent variable is the importer-exporter-bank level dummy variable equal to 1 if an importer-exporter pair discontinued letter of credit transactions supported by a bank in the post-crisis period, and 0 otherwise. The sample is the subset of all importer-exporter pairs of which letter of credit transactions were undertaken by multiple issuing banks in the pre-crisis period, which is restriced to those that have any variation in the dependent variable within importer-exporter pair (Column (1)-(3)), importer-country pair (Column (4)-(6)), or importer (Column (7)-(9)). Independent variables are the bank level growth in the deposits between two periods, importer-exporter-bank level pre-crisis value of letter of credit transactions in logarithm, and bank's pre-crisis asset value in logarithm. Column (1)-(3) include importer-exporter fixed effects, column (4)-(6) include importer-country fixed effects, and column (7)-(9) include importer fixed effects. Standard errors in parentheses are clustered at the bank level. Significance: * 10 percent; ** 5 percent; *** 1percent.

Table 8: Impacts of Bank Liquidity Shocks on Letter of Credit Issuance: Extensive Margin (Logit)

reduced letter of credit supply *relative to* other banks hit less for a given importer-exporter pair. It is perfectly plausible that the results were mainly driven by switching across issuing banks within an importer-exporter pair, without any significant effect on total imports by the importer-exporter pair. That is, if banks with smaller liquidity shocks had absorbed the market share of the letter of credit issuance from those with bigger adverse liquidity shocks, we would have still obtained the sizable estimate of the letter of credit channel, but there would have been no such transmission of bank liquidity shocks to import transactions.

In order to check this possibility, we aggregate the specification in (4) over banks for each importer-exporter pair:

$$\Delta LC_{ij} = \beta_0' + \beta_1' \Delta \overline{B}_{ij} + \beta_2' LC_{ij,pre} + \eta_i + \eta_{ij}, \tag{5}$$

where $\Delta \overline{B}_{ij}$ is now the average liquidity shocks faced by an importer-exporter's pre-crisis issuing banks. This is measured as the importer-exporter level average of bank liquidity shocks weighted by the pre-crisis value of letter of credit issued by each bank. The more an importer-exporter pair had initially received letters of credit from banks with bigger adverse liquidity shocks, the lower $\Delta \overline{B}_{ij}$ is. If the share of letters of credit issuance was simply reallocated across banks for import transactions by an importer-exporter pair, the coefficient estimate β_1' will be close to zero because the average liquidity shocks would have no impact on the importer-exporter pair's total letter of credit import transactions. On the other hand, if an importer-exporter pair could not easily switch across banks to compensate for letters of credit cut by hardest hit banks, we would obtain the coefficient estimate β_1' greater than zero, proving the presence of the transmission channel from bank liquidity shocks to import transactions.

Dependent variable	$(LC_{ib,post}-LC_{ib,pre})/(LC_{ib,post}+LC_{ib,pre})$			$\Delta \ln(LC)_{ib}$			$EXIT=1_{ib}$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\Delta \ln(Deposit)_b$	0.451	0.257	0.243	2.148	3.556	3.485	-0.537	-0.148	-0.159
	(0.494)	(0.377)	(0.372)	(2.073)	(2.614)	(2.733)	(0.601)	(0.343)	(0.339)
$\ln(LC)_{ib,pre}$		0.066 ***	0.067 ***		-0.188 **	-0.185 **		-0.132 ***	-0.132 ***
		(0.010)	(0.009)		(0.081)	(0.083)		(0.010)	(0.010)
$\ln(Assets)_{b,pre}$			-0.006			-0.038			-0.005
			(0.022)			(0.217)			(0.015)
fixed effects	importer	importer	importer	importer	importer	importer	importer	importer	importer
Obs	1,033	1,033	1,033	365	365	365	1,033	1,033	1,033
R squared	0.418	0.452	0.619	0.579	0.597	0.597	0.464	0.579	0.619

Notes: The dependent variable in column (1)-(3) is the importer-bank level growth in the value of letter of credit transactions measured as the change in the value of letter of credit transactions between the pre-crisis and the post-crisis period scaled by the sum of the value of letter of credit transactions in these two periods. The dependent variable in column (4)-(6) is the importer-bank level growth in the value of letter of credit transactions measured as the change in the log value of letter of credit transactions between the pre-crisis and the post-crisis period. The dependent variable in column (7)-(9) is the importer-bank level dummy variable equal to 1 if an importer-exporter pair discontinued letter of credit transactions supported by a bank in the post-crisis period, and 0 otherwise. The sample is the subset of all importers of which letter of credit transactions were undertaken by multiple issuing banks in the pre-crisis period. Independent variables are the bank level growth in the deposits between two periods, importer-bank level pre-crisis value of letter of credit transactions in logarithm, and bank's pre-crisis asset value in logarithm. All columns include importer fixed effects. Standard errors in parentheses are clustered at the bank level. Significance: * 10 percent; ** 5 percent; *** 1percent.

Table 9: Impacts of Bank Liquidity Shocks on Letter of Credit Issuance: Importer-Bank Level

Since the resulting observations are at importer-exporter level and there are many importers that transacted with multiple exporters using letters of credit, we can include importer fixed effects to control for importer specific demand and credit shocks. In other words, we ask if an importer reduced imports by letters of credit relatively more from an exporter with which the importer had received letters of credit from banks with larger negative liquidity shocks.

The regression results are reported in <Table 10>. The coefficient estimate of the bank liquidity shocks is big positive and statistically significant (column (2)), and omitting the pre-crisis value of letters of credit transaction leads to downward bias (column (1)). Admittedly, running a regression specified in (2) implicitly assumes that importer-exporter level shock is uncorrelated with independent variables including the average bank liquidity shocks (i.e., $corr(\Delta \overline{B}_{ij}, \eta_{ij}) = 0$), which may not hold for a similar reason discussed earlier. To the extent that potential bias arises mostly from exporting country level shocks, one remedy to reduce potential bias is to include exporter's country fixed effects along with importer fixed effects. Our results in the previous section that importer-country fixed effects reduce potential bias support the idea. Column (3) and (4) report the regression results when country fixed effects are added.[17] Including country fixed effects raises the coefficient estimate on the bank liquidity shocks, reflecting downward bias in a regression with importer fixed effects only. The size of the coefficient estimate is comparable to the one from the importer-exporter-bank level regression reported in <Table 6>. This is the evidence against the possibility that an importer-exporter pair could turn to another bank when it became hard to receive a letter of credit from a bank.

[17] In fact, there are 2 observations unused in these regressions because two countries in the sample have only one exporter each.

Still, there is another possibility that might have dampened the letter of credit channel through which bank liquidity shocks deliver real impacts. If an importer-exporter pair could find alternative sources of trade financing easily, and thus could switch to other types of payment methods from a letter of credit, a reduction in letter of credit transactions would not necessarily lead to an overall reduction in import transactions. To see if this is actually what had happened, we replace our dependent variable with total value of import transactions between an importer and an exporter, which now includes, if any, cash-in-advance and open account transactions. A lower coefficient estimate on the average bank liquidity shocks than the ones in previous columns would imply that trading partners could use alternative payment methods when they found it hard to receive letters of credit. The results reported in column (5)-(8) show strong evidence against this possibility. The coefficients do not change much, suggesting that it was not easy for them to find alternative sources of trade financing at the time of bank liquidity shocks.

Overall, our results in <Table 10> strongly confirm that the letter of credit channel we identified in the previous section has real consequences indeed: bank liquidity shocks are directly passed on to real economy via a reduction in letters of credit supply.

Dependent variable	$\Delta\ln(LC)_{ij}$				$\Delta\ln(Import)_{ij}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta\ln(Deposits)_{ij}$	2.644	2.893 *	2.870	3.339 *	2.488	2.698 *	3.019 *	3.428 **
	(1.681)	(1.726)	(1.818)	(1.767)	(1.531)	(1.543)	(1.588)	(1.553)
$\ln(LC)_{ij,pre}$		-0.267 ***		-0.281 ***		-0.225 ***		-0.245 ***
		(0.053)		(0.056)		(0.044)		(0.048)
Fixed effects	imp	imp	imp+cty	imp+cty	imp	imp	imp+cty	imp+cty
Obs	715	715	715	715	715	715	715	715
R squared	0.430	0.487	0.467	0.523	0.441	0.491	0.467	0.534

Notes: The dependent variable in column (1)-(4) is the importer-exporter level growth in the value of letter of credit transactions measured as the change in the log value of letter of credit transactions between the pre-crisis and the post-crisis period. The dependent variable in column (5)-(8) is the importer-exporter level growth in the value of total import transactions measured as the change in the log value of total imports between the pre-crisis and the post-crisis period. The sample includes all importer-exporter pairs that undertook letter of credit transactions in both periods. Independent variables are the importer-exporter level (pre-crisis value of letter of credit issuance) weighted average of the bank deposits growth between two periods, importer-exporter level pre-crisis value of letter of credit transactions in logarithm. Column (1)-(2) and (5)-(6) include importer fixed effects, and column (3)-(4) and (7)-(8) include both importer and country fixed effects. Standard errors in parentheses are clustered at the bank level. Significance: * 10 percent; ** 5 percent; *** 1percent.

Table 10: Impacts of Bank Liquidity Shocks on Letter of Credit Issuance: Importer-Exporter Level

5.3. Quantifying the Relative Role of Bank Liquidity Shocks in the Imports Collapse

Given the results presented so far, it is tempting to further explore our estimates to gauge the relative role of trade finance in the great trade collapse. Although this is not an easy task because neither import demand shocks nor trade finance supply shocks are fully observable, we nevertheless apply several methods to quantify the relative role of trade finance in the import collapse, albeit only suggestive, for the sample of importer-exporter pairs included in regressions reported in <Table 10>.

The basic idea is to calculate the hypothetical aggregate imports growth that would have been obtained if trade finance shocks had been the only factor causing the trade collapse, and compare it to the actual aggregate imports growth. The hypothetical value can be obtained by (a) collecting importer-exporter level predicted growth rates from a simple OLS regression with the average bank liquidity shock variable, (b) backing out importer-exporter level predicted imports value in the post-crisis period, and (c) summing them up over importer-exporter pairs to calculate the aggregate imports growth rate. We choose to run a simple OLS regression because it is the correct model under the hypothetical scenario, and this will allow us to be conservative because a simple OLS regression underestimates the impact of bank liquidity shocks.[18] The resulting hypothetical growth rate for the sample is -6.4%, which is about 47% of the actual growth rate (-13.7%).

Alternatively, we can follow the methodology employed in Mian and Sufi (2012) in order to remove economy wide shock that is included in the above calculation but may not necessarily be attributable to trade finance shocks. This requires a simple fix for the above procedure, which amounts to subtracting the predicted growth rates for the least affected importer-exporter pair from importer-exporter level predicted growth rates. Following their approach to remain conservative, we pick the importer-exporter pair with the 95 percentile of the average bank deposits growth (i.e., the importer-exporter pair with top 5 percentile of predicted imports growth (-0.002)) as the least affected. This exercise yields the hypothetical growth rate of -6.3%, which is not very different from our earlier figure.

Yet another possible approach is to use the regression result in column (1) in <Table 10> by collecting predicted values excluding the ones from importer fixed effects. This is supposed to deliver the aggregate imports growth due only to bank liquidity shocks with the idea that importer fixed effects capture any other demand shock operating at the importer level. Again, this will deliver a conservative quantification because some portions of importer fixed effects would include importer level credit shocks attributable to the trade finance channel. This approach gives the predicted aggregate imports growth rate of -5.2%, implying that about 38% of the actual imports collapse is explained by bank liquidity shocks.

6. Conclusion

This study identifies, and provides the precise estimate of, the direct impact of bank liquidity shocks on real economic activity, exploring letters of credit import transactions in Colombia during the 2008-2009 global financial crisis. The extremely detailed dataset on letters of credit transactions enabled us to exploit within importer-exporter variations across issuing banks. We find substantial impacts of bank liquidity shocks on import transactions

[18] The estimated coefficient on bank liquidity shocks from an OLS regression is 1.851 with the standard error 1.012.

by letters of credit: an 1 percentage point decline in bank deposits growth led to a 4.5 percentage point decline in imports in intensive margins, and to a 6 percent increase in the exit probability in extensive margins. Further, our estimate suggests that adverse bank liquidity shocks can explain at least 38% ~47% of the collapse in import transactions by letters of credit in Colombia. *[to be added]*

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[to be added]