Firm size, liquidity and optimal heterogeneous hedging

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Abstract

This paper studies the heterogeneous hedging strategies of non-financial firms in emerging market economies against exchange rate uncertainty. We show that even if large firms are prevalent in the derivatives market, they present smaller shares of covered Foreign Currency (FC) debt in comparison to smaller firms. We rationalize this pattern in two ways: i) The market of covered FC debt presents lack of liquidity related to the financial frictions faced by banks; which limits entry of small firms and the extent of large firms' hedges. ii) Sterilized Foreign Exchange (FX) interventions distort firms use of covered FC debt. Moderate FX sales reduce hedge size and the probability of entry for small firms that are implicitly protected by the monetary authority, enabling them to bypass fixed entry costs. Large FX sales spillover FC liquidity to the derivatives market, increasing the hedges of big firms as these interventions reduce their variable costs. We provide theoretical and empirical evidence for these two explanations with rich firm-level panel data for Colombia.

JEL Classification: F31, F41, G11, G32
Keywords: FC debt, FC forwards, exchange rate, FC exposure

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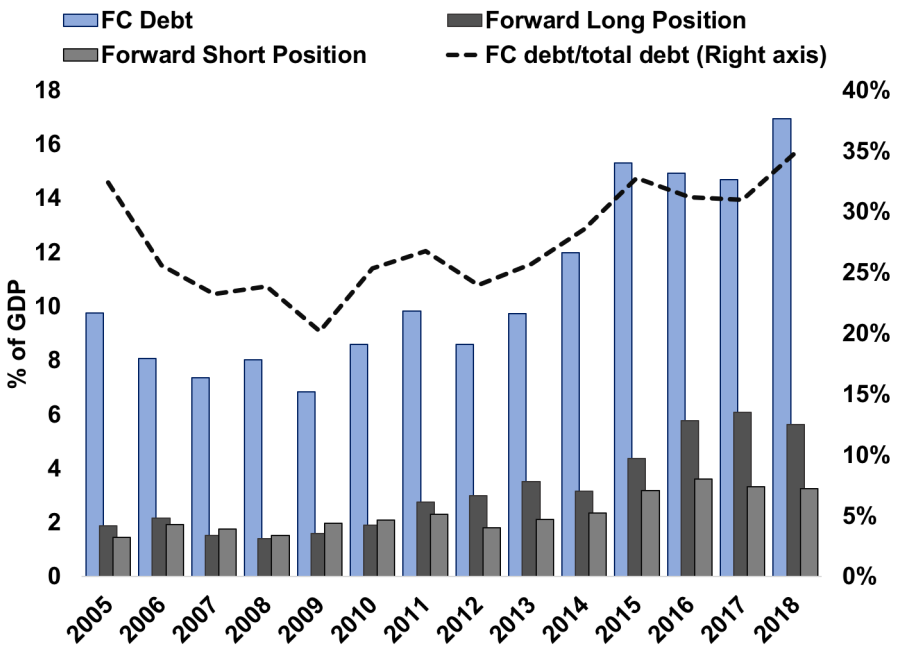
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1 Introduction

For almost a decade and a half (2000-2014), many Emerging Market Economies benefited from easy access to Foreign Currency (FC) markets (Bastos et al. (2015)). This was possible because of strong macroeconomic fundamentals and favorable terms of trade. It was also facilitated by low yields and ample liquidity in mature markets, especially after the Global Financial Crisis (GFC) with the unconventional monetary policies implemented by Central Banks of developed countries.

Colombia is an example of an Emerging Market Economy (EME) that took advantage from global liquidity. As figure 1 shows, after a period of domestic currency debt growth (2005-2009), the private, corporate, non-financial sector increased FC debt as a share of total debt from 20 percent in 2009 to 35 percent in 2018. Widespread FC liquidity, however, did not contribute to a similar development of the FC forward market. While the FC debt market increased by more than 7 points of GDP from 2009 to 2018, the long position, forward contracts grew by less than 4 and the short position contracts increased by just 2.

Figure 1: FC Forwards, Domestic and FC debt: Non-financial corporate private sector in Colombia



Source: Authors' calculations based on Banco de la República.

Slow growth of the covered FC debt market[1] is a source of risk and vulnerability for an economy. Specially in situations of exchange rate depreciation and volatility[2]. This is the scenario faced by Colombia after the second semester of 2014, when commodity prices collapsed, leaving countries with weakened exchange rates and lower economic growth.

[1]The FC debt that has been hedged with a long position FC forward.

[2]From a macro perspective we got Eichengreen et al. (2003) Original Sin, and Kaminsky and Reinhart (1999) twin crisis. From a micro perspective we have Céspedes et al. (2004) balance sheet mismatches.

For any agent in the economy, having debt in FC on its balance sheet carries a risk linked to the uncertainty of the exchange rate. Since the agent does not know how much each unit of FC debt today will cost in domestic terms tomorrow, there is also uncertainty about the agent's future income/cash flows. One way to reduce this uncertainty, is to take a forward contract with which the agent sets the price of a future operation denominated in a FC, today. The financial system provides such insurance. Thus, what is surprising about Colombian macroeconomic aggregates is that despite: i) the existence of this tool to make debt in FC safe; and ii) ample international liquidity, the covered FC debt market for non-financial firms did not develop as fast as its uncovered FC debt market counterpart.

In order to explain these macroeconomic aggregates, it is key to understand firm behavior. As shown by Salomao and Varela (2022), firms face the trade-off between the cost of debt (as uncovered FC debt is often cheaper[3] [4]) and the risk attached to it. This is particularly true, if firms do not match the currency composition of their liabilities[5] with that of their assets, if they do not benefit from a natural hedge in the form of FC revenues (exports), or if they do not use financial hedging (e.g. FC forwards).

In this paper, we study non-financial firms' optimal hedging in the context of a representative EME such as Colombia, and find out it is quite heterogeneous. We reveal that although large firms are prevalent in the derivatives market, they present smaller shares of covered FC debt in comparison to smaller firms; the larger the firm the higher the exposure to exchange rate uncertainty. A topic that not has not yet been addressed by the literature.

To comprehend this pattern, we extend a theoretical model that provides a set of priors that we then test on a rich firm-level panel data (2005-2013) for Colombia, with two-stage tobit estimations and a novel instrumental variable. With this methodology, we find that the heterogeneous hedging of non-financial firms has two causes: i) market imperfections in the form of financial frictions; and ii) policy-induced distortions.

With respect to market imperfections, the supply side of the FC derivatives market faces multiple financial frictions that limit its liquidity: i) Strict macroprudential policies on FC exposures of banks[6] act as a funding constraint that curtails the covered FC debt market liquidity; ii) In the context of a granular economy, banks' search for FC in the short side of the market (with firms that sell FC) is costly and translates into a search effort/intermediation cost that is increasing on the size of the firm. This two market imperfections map into a hedging pricing schedule which is an increasing function of firm size. In this circumstance, we show how optimal hedging is a negative function of the size of the firm. Since bigger firms need larger portions of aggregate market liquidity, they face higher

[3]Gutierrez et al. (2020) find that dollar denominated loans in Peru have an interest rate that is 2 percent lower per year than a loan in Peruvian Soles, expectations of exchange rate movements do not explain this difference. Furthermore, the firms that use FC derivatives experience even lower interest rates (2.3 percent).

[4]Kalemli-Ozcan and Varela (2022) document a UIP premium in EM economies driven by interest rate differentials that compensate investors for "excess risk" which is endogenous to policy uncertainty.

[5]Because liabilities are denominated in FC, a real devaluation has detrimental effects on firms' net worth, which in turn constrains investment due to financial frictions and limits further access to financial markets (Céspedes et al. (2004)).

[6]Banks' FC assets cannot be lower than their FC liabilities. With this constraint, banks are prevented of having any exposure to exchange rate uncertainty as their assets in FC: i) co-move with their FC liabilities when the exchange rate fluctuates, and ii) are larger than the FC liabilities, so any future depreciation of the exchange rate will only increase banks' net worth in domestic currency.

forward exchange rates/prices, which makes them internalize illiquidity[7], putting a limit to the size of their hedges: the bigger the firm, the smaller the proportion of covered FC debt.

Regarding policy-induced distortions, we find non-linear and asymmetric effects of Foreign Exchange Interventions (FXI) on firms' covered FC indebtedness decisions. These interventions aim at reducing the exchange rate volatility, and/or its depreciation. In general terms, these interventions conditional on being effective, reduce exchange rate uncertainty. However, they have as an unintended consequence, the spillover of FC liquidity to markets of other financial products; covered FC debt included[8]. As a result, for FX sales below a critical threshold, firms feel implicitly protected by the Central Bank's (CB) action. Given this insurance against exchange rate fluctuations, firms choose to reduce the shares of FC liabilities that are hedged. Above the critical threshold of intervention, the FX sales spill liquidity to the covered FC debt market, increasing the hedges of large firms while the behavior of small firms remains unchanged. This asymmetry depicted by the policy shocks on big and small firms comes from the relative importance of the components of the cost function for covered FC debt. While big firms face a proportionally higher variable cost (as a consequence of higher prices), small firms face a proportionally higher fixed entry cost. The increase in the market's liquidity introduced by the intervention, reduces the variable cost for big firms, but it does not do much for small firms, as it does not affect the fixed cost of entry to this market.

This evidence makes explicit the trade-off of public policies and regulation that aim to reduce the economy's vulnerability to exchange rate risk (FXI and macropudential regulation on banks) and their costs in terms of financial (under)development. This cost has the unforeseen consequence of exposing the real sector to the same exchange rate fluctuations these policies want to offset. This paper is a first step to take into account financial deepening in the calibration of macro-financial policy of CBs with respect to exchange rate shocks. Correct calibration can help the development and sophistication of the financial system, which in turn can provide the tools to the private sector to protect itself against exchange rate movements.

In relation to the state of the art, this paper adds to four strands of literature: i) the incipient literature on the drivers and uses of FC derivatives in EMEs; ii) the well developed literature of balance sheet currency mismatches, its build up and consequences; iii) the micro-finance theoretical literature on hedging; and iv) the macro-finance literature related to big financial market participants' behavior and their impact on volumes and price changes in the context of illiquid markets. One of our main contributions is to study these topics simultaneously with the objective of better understanding the macroeconomic impacts of the FC derivatives market micro-structure.

With respect to the FC derivatives literature based on firm level data, this paper is connected with Alfaro et al. (2023). In this paper the authors uncover the main stylized facts of the use of FC derivatives in an EME such as Chile. The Colombian and Chilean case have similarities and disparities.

[7]The theoretical structure of the paper is related to the finance market liquidity literature surveyed by Vayanos and Wang (2013). The paper is similar in spirit to Cantu (2019) who builds a theoretical micro-structure that explains the effects of capital controls on foreign exchange liquidity. From an empirical point of view, Mancini et al. (2013) also test for the effects of liquidity in the foreign exchange market.

[8]During exchange rate depreciation periods (FC is scarce), the Central Bank intervenes by selling FC to banks which increases FC liquidity within the economy.

Following a similar empirical methodology, we find evidence that, as in Chile, Colombian firms make very limited use of their natural/operational hedges. In other words, the match between payables and receivables in FC is low. Alfaro et al. (2023), explain this phenomenon with 4 practical reasons. The difference between payables and receivables in terms of maturity, frequency, quantity, and uncertainty. As a consequence, firms in both economies use the FC derivatives market to hedge their gross and not their net positions.

As for disparities, we find that while in Chile, the firms that use the FC forwards the most are firms with trade credit (which are on average smaller)[9], in Colombia this tool is mostly used by firms with financial FC debt (which are on average bigger). We find two plausible explanations for this disparity[10]. The first explanation is that in Colombia, the capital flow regulations and macro prudential policies are much stricter; in particular with banks. This limits not only the aggregate liquidity of the derivatives market, but also the level of financial sophistication and development of the economy. The second explanation is how unhedged positions of small firms might have been encouraged by the FXI of the CB[11] [12]. From the point of view of firms, such interventions might be perceived as an implicit insurance against exchange rate risk, reducing the incentives of small firms to enter the FC derivatives market.

With respect to the empirical literature related to EMEs firms' balance sheet health, Alfaro et al. (2019) find that in the post-GFC scenario the number of EMEs with corporate financial fragility[13] has increased. In particular, the authors find that larger firms are usually more fragile to extreme exchange rate fluctuations. Surprisingly, this is not always the case for more levered firms, for which the movement of the exchange rate is not always harmful. A plausible explanation for this puzzle, is that larger firms have larger shares of uncovered FC liabilities which make them more vulnerable to exchange rate movements.

From a theoretical perspective, this paper is directly linked to Kim (2019). The author develops a framework to illustrate how a firm's choice of debt currency depends on macroeconomic variables and the currency composition of its sales. The model shows how the firm's incentive to borrow depends on natural hedging against the exchange rate risk and is motivated by funding cost saving.

[9] Alfaro et al. (2023) find that Chilean firms use FC derivatives predominantly to hedge "cash exposure". Firms turn FC exposure into local currency but keep their transactions in FC motivated by the use of the FC (in this case the USD) as a unit of account and/or network liquidity effects. They also find a FC derivatives' maturity premia, short-term transaction funding is cheaper in relation to long-term transaction funding (the forward premium is increasing in maturity).

[10] In 2013 the Chilean GDP per capita was of 15,833 USD, Colombia's was 8,264 USD. This is a first approximation to exemplify the difference in the broad level of economic development between both countries.

[11] The Central Bank of Colombia carried Sterilized FX intervention during 2002-2014 (excluding operations whose main objective was to accumulate/de-accumulate Reserves.

[12] Other papers have documented from empirical and theoretical perspectives how central banks' actions distort firms' behaivior. Kim et al. (2020) and Salomao and Varela (2022) find that the FXI of central banks can distort allocations in the FC debt markets. Aizenman et al. (2022) find that active international reserve management (not FXI) protect firm level investment from global financial shocks. Barajas et al. (2017) give preliminary evidence of distorted allocations in the FC Forwards market given FXI.

[13] Alfaro et al. (2019) define financial fragility as linear combination of working capital to total assets, retained earnings to total assets, operating income to total assets, and book value of equity to total liabilities.

We extend this model to incorporate the covered FC debt choices of firms, while also including a reduced form for the market imperfections faced by the supply side, imperfections that can limit this market's liquidity. The main results are: i) the existence of a tension between the economies of scale required to enter the covered FC debt market and the exchange rate risk exposure. Small firms profit from the funding cost saving characteristics of uncovered FC debt at the expense of a higher potential vulnerability to exchange rate movements; and ii) in comparison to small firms, big firms' optimal hedges are constrained by the liquidity of the market.

In regard to the micro-finance theoretical literature, we know that in a world with financial frictions[14], the fundamental objective of hedging by firms is to match their demand for funds with their internal supply. Since financing projects with external resources is expensive, the use of hedges creates real value by guaranteeing the availability of internal resources when investment opportunities arise. However, Froot et al. (1993) have shown that this is not the same as having full hedge. In the particular case of exposure to exchange risk, the size of the optimal hedge will depend on the covariance between exchange rate shocks and business growth opportunities.

Nonetheless, the between-sector heterogeneity present in Froot et al. (1993) is not enough to explain the firm-level heterogeneity. To fill this gap, Rampini and Viswanathan (2010) show that, in the context of a dynamic model with complete markets and limited enforcement, firms with low net-worth (smaller firms) exhaust their debt capacity and hedge less given that financing needs override hedging concerns.

While Rampini and Viswanathan (2010) framework is only able to rationalize the fact related to the extensive margin of hedging, our theoretical model encompasses an explanation for both the extensive and intensive margin. On the one hand, we have a fixed entry cost that captures the lack of financial development of an economy that prevents small firms from hedging. On the other hand, the lack of liquidity of covered FC debt markets acts as an external constraint on firms' optimal hedges and pins them down as a negative function of firm size.

With respect to the macro-finance literature, we follow Gabaix et al. (2003) and Gabaix et al. (2006), who document how large market participants' behavior has an impact on the size of volumes traded and on price movements. We document how short positions fit a power law: The probability of large size transactions in the short side of the market is very low. As a consequence, the search cost of banks becomes and increasing function in the amount of FC to be procured, and maps into a hedge pricing schedule that is increasing in the size of the hedge, limiting the equilibrium covered FC debt of large firms.

The rest of the paper is organized as follows. Section 2 presents the data-set, provides the descriptive statistics and stylized facts that will shape the theoretical model. Section 3 proposes the theoretical framework. Section 4 has the econometric specifications, identification strategy and results. Section 5 concludes and provides policy recommendations.

[14]In a frictionless world à la Modigliani and Miller (1958), there is no role for hedging, as it does not add value to the firm. Furthermore, given its costs it may take value from the firm.

2 The data

In the first part of this section we present the data-set, its sources, along with its main descriptive statistics. In particular, we show the FC debt composition and the characteristics of firms with FC forwards. In the second part, following Alfaro et al. (2023), we provide evidence for the lack of natural/operational hedging of non-financial firms. In the third part, we give novel stylized facts that relate firm size with firm hedging behavior. In the fourth part, we document new stylized facts related to the costly search faced by banks in the short side of the FC hedging market, and the regulation on their FC exposures. These stylized facts are fundamental for the construction of the theoretical model.

2.1 Data-set and descriptive statistics

The data-set contains information on the end of year balance sheet and income statement of non-financial firms in Colombia, provided by the Colombian Societies Superintendency (SS) and the Financial Superintendency of Colombia (SFCC) from 2005 to 2013. This standardized data-set covers approximately 40 percent of Colombia's formal firms[15]. The number of firms per year in the data-set range between 19,744 and 27,210 with an average of 23,891 firms.

The information is supplemented by the currency composition of assets and liabilities[16], firm-level Foreign Direct Investment (FDI) and the use of financial derivatives, all from Banco de la República de Colombia (BdR[17]). The data-set also contains firm level imports (CIF) and exports (FOB) from DANE-DIAN [18]. The definition of all variables are reported in annex A. All firm level variables are in constant 2008 Colombian Peso (COP)[19].

This is a very rich data-set as it presents important heterogeneity in firms' characteristics. Table 1 shows that, on average, foreign owned firms –defined as firms for which more than 50 percent of its shares belong to non-Colombian residents, represent 13 percent of the sample[20]. On average, firms that belong to the tradable sector are 28 percent, firms with FC debt are 13 percent and firms with FC forwards are 3 percent.

Table 2 presents the decomposition of FC debt. In the data-set, the number of firms with FC bonds per year ranges between 4 to 6, firms with FC loans range between 1505 and 2118, and firms with trade credit range between 632 and 1328.

With respect to FC derivatives, FC forwards[21] account for 95 percent of the value of

[15]We compare with the data set that holds the universe of Colombia's formal firms: Planilla Integrada de Liquidación de Aportes (PILA), the official registry and payment system of payroll taxes and social security contributions for formal employers and workers in Colombia.

[16]Check annex B, part 1, for the evolution of total assets and liabilities of the data-set's median firm.

[17]The Central Bank of the Republic of Colombia.

[18]DANE is the acronym for the Colombian National Administrative Department of Statistics. DIAN is the acronym for the Colombian National Tax and Customs Administration.

[19]For this section we used the nominal COP/USD exchange rate to express all variables in USD. This with the intention of the reader having clearer orders of magnitude for firm's level variables.

[20]Is important to highlight the fall in the number of foreign firms in between 2012 and 2013. There are three explanations/hypothesis for this: i) a tax reform implemented in 2013, in which capital intensive firms where taxed more heavily vis à vis labor intensive firms; ii) the beginning of the end of the super cycle of commodities' prices, which had a full impact in Colombia on 2014 with the fall in oil prices and; iii) data reporting problems.

[21]The forward contract is the active contract as of December 31st of each year for each firm. In general,

Table 1: Firm Characteristics

Year	Number of Firms	Percentage of Foreign Owned Firms	Percentage of Firms Tradable Sector	Percentage of Firms of a with FC debt	Percentage of Firms with FC forwards
2005	19744	10.4%	29.1%	10.8%	2.2%
2006	23633	10.6%	28.5%	10.1%	2.3%
2007	21746	11.4%	28.9%	10.5%	2.7%
2008	22355	11.9%	28.5%	10.6%	2.7%
2009	24689	11.8%	27.6%	11.1%	3.2%
2010	23831	11.2%	27.2%	12.6%	4.3%
2011	27210	20.2%	25.9%	12.7%	3.9%
2012	25472	20.1%	26.4%	13.3%	3.9%
2013	26636	6.4%	25.2%	13.3%	3.7%

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Table 2: Composition of FC Debt

Year	Number of Firms with Bonds	Number of Firms with Loans	Number of Firms with Trade Credit	Bonds in USD Millions (1)	Loans in USD Millions (2)	Financial debt in USD Millions (3) = (1) + (2)	Trade Credit in USD Millions (4)	FC debt in USD Millions (5) = (3) + (4)
2005	5	1505	925	882	7219	8101	517	8617
2006	4	1613	1064	214	6829	7044	494	7538
2007	4	1569	1015	164	8271	8435	482	8917
2008	5	1630	1053	147	8376	8523	554	9077
2009	6	1806	1328	1571	9172	10743	800	11543
2010	4	2135	1301	1500	10458	11958	738	12696
2011	4	2648	1194	1446	17986	19432	473	19905
2012	5	2850	887	2083	15953	18035	294	18329
2013	4	3118	632	4231	15070	19300	207	19508

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

operations[22] and for 99 percent of the number of operations[23]. FC forwards are not intensively nor extensively used by Colombian non-financial firms. Nonetheless, their use has increased during this time period: while in 2005 2.2 percent of the firms in the data-set used FC forwards, in 2013 they were used by 3.7 percent of firms.

Table 3 describes the characteristics of firms with FC forward derivatives. On average, 32 percent had long positions[24], 76 percent had short positions[25][26], 67 percent had some type of FC debt[27], 27 percent were foreign owned and 90 percent participated in international trade.

the average duration of a COP/USD forward contract ranges between 1-3 months and is traded between non-financial firms and banks.

[22]Contracts in the FC derivatives market.

[23]Reason why we will use FC derivatives and FC forwards interchangeably.

[24]In a long position FC forward contract, the firm agrees to buy FC at a given price at a future date.

[25]In a short position FC forward contract, the firm agrees to sell FC at a given price at a future date.

[26]A firm can have short and long positions in her balance sheet simultaneously given the different maturities, amounts and frequencies of her FC assets, liabilities, and revenues. These tools can at the same time, reduce exchange rate uncertainty and provide FC liquidity.

[27]In annex B, part 2, we show how firms that exclusively use financial FC debt represent 42 percent of firms with long positions in the forward market, and 61 percent of firms with short positions. Firms that use exclusively trade credit represent 4 percent of the firms with long positions and also 4 percent of firms with short positions.

Table 3: Characteristics of firms with FC Forwards Derivatives (Percentage of firms)

Year	Firms with Long Positions	Firms with Short Positions	FC indebted Firms	Foreign firms	Firms with international trade
2005	25%	80%	75%	25%	86%
2006	27%	79%	60%	24%	93%
2007	37%	73%	60%	26%	94%
2008	47%	65%	60%	29%	95%
2009	34%	75%	58%	27%	93%
2010	32%	77%	73%	22%	89%
2011	35%	74%	75%	34%	85%
2012	25%	82%	72%	30%	86%
2013	28%	83%	72%	25%	85%

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

When one compares firms with FC forwards with firms without[28], it is clear how firms involved in the FC derivatives' market have also larger FC debt shares. It is also worth mentioning that, despite the fact that net forwards are negative in the aggregate[29], they are positive for the average firm[30]. Another striking fact is that firms with FC forwards have on average 31 percentage points (p.p) more net exports (as a share of assets) than firms without FC derivatives (table 4): more naturally hedged firms are also more financially hedged.

Table 4: Firms with FC Forwards vs Firms without FC forward (2005-2013 averages)

	Firms without FC Forwards (1)	Firms with FC Forwards (2)	(3) = (1)-(2)	St Error (percentage points)	T Value	p Value
FC debt / liabilities (%)	2.9	13.3	-10.3	1.8	-5.8	0.000
FC debt / assets (%)	2.8	7.4	-4.7	6.4	-0.75	0.463
FC assets / assets (%)	0.3	0.7	-0.4	0.2	-2.9	0.004
Net Fwds / assets (%)	0.0	1.8	-1.8	0.4	-4.8	0.000
Balance Sheet Exposure / assets (%)	2.5	5.0	-2.5	6.4	-0.4	0.698
Net exports / assets (%)	-2.9	27.8	-30.7	2.3	-13.4	0.000
Total number of Firms' observations without FC forwards 207,223						
Total number of Firms' observations with FC forwards 6995						
Two-sample t-test with equal variances						

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

2.2 (Lack of) Natural/Operational Hedging

The fact that the great majority of firms with FC forwards have international trade and are on average net exporters makes it necessary to review for natural/operational hedging. Following Alfaro et al. (2023), table 5 exhibits some correlations for the FC receivables and payables (in logs). A coefficient equal to one would mean that firms perfectly match their FC liabilities and imports with their exports. This is not the case. Despite that

[28]For a similar exercise but for firms with and without FC debt see annex B, part 3.

[29]See annex B, part 4 for a proxy of the aggregate and firm level Balance Sheet Exposure.

[30]While on average, firms exhibit larger long than short positions, on the aggregate level, net forwards are negative. This is due to one firm, Ecopetrol, the national oil company which accounts for a large share of all FC transacted in the derivatives' market.

both exports (panel A) and net exports (panel B) are statistically significant and positively correlated with FC liabilities and imports, the coefficient in all specifications is far below one[31]. This is suggestive evidence of a limited natural/operational hedging. Alfaro et al. (2023) give four explanations for the lack of perfect matching: frequency, maturity, amount and uncertainty of FC transactions.

Table 5: Natural/Operational hedging (2005-2013)

Panel a. Correlation of Exports with:

Variables	(1)	(2)	(3)	(4)	(5)
(in logs)	Imports	Total FC debt	Financial FC debt	Trade credit	Exposure
Exports	0.078***	0.03**	0.05***	-0.013	0.022*
	(0.005)	(0.013)	(0.015)	(0.019)	(0.012)
Observations	25,508	12,371	9,687	4,795	11,497
Firm FE	Yes	Yes	Yes	Yes	Yes
R-squared:	0.06	0.14	0.16	0.004	0.15

Panel b. Correlation of Net exports with:

Variables	(1)	(2)	(3)	(4)
(in logs)	Total FC debt	Financial FC debt	Trade credit	Exposure
Net Exports	0.108***	0.104***	0.06*	0.062***
	(0.022)	(0.024)	(0.036)	(0.022)
Observations	5,577	4,891	1,540	4,844
Firm FE	Yes	Yes	Yes	Yes
R-squared:	0.28	0.3	0.02	0.32

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

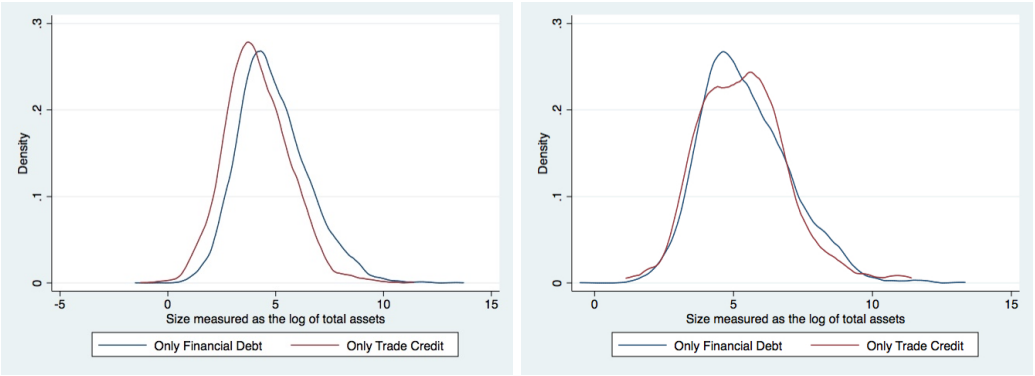
[31]Results hold when not controlling for firm fixed effects. The size of coefficients increases but are far below 1. See annex B, part 5.

2.3 Firm Size and use of hedging

Now we present some suggestive evidence about the relationship between firm size and the use of hedging in the extensive and intensive margin. First, firms that use the forward market and have FC debt seem to be bigger with respect to firms that do not use the forward market but have FC debt. Second, despite that larger firms hedge larger amounts of their FC debt, the shares of covered FC debt are a decreasing function of size.

Figure 2 panel (a), exhibits the firm size distributions of firms with financial FC debt or trade credit exclusively. Panel (b) shows the same distributions excluding firms without FC forwards. In general, firms that only have financial FC debt are larger than firms that only have trade credit (the distribution of the former is at the right of the distribution of the latter). However this distinction no longer holds when restricting the sample to firms that use FC forwards. These facts are suggestive evidence for a fixed cost of entry to the covered FC debt market.

Figure 2: Firm size, FC debt type and use of FC forwards (2005-2013) - extensive margin



(a) Size by type of FC debt (b) With FC Forwards

Source: Authors' estimations based on BdR.

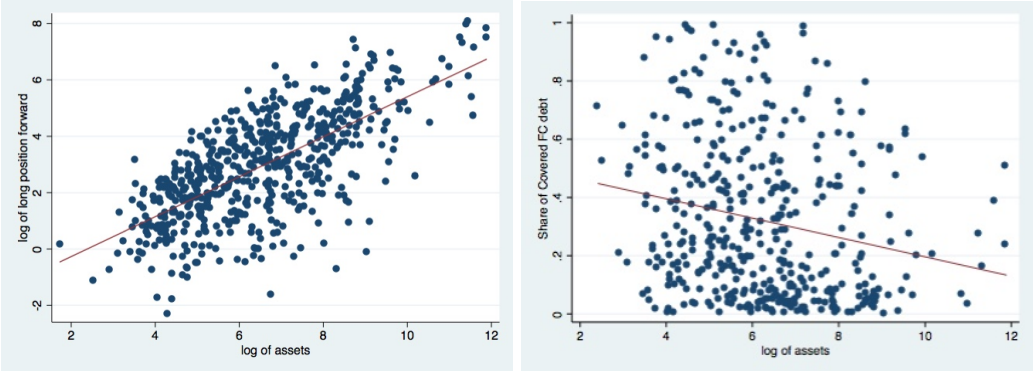
With respect to the intensive margin, figure 3 panel a shows the correlation between the log of the long positions in the FC forward market and firm size. The bigger the firm, the longer the forward positions. Panel b, on the other hand shows a negative relationship between firm size and the shares of covered FC debt (long position FC forwards/FC debt[32]). The bigger the firm the lower the shares of FC debt that are hedged[33].

This is indicative of the presence of a financial friction that limits the shares hedged by big firms. In particular, banks face market imperfections embodied in costly search coupled with funding constraints (regulations on their FC exposures) that limit the liquidity of the derivatives market.

[32]The median share of covered FC debt is 27 percent while the average is 35 percent. See Annex B, part 6 for the whole distribution.

[33]These relationships are robust to outliers in terms of size, amounts of FC forwards and shares of covered FC debt. It also holds when only taking into consideration firms that exclusively use financial FC debt. See annex B, part 7. Also see this annex for unconditional relation between size and shares of covered FC debt.

Figure 3: Firm size, FC debt type and use of FC forwards (2005-2013) - intensive margin



(a) Long positions in the FC forward market vs firm size (both in logs)

(b) Shares of covered FC debt vs firm size (controlling for firm fixed effects); $R^2 = 0.05$, t-statistic=-4.5

Source: Authors' estimations based on BdR.

2.4 Supply side of the derivatives market - Market imperfections, regulations and liquidity

As described by Cardozo-Alvarado et al. (2014), banks in the Colombian OTC forward market offset the exchange rate exposure taken in the derivatives market through opposite operations in the same market. They try to match –taking into account maturity and quantity- the long position of a firm with the short position of another firm. If they fail to do so, they sell their most liquid FC assets.

Nonetheless, banks are subject by regulation to constraints on their holdings of net FC assets. Since January of 2004, a constraint on the FC assets and liabilities with maturities less than or equal to one year was implemented: the difference between short-term FC assets and liabilities cannot exceed 50 percent of their equity and cannot be negative. Then on July of 2005, an additional constraint on long term FC assets, liabilities and derivatives was implemented: banks cannot have a total FC balance sheet exposure (including derivatives, long term assets and liabilities) of more than 20 percent of their equity or less than -5 percent (Mora-Arbelaez et al. (2015)).

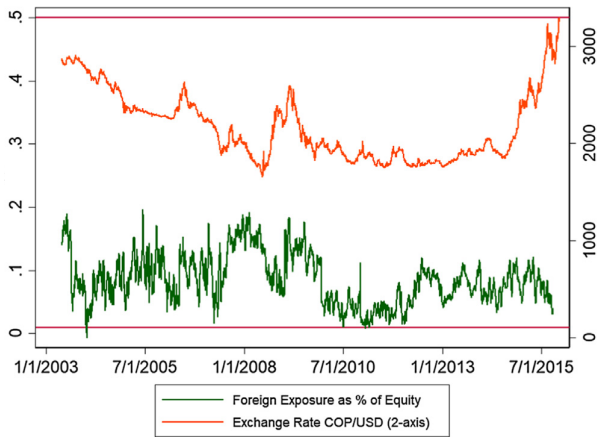
From a theoretical point of view these are features of a market with costly search coupled with funding constraints. These market imperfections impede banks from providing liquidity in the derivatives market: the intermediation cost is an increasing function of the size of the FC procured. As a result, supply becomes very inelastic, and the pricing schedule becomes a positive function of firm size (Figure 3, Panel a, shows that the size of the amount of FC demanded on the long side of the market has a positive and monotonic relationship with firm size).

Part a) Banks' behavior with respect to FC exposure regulation

As shown in figure 4, over 2003-2015, banks were never close to the upper limit of short term FC exposure (50 percent) and in a few occasions they were below the lower limit (0 percent). Perez-Reyna and Villamizar-Villegas (2019) notice that the actual limit, relevant for banking operations is 1 percent. The main explanation is the penalty involved when banks have a short-term negative exposure. Given that banks face unexpected changes

in their daily exposures[34], they take preventive measures to avoid being penalized. As a consequence, banks use a buffer of at least 1 percent (the total daily change in banks short-term FC exposure during 2004-2015). Figure 4 shows how this precautionary buffer seems to bind between 2010 and 2012 on aggregate. After 2012, the aggregate exposure slightly increases, but given bank heterogeneity, it is likely that the constraint continues to bind. This means that banks may be unable to offer a hedge to non-financial firms that have FC debt and are therefore willing to sign a long position on the FC forward market.

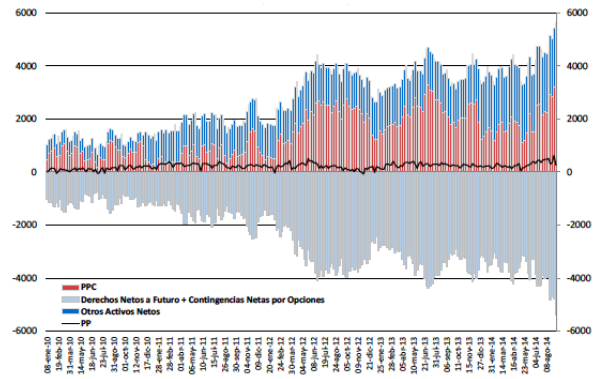
Figure 4: Short term Banks' FC exposure



Source: Perez-Reyna and Villamizar-Villegas (2019).

In addition to the precautious use of their short-term FC denominated balance sheet, banks seem to be also cautious with the use of their long-term exposure. Figure 5 shows how, between 2010 and 2014, the total FC exposure (black line) of banks was almost constant. Given the regulations on total FC exposure (it cannot exceed 20 percent of equity and cannot be less than -5 percent of equity), banks seem to be targeting a constant long run level which might limit further the supply of FC in the forwards market.

Figure 5: Total Banks' FC exposure



Red bars are short-term FC net assets, grey bars are net FC derivatives, blue lines are long-term FC net assets. Source: Cardozo-Alvarado et al. (2014).

[34] A depreciation of domestic currency decreases the value of equity expressed in FC. This will make a positive value of exposure to increase while a negative value will be more negative.

Part b) Costly search

Due to theses constraints, banks cannot offer hedge unless they find firms who want to hedge in the opposite direction, for instance exporters who want to sell FC forward. This search process is costly for banks. Here we show evidence of how few firms are willing to take large short positions on the forward market[35]. We fit a power law distribution on the short positions of our data. The power law captures the fact that big transactions on the short side of the market have a lower probability of happening in comparison to small sized transactions. Given this, matching a large demand for FC on the long side of the market with the FC procured on the short side, would entail a much higher search cost for banks.

Figue 6 provides evidence that our data fits a power law for 2005 (panel a and c) and 2013 (panel b and d). We estimate the power law with two different definitions for the dependent variable. Panel a) and Panel b) show the regression of the log of the short positions on the counter cumulative distribution function of short positions. Panel c) and Panel d) exhibit the results regressing the log of the short positions on the log of the rank of short positions as suggested by Gabaix and Ibragimov (2011)[36].

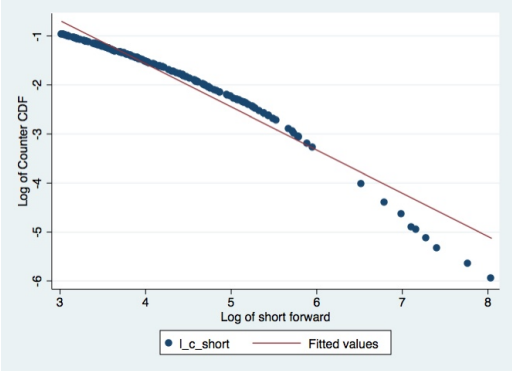
Let us follow the most intuitive definition of the dependent variable: the countercumulative distribution. If short positions fit a countercumulative distribution $P(S > x) = kx^{-\alpha}$, then the specification of panel a) fits $log(P(x)) = k + \alpha log(x)$, where the OLS estimate $\alpha = -.88$. This means that the probability of a short position's size being greater than some x is proportional to $1/x$. The lower α in absolute value, the fatter the tail of the distribution, the higher the dispersion between values in the top quantiles of the distribution. Figure 6 provides evidence for a power law with an exponent that ranges between -.78 and -.88. This implies that it is difficult for banks to find customers who are willing to take large, short positions on the forward market. Hence, it is difficult for banks to compensate for the binding constraints on their own short positions.

To recapitulate, this section main takeaways are: i) operational hedge is limited; ii) firms that use FC derivatives are bigger than firms without, no matter the type of FC debt they have; iii) larger firms use less intensively the hedging market; and iv) banks face costly search and funding constraints that might curtail the liquidity of the FC hedging market. These four stylized facts will guide the structure of the theoretical model presented in the next section.

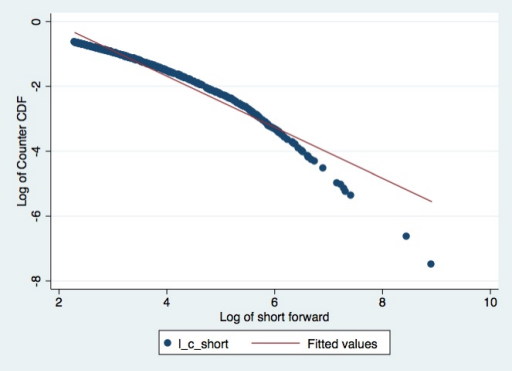
[35] We are the first to document these stylized facts in the context of the FC derivatives market. Similar behavior by large sized players in financial markets and their impact on volumes of trades and prices movements has been documented and rationalized by Gabaix et al. (2003) in the case of mutual funds, and Gabaix et al. (2006) in the case of institutional investors.

[36] Gabaix and Ibragimov (2011) find that using log(Rank-1/2) reduces small sample bias in estimation to a leading order.

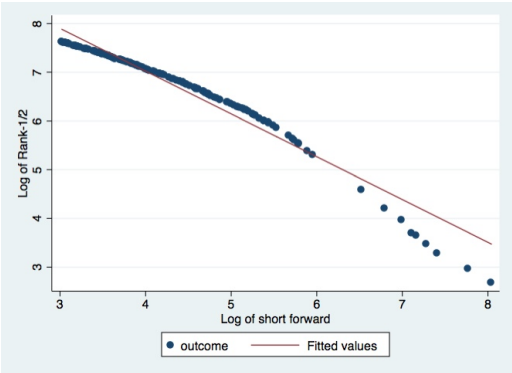
Figure 6: Search effort increasing in amount of FC procured: Short positions fit a power law



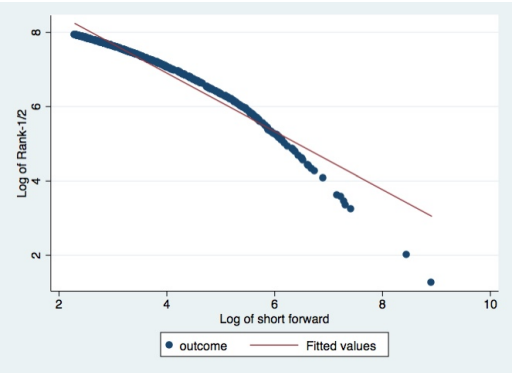
(a) Short positions 2005: OLS fit of α = -.88; t-student = -58.19; R-squared = 0.952. Fitted for observations above the median. Using CCDF.



(b) Short positions 2013: OLS fit of α = -.79; t-student = -83.68 ; R-squared = 0.946. Fitted for observations above the median. Using CCDF.



(c) Short positions 2005: OLS fit of α = -.88; t-student = -58.74; R-squared = 0.953. Fitted for observations above the median. Using Rank.



(d) Short positions 2013: OLS fit of α = -.78; t-student = -85.19; R-squared = 0.948. Fitted for observations above the median. Using Rank.

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

3 A theoretical framework

To construct a theoretical prior for the econometric analysis, we build on Kim (2019) model and section 2 stylized facts. This extended model shows how a firm's optimal choice of debt currency and exposure/hedging to/of exchange rate risk is a function of macroeconomic variables, firm's characteristics and liquidity conditions in the debt markets. This is a partial equilibrium model coupled with a reduced form for the creditor side of the economy. With this, we intend to depict the drivers for debt composition, participation in the covered FC debt market (extensive margin), and the importance of this participation (intensive margin) within the firm's liabilities.

The difference between Kim's model and our own's is that Kim's firms do only choose shares of FC and local currency debt. Meanwhile, in our model we introduce the covered FC debt decision. In other words, while the cost function of Kim's model only incorporates local and uncovered FC debt, ours also incorporates the covered FC debt.

3.1 The model

The economy is populated by a continuum of firms, indexed by $i \in [0, 1]$, which live for two periods. Firms are risk averse. They are born with different expectations about the second period's spot exchange rate, risk aversion, productivity, size and composition of revenue. They are also aware of the relative liquidity conditions of the debt markets. The only source of uncertainty in this economy is the second period's exchange rate.

Firms maximize the second period utility by choosing in the first period the currency composition of their principal (normalized to 1). Part of their borrowings are in domestic currency and the other part in FC. Firms can opt to have uncovered and/or covered FC debt. Firms choose the composition of their liabilities based on their expectations about the second period's exchange rate. In the second period, the exchange rate is realized and firms pay what they owe for their financial products with their realized revenues.

In the second period, firm i earns income y_i, of which θ_i is the share denominated in local currency and $1 - \theta_i$ is the share denominated in FC. The currency composition of the firm's income is exogenous and known from period 1. $z_i > 1$ is a productivity shifter also exogenous and known in the first period. Expressed in local currency terms, firm i's second period income is[37]:

$$y_i = z_i[\theta_i + (1 - \theta_i)s]. \tag{1}$$

The exchange rate denoted as s[38], is in units of local currency per FC unit, and set equal to 1 in the first period. The second period exchange rate follows a normal distribution $\mathcal{N}(E[s], \sigma_s^2)$ and is assumed to be the only source of shock in the economy.

Conditional on firm i using all types of debt, her second-period expected profit per unit of debt in local currency terms is given by:

$$E_i[\pi_i] = z_i[\theta_i + (1 - \theta_i)E_i[s]] - R^l\gamma_i - R^{FC}\alpha_i E_i[s] - R^{FC}\delta_i^{\epsilon}F^{m_i} - \frac{K}{m_i}. \tag{2}$$

Firm i borrows a share γ_i of its principal in local currency at gross interest rate R^l, and α_i in uncovered FC at gross interest rate R^{FC}, with $R^l > R^{FC}$. We assume a representative investor that sets both interest rates[39] [40]. Firm i has its own belief of tomorrow's spot exchange rate $E_i[s]$[41] [42].

[37] We implicitly assume dominant currency pricing. The demand for firm's i production does not move with changes in s, only income expressed in local currency terms does move with s.

[38] See annex C, part 0 for a glossary of the model.

[39] In this economy we do not impose non-arbitrage conditions to the equilibrium. This means that ex-ante the uncovered interest rate parity, and the covered interest rate parity do not necessarily hold. Non-arbitrage is an equilibrium outcome achieved by the representative investor with the help of firm idiosyncratic forward exchange rates that implicitly capture liquidity premiums. See annex C part 5b for an ample discussion on non-arbitrage.

[40] Despite that in equilibrium firms are indifferent in the margin between domestic currency and covered interest rate, outside of equilibrium, for shares of covered FC debt below the optimum, the marginal cost of covered FC debt would be lower than the marginal cost of domestic currency debt (reason why there is a incentive to hedge). See annex A, part 5A.

[41] In annex C, part 5c, we provide a brief discussion on why firms do not arbitrage uncovered FC debt in the spot market among themselves.

[42] In this paper we are agnostic with respect to how these beliefs are created and how they aggregate. Nonetheless, the aggregate exchange rate expectations play the key role of centering the normal distribution from which the second period spot exchange rate is drawn.

It is assumed that the covered FC debt market is less liquid in comparison to the uncovered FC debt and to the domestic currency debt markets[43]. From the point of view of supply, liquidity of the covered FC debt market is going to be governed by parameter ϵ. ϵ is a reduced form to capture market imperfections faced by the supply side that impede liquidity. The higher ϵ, the lower the market imperfections faced by the representative investor, the higher the liquidity provided[44].

δ_i is the share of covered FC debt at gross interest rate R^{FC} and firm-specific price F^{m_i}. F is the forward exchange rate and m_i is the normalized firm's size in terms of assets ($m_i \in]0,1]$). Given market imperfections faced by the representative investor; for the same share of covered FC debt, larger firms will face higher forward rates when compared to smaller firms. The bigger the firm, the larger the portion of aggregate liquidity needed to hedge, the higher the price of the hedge charged by the representative investor.

In the cost function, the share of covered FC debt is power ϵ (δ_i^{ϵ}). $\epsilon > 1$ is also the semi-elasticity of profits to covered FC debt[45]. The higher the market imperfections, the smaller ϵ, the higher the increase in the firm's marginal cost per p.p of covered FC debt. Intuitively, the more difficult it is for the representative investor to procure funds, the more costly the use of covered FC debt by firm i.

The last component of the cost function is K. K is a fixed cost of entry (denominated as a share of principal and normalized by firm size) to the covered FC debt market. As shown by stylized fact ii) of section 2, firms with covered FC debt are bigger with respect to firms without.

Firms are risk averse and choose the currency composition of their principal in the first period, to maximize the second-period utility given by:

$$E[U(\pi_i)] = E[-e^{-\Psi_i \pi_i}] \tag{3}$$

subject to the constraint: $\alpha_i + \delta_i + \gamma_i = 1$. This constraint tells us that the sum of the shares of the different liabilities must equal the principal. $\Psi_i > 0$ denotes the degree of risk aversion for each firm, which differs across firms.

The optimization program of firm i is:

$$\begin{aligned} \max_{\gamma_i \geq 0, \alpha_i \geq 0, \delta_i \geq 0} & E[U(\pi_i)] \quad s.t \\ & \alpha_i + \delta_i + \gamma_i = 1. \end{aligned} \tag{4}$$

[43]This assumption can be justified by how banks operate in the OTC forward market in Colombia. Banks offset the exchange rate exposure taken in the derivatives market through opposite operations in the same market. They try to match –taking into account maturity and quantity, the long position of a firm with the short position of another firm. If banks are not able to do so (the market is very illiquid), they sell their most liquid FC assets (Cardozo-Alvarado et al. (2014)). Nevertheless, FC exposures of banks are heavily regulated. These are clear features of costly search coupled with funding constraints.

[44]Vayanos and Wang (2013) enumerate six market imperfections than can reduce a market's liquidity: i) Participation costs; ii) Transaction costs; iii) Asymmetric information; iv) Imperfect competition; v) Funding constraints; and vi) Search.

[45]Which is part of the elasticity of substitution between debt types. See annex C, part 2 for a proof.

3.2 Intensive margin

From the first-order conditions the optimal share of uncovered FC debt α_i^*, covered FC debt δ_i^* and domestic currency debt γ_i^* are given by[46] [47]:

$$\alpha_i^* = \frac{R^l - R^{FC}E_i[s]}{\Psi_i {R^{FC}}^2 \sigma_s^2} + \frac{z_i(1-\theta_i)}{R^{FC}} \tag{5}$$

$$\delta_i^* = \left(\frac{R^l}{\epsilon R^{FC} F^{m_i}}\right)^{\frac{1}{\epsilon-1}} \tag{6}$$

$$\gamma_i^* = 1 - \alpha_i^* - \delta_i^*. \tag{7}$$

The uncovered FC debt share depends positively in the interest rate differential, productivity and FC share of revenue. It depends negatively in firm i's expectations of exchange rate depreciation, in her risk aversion, and exchange rate volatility. Intuitively, the first term on the right hand side of equation (5) captures the funding cost saving characteristic of uncovered FC debt. The second term exhibits the natural/operational hedging provided by the importance of FC revenues in firm i's income.

With regard to the share of covered FC debt, equation (6) shows it depends positively in the domestic currency interest rate and negatively in the forward exchange rate and FC interest rate; the higher the relative cost of covered FC *vis à vis* local currency debt, the lower the share of covered FC debt. Equation (6) also indicates that, irrespective of F, R^l, R^{FC} and ϵ, the share of covered FC debt is a decreasing function of firm size. For given interest rates and a determined market's liquidity; larger firms choose smaller shares (stylized fact iii)) as they internalize the market's illiquidity when faced with higher prices.

With respect to ϵ[48]: i) Irrespective of m_i, R^l, R^{FC} and F, after a critical value of ϵ the optimal shares become unambiguously larger[49] ($\frac{d\delta_i^*}{d\epsilon^c} > 0$). ii) When market imperfections become negligible ($\epsilon \to \infty$), the optimal shares of covered FC debt tend to 1. iii) The larger the ϵ, the lower market imperfections, the lower the variation in the optimal shares across firms of different sizes ($lim_{\epsilon\to\infty}\frac{d\delta_i^*}{dm_i} = 0$). This characterization tells us that the bigger ϵ, the larger and more homogeneous the optimal shares across firms of different sizes. Intuitively, the lower the market imperfections faced by the representative investor, the easier to procure and supply funds to the covered FC debt market, the less constrained the optimal hedges of firms and the more homogeneous across the size distribution[50].

Equation (6) also corroborates the stylized fact i). The shares of covered FC debt do not directly depend on the importance of FC revenues in income. In theory, firms hedge their

[46] See annex C, part 3 for the derivation of the first-order conditions.

[47] See annex C, part 6 for the special case where the optimal conditions yield shares for covered and uncovered FC debt larger than 0.5. In this case the firm equates the marginal costs of both types of debt and finds that the optimal share of covered FC debt will be a function of liquidity and the ratio between her expectations about tomorrow's spot exchange rate and the idiosyncratic forward exchange rate. The remainder of the principal is used as uncovered FC debt.

[48] Annex C, part 4 presents a graphical representation of its comparative statics.

[49] The specific threshold would depend on the size of the smallest firm considered within the grid of the economy's simulation. In annex C, part 4 the smallest firm in the simulated economy is of size 0.01. In this case the critical threshold of ϵ is around 1.4.

[50] In consequence, from the point of view of aggregate demand, ϵ is going to capture both the slope and position of the covered FC debt demand curve. Coupled with the fixed entry cost K, ϵ will also determined the size/extent of the demand curve (the extensive margin)

gross and not their net exposures[51].

3.3 Extensive margin

Now, consider the firm's decision of whether or not to enter the covered FC debt market. For this, it is necessary to compare the expected profits of firm i in the optimal shares for each type of debt (α_i^*, δ_i^*, γ_i^*) with the expected profits of firm i using a share α_i^* of the principal as uncovered FC debt, and the remainder of the principal as domestic currency debt ($\gamma_i = 1 - \alpha_i^* = \delta_i^* + \gamma_i^*$). The firm will use the covered FC debt market if its expected profits are greater or equal to its expected profits without:

$$E_i[\pi_i|\alpha_i^*, \delta_i^*, \gamma_i^*] \geq E_i[\pi_i|\alpha_i^*, \gamma_i = 1 - \alpha_i^*] \iff \tag{8}$$

$$R^l \delta_i^* - [R^{FC} \delta_i^{*\epsilon} F^{m_i} + \frac{K}{m_i}] \geq 0. \tag{9}$$

As it is shown in equation (9), firm i will use a share δ_i^* of its principal as covered FC debt instead of domestic currency debt, if and only if the total cost of hedging the share δ_i^* is below the total cost of using it as domestic currency debt[52].

Very interestingly, this discontinuity region is a concave and non-monotonic function of firm size[53]. While the fixed cost is more stringent with small firms[54], the combination of the variable and fixed cost is heavy on big firms.

On the one hand, when liquidity gets huge ($\epsilon \to \infty$), but the firm is very small ($m_i \to 0$), the fixed cost becomes exorbitant, making the cost of hedging prohibitive. On the other hand, when illiquidity gets huge ($\epsilon \to 1$), the largest firm ($m_i = 1$) will not enter the covered FC debt market as the total cost of hedge will be larger than the total cost of local currency debt.

3.4 Firm-specific Forward Exchange rate and Intermediation cost as a function of search efforts

Now lets formalize the intuition for the firm-specific forward exchange rate. Let B_i be the benefits derived by the representative investor from the intermediation of future FC as:

$$B_i = I_i + K. \tag{10}$$

Where I_i is the intermediation technology for future FC and K is the fixed cost payed by firm i in order to hedge. The intermediation technology is defined as:

$$I_i = \Delta_i(F_i - S(\Delta_i)). \tag{11}$$

Where Δ_i is the amount of FC to be procured by the representative investor on the short side of the market, F_i is the forward exchange rate charged to firm i from the procurement

[51] In annex C, part 5a, we explore the equilibrium relationship between domestic currency and covered FC debt. In annex C, part5b, we explain why there is no arbitrage in equilibrium and outside of equilibrium.

[52] See annex C, part 7 for the derivation of the entry condition.

[53] See annex C, part 8 for a graphical representation.

[54] Although, in the margin, lower market imperfections/higher liquidity would make the condition less binding for small firms. See annex C, part 8.

of Δ_i, and $S(\Delta_i)$ is the search effort done by the representative investor to procure Δ_i.

The FOC with respect to Δ_i is:

$$\frac{dB_i}{d\Delta_i} = F_i - [S(\Delta_i) + S`(\Delta_i)\Delta_i] = 0 \tag{12}$$

$$\rightarrow F_i = S(\Delta_i) + S`(\Delta_i)\Delta_i \tag{13}$$

$$\frac{dF_i}{d\Delta_i} = 2S'(\Delta_i) + \Delta_i S''(\Delta_i) > 0 \tag{14}$$

Where we assume that the search effort is an increasing and convex function of the size of Δ_i. We find this assumption plausible as Colombia is a granular economy where the short positions in the forward market fit a power law (figure 6). In consequence, F_i will be increasing in Δ_i. In addition, figure 3, panel A, shows how the size of the long position forward is a monotonic and increasing function of size. Given this empirical and theoretical evidence, we assume for simplicity and without loss of generality that: $F_i = F^{m_i}$. The price of the forward exchange rate is an increasing function of firm size[55].

3.5 Model hypothesis

We can conclude that smaller, more productive, export-oriented, and less risk averse firms profit from the cost saving advantage of FC debt at the expense of exposure to exchange rate risk. Smaller firms have a limited presence in the covered FC debt market because of entry costs. Larger firms limit their shares of covered FC debt given the lack of market liquidity. Finally, smaller and more risk averse firms decide to only acquire local currency debt.

Given these priors, in section 4, we will test the following hypotheses: i) uncovered FC debt shares are an increasing function of export shares in revenue; ii) uncovered FC debt is an increasing function of the interest rate differential corrected by the exchange rate volatility; iii) uncovered FC debt is a decreasing function of the expectation of exchange rate depreciations; iv) the probability to enter the covered FC debt market is a concave and non-monotonic function of size; v) shares of covered FC debt are a decreasing function of size; vi) the bigger the firm, the higher the forward exchange rate and the lower the shares of covered FC debt; and vii) the lower the covered FC debt market's liquidity and the bigger the firm, the lower the firm's hedges.

4 Econometric Specifications and results

This section provides the identification strategy, econometric specifications (based on the theoretical priors of section 3), and the results of the estimations. We use a two-stage

[55] In annex C, part 1a, we show how the idiosyncratic forward exchange rate inherits a power law distribution from the assumption of a intermediation cost that follows a power law. In the context of a granular economy where big firms are not numerous, the bigger the firm on the long side, the bigger the search effort for FC in the short side of the market, the higher the intermediation cost and therefore the higher the price faced by big firms. In part 1b we extend the model to include the funding constraints imposed by regulation on banks. With this intermediation function the pricing schedule is no longer increasingly monotonic on firm size, it becomes discontinuous and might be able to rationalize a bunching behavior.

Instrumental Variable (IV) procedure. We test the seven hypothesis depicted in section 3. More broadly, we address three questions: i) what are the drivers of the firm's decision to have FC debt? ii) what are the determinants to use FC forwards? and most importantly iii) Why non-financial firms of an EME present heterogenous exposure to exchange rate risk?

4.1 Identification Strategy

We propose a novel IV[56] in order to fight the potential endogeneity that comes from the simultaneous choice of the firm's shares of FC indebtedness and FC forwards. As it is shown in the theoretical section, these two variables co-move and are jointly determined in equilibrium. More FC debt may cause the firm to decide to hedge more with long positions in the forward market. At the same time, when the firm has already covered much of its FC debt, it may have incentives to increase –in the margin- the uncovered portion of its debt.

The firm level share of FC debt is instrumented with the interaction of firm level exports to sales ratio and the average excess reserves of credit establishments at the CB. High excess reserves mean excess capacity to extend domestic credit. Since hoarding reserves is costly for banks, excess capacity to extend credit is likely to reveal weak demand for credit in domestic currency. If both types of firms' borrowing are complements, then the demand for debt in FC is also weak. If they are substitutes, the demand for debt in FC increases. The idea then, is to interact excess reserves to a proxy for the exposure of the firm to foreign markets: the export/sales ratio. As shown in the model, export shares respect the exclusion restriction as they only define the extensive margin of FC forwards (covered FC debt) indirectly through the shares of (uncovered) FC debt (equation (8)).

Excess Reserves are defined as follows:

$$Excess\ Reserves = \frac{Available\ Reserves\ -\ Required\ Reserves}{Required\ Reserves}. \tag{15}$$

Where, required reserves are the amount of funds ordered by the CB on credit establishments[57] to keep as non-remunerated deposits in the CB or withheld in cash during each reserve period. Available reserves are additional funds kept as withheld cash or as non-remunerated deposits in the CB.

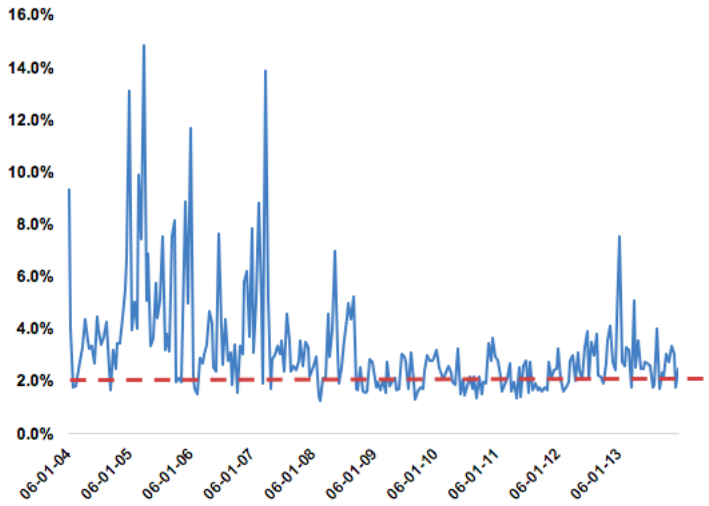
The CB only provides aggregate information (averages) on the quantities of reserves required on a biweekly basis. With this information we construct the indicator plotted in figure 7. For the econometrics, we take the year's average of the indicator.

The IV is exogenous as it captures the variation of the firm level FC debt, given the adjustments of the market for credit in domestic currency to policy shocks of the CB (e.g

[56]The type of IV used here is better known as a Bartik Instrument or shift-share instrument. In Borusyak et al. (2022), identification relies in the quasi-random assignment of shocks while exposure shares are allowed to be endogenous. In Goldsmith-Pinkham et al. (2020), identification is based on the exogeneity of the shares. This section argues for the exogeneity of both the shares and the shock used for the construction of the IV.

[57]All credit establishments are subject to reserve requirements with the exception of Financiera de Desarrollo Territorial (FINDETER) and Caja de Vivienda Militar.

Figure 7: Excess Reserves



Source: Authors' calculations based on BdR.

changes in required reserves[58]). These shocks are exogenous to the market of FC debt, as the CB does not choose the required reserves in function of the FC credit nor deposit market[59].

To cleanse the IV from any potential confounding variation coming from the credit establishments behavior, we subtract its long-term component. As it is shown in figure 7, credit establishments exhibit a cautious behavior as they use the capacity to extend domestic currency credit until they hit a 2 percent restriction[60].

Nonetheless and despite the attempts to procure exogeneity, the instrument does not comply with the exclusion restriction. We found anecdotal evidence showing that the CB used required reserves to sterilize its FXI[61]. The simultaneous use of both policy tools introduces a co-movement between the chosen IV and the FC forwards (the second stage dependent variable). In this case, the IV could determine the FC forwards directly and not only through the instrumented endogenous variable (FC debt). However, it is enough to control for the FXI in the second stage to make the IV respectful of the exclusion restriction.

Moreover, the introduction of FXI as a control in the second stage might be useful to avoid any omitted variable bias. Through the lens of the model, the sterilized FXI could impact

[58]Mora-Arbelaez et al. (2015) document that required reserves regulation changed in 2007, 2008, 2009 and 2012. In annex D, part 0, all changes regarding reserve requirements coefficients by bank liability type are displayed.

[59]One potential problem with the use of policy shocks as an instrument is the information effects they have on the beliefs of economics agents about the future path of the economy (Nakamura and Steinsson (2018)). In this respect, a surprise in required reserves may signal FC debt market participants of an increase of future economic growth, whom might react with a rise in their FC indebtedness. It is argued that this possible endogeneity might be offset by controls about market expectations. In particular, the expected spread (see equation (5)).

[60]In annex D, part 1, excess reserves are regressed against the VIX, the Colombian EMBI and a constant; this with the intent of filtering the shock from any variation coming from the shifts in banks' perception of risk. All results hold.

[61]Banco de la República (2008).

firms' decisions through three different channels. The first two channels conditional on the UIP not to hold.

In the case where the CB sells FC, equation (5) tells us that the shares of uncovered FC debt would increase given i) a lower expectation of exchange rate depreciation and ii) lower exchange rate volatility: The action of the CB in the spot market might be perceived by firms as an implicit protection against exchange rate risk, making them reduce their long positions in the FC derivatives market. On the other hand, equation (6) shows that the sales of FX could iii) increase the covered FC debt market liquidity, increasing the shares of covered FC debt.

In the following sections we will see if these policy shocks predictions hold empirically.

4.2 First Stage: Drivers of FC Debt

Equation (16) exhibits the econometric specification for the estimation of the drivers of FC debt. FCS_{it} is the ratio of FC debt to total assets of firm i in year t; $Exports_{it-1}$ is the share of exports in sales of firm i in year $t-1$; $E_{t-1}[Spread_t]$ is the market expectation formed in year $t-1$ for year t, of the difference between the real local deposit interest rate and the 3-months real libor overnight, divided by the annual standard deviation of the real exchange rate depreciation, and; $E_{t-1}[RER_t]$ is the market expectation formed in year $t-1$ of the Real Exchange Rate (RER) depreciation in year t[62][63]. $ExcessReserves_t$ are the excess reserves of credit establishments in t, defined as in equation (15). $ExcessReserves_t$ is in p.p.

X_{it-1} is a vector of firm level characteristics, such as firm size proxied by the log of assets (in 2008 constant COP). Leverage, FC assets, cash-flow, all as a ratio of assets, and indicator variables that take a value of one if the firm belongs to a foreign owner/tradable sector and zero otherwise. All firm-level independent variables are lagged one year to reduce endogeneity concerns;

Z_t is a vector of other macroeconomic variables such as private credit as a ratio of GDP; trade openness defined as aggregate imports plus exports as a ratio of GDP; and financial openness, for which we use the Fernández et al. (2016) capital control (overall restrictions) index. All data sourced and definitions are detailed in Annex A. In annex D, part 2 we include the sterilized FXI defined as a percentage of the volume transacted in the exchange rate spot market[64].

Finally, I_{it} is a vector that contains interactions of firm characteristics in $t-1$ and macroeconomic variables in t. We use three different definitions of FC debt: Total FC debt, Financial FC debt (FC bonds + FC bank loans) and Trade credit.

[62]For the construction of the expectation of the RER we use the expected inflation rates and expected nominal exchange rates.

[63]Predictions of the different macro variables are taken from the analysts expectations' survey from BdR and Reuters. For all macro variables we use the average prediction of analysts. For the period of study, the survey only contains expectations for the end of month, end of year, and twelve months.

[64]In this specification the expected RER depreciation and the expected spread are dropped because of perfect multicollinearity.

$$
\begin{aligned}
FCS_{it} = \beta_1 Exports_{it-1} + \beta_2 E_{t-1}[Spread_t] + \beta_3 E_{t-1}[RER_t] \\
+\beta_4 ExcessReserves_t + \beta_5 Exports_{it-1} * ExcessReserves_t \\
+\Theta X_{it-1} + \Phi Z_t + \gamma I_{it} + \epsilon_{it}; \\
FCS_{it} = FCS^*_{it} 1[FCS^*_{it} \geq 0].
\end{aligned} \tag{16}
$$

Alternatively we run a specification with firm level characteristics and year fixed effects. Both specifications are estimated with a Tobit estimator with robust standard errors. We use a Tobit model as the data might be left censored in zero[65]. For some firms it might be optimal to take a ratio of FC debt to assets equal to zero (a corner solution). The Tobit model takes this into account and yields consistent and unbiased estimates (OLS does not)[66] [67].

Hypotheses i) to iii) of the theoretical model tells us to expect a positive relationship of uncovered FC debt with exports (a higher natural hedge implies large shares of uncovered FC debt) and the expected spread (the higher the expected difference between the interest rates corrected by the exchange rate volatility, the more the firm wants to profit from cheaper uncovered FC debt); and a negative correlation with respect to the expected RER depreciation (the higher the expected RER depreciation the higher the expected cost to service the uncovered FC debt). That means β_1 and β_2 positive and β_3 negative.

Table 6 presents the results. Columns (1) to (3) include the firm level characteristics and year fixed effects. Column (4) to (6) exhibit the specifications with the macroeconomic controls, and the interactions between firm level characteristics and macroeconomic variables. Columns (1) and (4) capture the drivers to have any type of FC debt, (2) and (5) the drivers to have financial FC debt, and (3) and (6) the drivers to have trade credit.

As it can be seen, the expected spread is not statistically significant in any specification. The expected RER depreciation is significant for both Financial FC debt and trade credit. Nonetheless, it only presents the expected sign for trade credit (column 6). A 1 percent increase in the expectations of RER depreciation decreases the ratio of trade credit to assets by 0.08 p.p.

The export to sales ratio is statistically significant but presents a negative relationship with respect to FC debt (contrary to the prediction of the model). A firm with an exports

[65] We prefer a Tobit over the Heckman procedure or a Type 2 Tobit as we do not have a problem of selection or missing data. We observe firms with and without FC debt/forwards without missing information. We would need to use a Heckman procedure in the case in which we only had in our dataset firms with FC debt/forwards or firms with missing information about their FC indebtedness and hedging: clear selection bias problems. From a theoretical point of view, we model the intensive and extensive margin to be choices that happen simultaneously and with the same determinants (firm size, liquidity and prices). Given this, we opt for the standard Tobit in which the latent variable absorbs both the process of participation and the outcome of interest. Type II tobit allows the process of participation (selection) and the outcome of interest to be independent, conditional on observable data. From a theoretical point of view, this is not our case.

[66] In annex D, part 3 - 5, We define the dependent variable as an indicator function that takes a value of 1 if firm i had FC debt in year t and 0 otherwise. We use a pooled logit (part 3), RE logit (part 4) and FE logit (part 5) for its estimations. Results hold no matter the assumption made on the error term of the regression (logistic distribution instead of normal distribution), nor on the assumption made on the time-invariant and unobservable idiosyncratic characteristic.

[67] When predicting this instrumented variable, it is important to take into consideration its censored nature. Otherwise, the prediction would be wrong.

to sales ratio that increases by 1 p.p would decrease its total FC debt by 0.39 p.p (column 4).

Nevertheless, once the share of exports is interacted with excess reserves, we have a positive and statistically significant relationship. While the average firm use domestic and FC debt as complements, more export-oriented firms use them as substitutes. On average, the higher the excess reserves –the weaker the domestic currency credit demand, the lower the shares of all types of FC debt. However, the higher the excess reserves and the more export-oriented the firm is, the higher the shares of FC debt.

Interestingly, this substitution effect is larger for financial debt than for trade credit. An increase of a 1 p.p in the excess reserves, increase the financial FC debt of a firm with a 0.5 exports to sales ratio by 4.77 p.p (column 5). An increase of 1 p.p in excess reserves, decreases the trade credit of a firm with a 0.5 exports to sales ratio by 2.45 p.p (column 6).

Table 6: First Stage - Determinants of FC debt - Tobit

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Total FC debt	Financial FC debt	Trade Credit	Total FC debt	Financial FC debt	Trade Credit
Size	0.052***	0.06***	0.026***	0.07***	0.1***	0.047***
	(0.0006)	(0.0007)	(0.0008)	(0.004)	(0.004)	(0.005)
Leverage	0.0208***	0.219***	0.092***	0.21***	0.221***	0.09***
	(0.006)	(0.007)	(0.008)	(0.025)	(0.028)	(0.017)
FC Assets	0.012***	0.0121***	0.008	0.018***	0.018***	0.011**
	(0.004)	(0.004)	(0.005)	(0.006)	(0.006)	(0.005)
Exports	-0.012***	-0.137***	-0.001	-0.387***	-0.466***	-0.147***
	(0.001)	(0.011)	(0.001)	(0.103)	(0.104)	(0.047)
Tradable	0.056***	0.08***	0.005*	0.048***	0.071***	0.001
	(0.0021)	(0.022)	(0.003)	(0.002)	(0.003)	(0.003)
Foreign	0.097***	0.043***	0.146***	0.136***	-0.024	0.168***
	(0.0025)	(0.003)	(0.003)	(0.019)	(0.0204)	(0.023)
E[Spread]				-0.001	-0.004	0.002
				(0.003)	(0.003)	(0.004)
E[RER Depreciation]				-0.0002	0.041**	-0.0791***
				(0.0143)	(0.0162)	(0.0175)
Excess Reserves				-1.747***	-1.896***	-3.4***
				(0.279)	(0.3)	(0.394)
Exports*Excess Reserves	6.586***	7.50***	1.36**	5.806***	13.34***	1.902***
	(0.38)	(0.38)	(0.53)	(1.47)	(1.93)	(0.5)
Other firm controls	YES	YES	YES	YES	YES	YES
Other macro controls	NO	NO	NO	YES	YES	YES
Other macro-firm interactions	NO	NO	NO	YES	YES	YES
Year Fixed Effects	YES	YES	YES	NO	NO	NO
Partial F-Statistic	18	22	10	24	25	16
Observations	163,927	163,927	163,927	146,954	146,954	146,954

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

In regard to the FXI, in annex D part 2, we show how CB's FX purchases did not explain firms' FC debt while FX sales impact it negatively[68]. When the CB sells FX to an equivalent of 0.2 percent of the volume transacted in the spot market[69], firms reduce on average their shares of uncovered FC debt by 0.3 p.p. The FXI do not seem to alter real exchange rate depreciations or its volatility; when the CB sells FX firms reduce their

[68] We do not choose this as our main specification, as it is necessary to drop exchange rate expectations, and the expected spread variables because of perfect multicolinearity. Our preferred specification is the one that follows the theoretical model the closest

[69] Average FX sold by the CB during the time period.

shares of uncovered FC debt instead of increasing them. The policy shocks predictions of equation (5) do not hold empirically. This is suggestive evidence of the UIP holding on average[70].

In reference to the IV, we claim it is valid. The partial F statistic is larger than 10 in all the econometric specifications[71]. In the following section, we use the results of table 6 as a first stage (columns (4) to (6)). In particular, we use them to estimate the instrumented firm level FC debt.

4.3 Second Stage: Drivers of FC Forwards

Equation (17) exhibits the econometric specification for the estimation of the drivers of FC forwards. $FWDS_{it}$ is the ratio of FC forwards to total liabilities of firm i in year t; $\hat{FCS}_{it-1}$ is the predicted ratio of FC debt to total assets of firm i in year $t-1$; $Size_{it-1}$ is the log of assets of firm i in year $t-1$ in constant 2008 COP; $Premium_t$ is the forward premium in year t, defined as the average of the annualized forward premium[72]; $CCindex_t$ is Fernández et al. (2016) capital control (overall restrictions) index; and FXI_t is the Sterilized FXI as a percentage of the volume transacted in the exchange rate spot market.

X_{it-1} is a vector of firm level characteristics all defined as in equation (16). All firm-level independent variables are lagged one year to reduce endogeneity concerns; Z_t is a vector of other macroeconomic variables: the forward premium volatility, private credit as a ratio of GDP, and trade openness; and I_{it} a vector that contains interactions of firm characteristics in $t-1$ and macroeconomic variables in t. Equation (17) only presents the variables and interactions that make explicit the hypotheses of interest. All other interactions or individual variables are therefore contained in X_{it-1}, Z_t, I_{it}.

We use two different definitions of the dependent variable: i) FC forwards long positions; and ii) FC forwards short positions. i) and ii) are estimated with a Tobit model and robust standard errors. We use a Tobit model[73] as the data might be left censored in zero. For some firms it might be optimal to take a ratio of FC forwards (either the long or short position) to liabilities equal to zero. The Tobit model takes this into account and yields consistent and unbiased estimates.

[70] Kim et al. (2020) find that FXI incentives firms to take more FC debt, in particular, non-exporting firms in shallow financial markets with no FC debt to begin with. An alternative explanation for the difference between our results and Kim et al. (2020) is that the CB does not intervene in the spot market to protect the agents with FC debt from exchange rate fluctuations. At least, it is not an explicit motive given in its means of communication. In consequence, agents should not change their decisions in the uncovered FC debt market because of FXI.

[71] As customary, we run a robustness check in which we hold constant the shares of exports to sales across years. For all years, we use the first observation of exports to sales per firm. Results hold with the exemption of trade credit, for which the IV is no longer valid (annex D, part 8).

[72] We do not have access to the contract level forward exchange rate, but only to aggregate forward premiums.

[73] We also run a third specification in which we use the ratio of net forwards to liabilities ratio as the dependent variable, with an OLS estimator. The results are not presented as they were non statistically significant. This might be evidence of net forwards being a very noise definition for a variable, and OLS the incorrect technique to run such a specification.

$$FWDS_{it} = \gamma_1 \hat{FCS}_{it-1} + \gamma_2 size_{it-1} + \gamma_3 Premium_t + \gamma_4 CCindex_t + \gamma_5 FXI_t$$
$$+\gamma_6 \hat{FCS}_{it-1} * Size_{it-1} + \gamma_7 \hat{FCS}_{it-1} * Size_{it-1} * Premium_t + \gamma_8 \hat{FCS}_{it-1} * Size_{it-1} * CCindex_t$$
$$+\gamma_9 \hat{FCS}_{it-1} * Premium_t + \gamma_{10} \hat{FCS}_{it-1} * CCindex_t + \gamma_{11} \hat{FCS}_{it-1} * FXI_t +$$
$$\gamma_{12} Size_{it-1} * Premium_t + \gamma_{13} Size_{it-1} * CCindex_t + \nu X_{it-1} + \psi Z_t + \Omega I_{it} + u_{it};$$
$$FWDS_{it} = FWDS^*_{it} 1[FWDS^*_{it} \geq 0]. \tag{17}$$

To test the hypotheses of the model we will exploit the non-linear nature of the censored Tobit estimator[74]. With this we can estimate the Average Marginal Effect (AME) of 1 p.p increase in the variable of interest (FC debt, forward premium, capital control index) on the outcome variable (FC forwards), on different parts of the distribution of a third variable (firm size, FXI).

Hypotheses iv) and v) of the theoretical model tell us to expect γ_1 positive and γ_6 negative, as they predict a non-linear relationship between size and covered FC debt. The intensive margin (the shares of covered FC debt) are decreasing in size, while the extensive margin is predicted to be a concave and non-monotonic function of size (the decision to enter the covered FC debt market).

Hypothesis vi) predicts a positive γ_3 and γ_9, and negative γ_7 and γ_{12}, as larger firms internalize the lack of market liquidity through higher prices. Hypothesis vii) predicts a negative γ_4 and γ_8, and a positive γ_{10} and γ_{13} as a lower aggregate liquidity of the covered FC debt market (captured by the capital control index) will have a negative impact on the hedging of the largest firms.

We do not have a clear prior for the sign of γ_5 and γ_{11}. On the one hand, FXI might distort firms' allocations in the derivatives market as it may be perceived as an implicit insurance from the CB to firms[75] (equation 5). On the other hand, the FXI provide the financial sector with liquidity that can spill out to the covered FC debt market, and therefore increase the access of firms to larger hedges (equation 6).

γ_1 to γ_{13} capture the results related to the market imperfections' hypotheses, but γ_5 and γ_{11} pertain to a combination of policy shocks induced distortions and market imperfections' hypothesis. We present and discuss each set of results separately in the following subsections. Both bring light to the heterogeneous hedging behavior of non-financial firms in EMEs.

[74] Following McDonald and Moffitt (1980) and Kim et al. (2020), we estimate the AME for the censored firms. The firms that in the data tap the FC derivatives' market (firms that have non-zero shares of derivatives). Another advantage of this estimator besides of its non-linearity is that it allows to decompose the AME between the extensive and intensive margin. See annex H for the details of the estimation.

[75] As a robustness check we run a specification only taking into account firm level variables and year-fixed-effects. All results hold. Nevertheless and as expected, this specification is too rigid and is not able to capture the non-linearities in firms' financial strategies caused by the CB's FXI. Alternatively, we introduce the squared variable of the instrumented FC debt in the second stage. With this, we want to better understand the source of the non-linearities; It could be the case that firms with FC debt only use FC derivatives to hedge against exchange rate risk after a certain critical amount of debt. The results show that this is not the case (annex F, part 1).

4.3.1 Market imperfections: Firm size and market liquidity

Figure 8 exhibits the AME of FC debt on FC forwards for different firm sizes. Following equation (17), panels (a) and (b) plot the results for financial FC debt and trade credit respectively. Panel (c) and panel (d) present the results for an specification with firm level variables and year fixed effects.

As it is shown, no matter the type of FC debt, nor econometric specification, there is a non-linear relationship between covered FC debt and firm size. The effect of FC debt on FC forwards is a concave and non-monotonic function of size. Firms below the 95th percentile[76] have relatively small (in absolute value), positive and precisely estimated coefficients. Firms above this threshold exhibit relatively large (in absolute value) and negative coefficients. On average, following a 1 p.p increase in FC debt, firms below the 95th percentile of size increase the shares of covered FC debt around 0.05 p.p. Firms above this threshold, following a 1 p.p increase in FC debt, decrease the shares of covered FC debt between 0.4 and 4 p.p on average[77] [78] [79] [80].

Furthermore, when we decompose the AME of figure 8 between the extensive and intensive margin, we find that the extensive margin is a concave and non-monotonic function of size (as predicted by the model, hypothesis iv), and that the intensive margin is a decreasing function of size (as predicted by the model, hypothesis v).

Through the lens of the model, this non-linear relationship between covered FC debt and firm size is explained by the lack of liquidity of this market. Larger firms internalize this when faced with higher forward rates (hypothesis vi). To test this hypothesis, we estimate the AME of the forward premium (our proxy to market prices) on the shares of FC forwards, for different firm sizes.

Figure 9 exhibits the results for financial FC debt (panel (a)) and trade credit (panel (b)). As predicted by the model, larger firms face higher prices that make them reduce the shares of FC forwards. For a 1 p.p increase in the forward premium, the largest firms in the economy (above the 95th percentile of the size distribution) will decrease their hedges between 0.5 and 1.4 p.p. Nonetheless, it is necessary to mention that this is only statistically true for firms with financial FC debt. Firms with trade credit, present a similar functional form but with a less pronounced gradient which is not statistically significant. Annex F, part 6, shows the results for the latent model (the whole sample). In this estimation, the non-linear relationship embodied in the triple interaction of equation (17) is statistically significant for all types of debt[81].

[76] Equivalent to 6.4 in the the log of assets scale (approximately 31 million USD). The median firm equivalent to 3.3 (approximately 1.4 million USD).

[77] The functional form is preserved when excluding outliers in terms of size (below the 5th percentile and above the 95th percentile), although not always statistically significant (annex F, part 2).

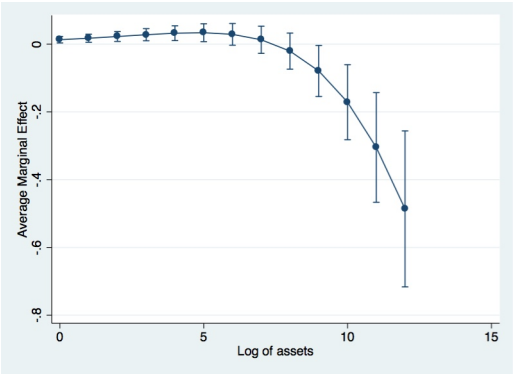
[78] Results are also robust to specifications with firm level controls, year FE and the interaction of FC debt and firm size (annex F, part 3); a specification with firm level controls, year FE and the squared of firm size (annex F, part 4); and a specification with covered FC debt as the dependent variable (long position FC forward/FC debt), firm level controls, year FE and the squared of firm size (annex F, part 5).

[79] Results are robust to the inclusion of trade-credit and short position contracts as controls. See annex F, part 6.

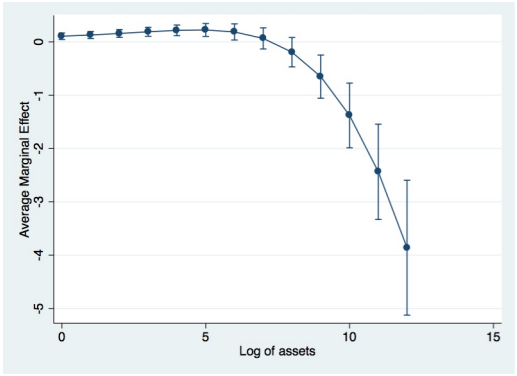
[80] Results are robust to firm level risk aversion alternative hypothesis: Bigger firms might be less risk averse and therefore they might hedge less against exchange rate uncertainty. Annex J shows evidence against this alternative hypothesis.

[81] Results hold for the latent model without outliers (annex F, part 7).

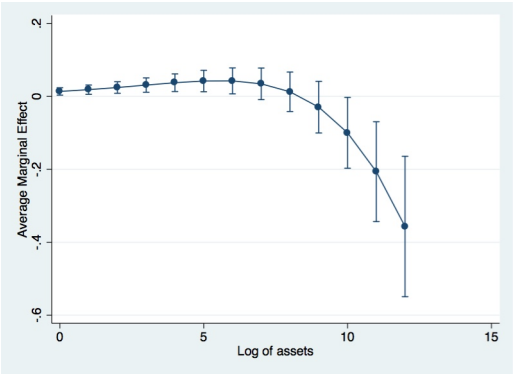
Figure 8: AME of FC debt on FC forwards long positions for different firm size



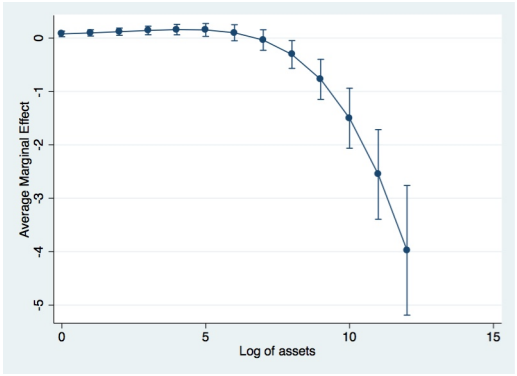
(a) Financial FC debt with macro controls and firm-macro interactions



(b) Trade credit with macro controls and firm-macro interactions



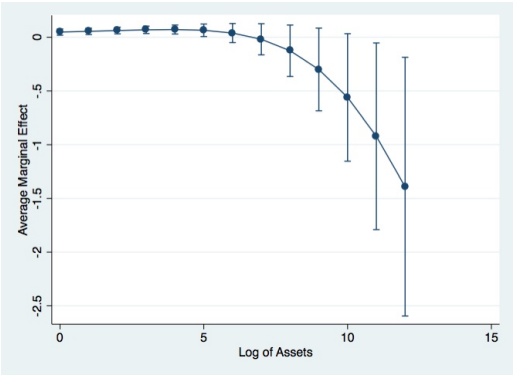
(c) Financial FC debt with year FE



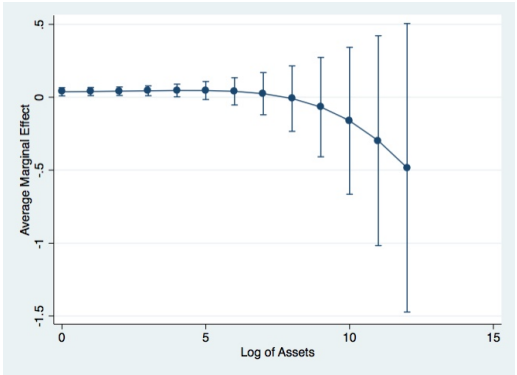
(d) Trade credit with year FE

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Figure 9: AME of the forward premium on FC forwards long positions for different firm sizes



(a) Financial FC debt



(b) Trade credit

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

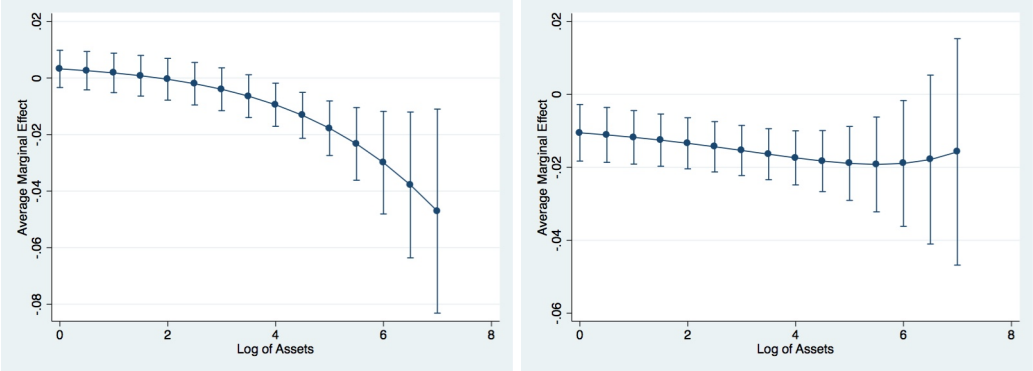
To test for the effects of the lack of liquidity of the FC forward market on the hedges of the largest firms of the economy (hypothesis vii); we use as an empirical measure for the market imperfections that limit the supply of FC in the derivatives market, the Fernández

et al. (2016) Capital Control overall restrictions index[82].

As figure 10, panel a shows, for firms with financial FC debt, an increase in the capital control overall index (a decrease of the aggregate liquidity), has a negative effect for firms above the median. A 1 p.p increase of the index[83] decreases the long positions in the derivatives market between 0.01 and 0.045 p.p. Panel b, shows that for firms with trade credit the effect of the lack of liquidity is quite homogeneous across firm sizes. An increase of 1 p.p in the capital control index, decreases the long positions in the forward market by 0.02 p.p[84] [85].

The heterogeneous effects of the lack of liquidity on the hedges of firms with financial FC debt and trade credit can be rationalized with the model. A decrease in the covered FC debt market's liquidity has a greater and heterogeneous effect on the biggest firms in the economy (e.g firms with financial FC debt) through an increase in their variable cost. Meanwhile this decrease in liquidity has a marginal and homogeneous effect on smaller firms (e.g firms with trade credit) for which the fixed cost of entry does not change.

Figure 10: AME of the capital control overall index on long positions for different firm sizes



(a) Financial FC debt (b) Trade credit

Source: Authors' calculations based on SS, DIAN-DANE, SFC, BdR and Fernández et al. (2016).

[82] In annex I, part 1, we explain further how the index is constructed and we do some comparisons with Chile and the United States. These comparisons are suggestive evidence on how an strict regulation of capital flows can limit the development/sophistication of the financial sector of an economy.

[83] From 1995 to 2013, the standard deviation in the capital control index for Colombia was equivalent to 0.1 p.p.

[84] In annex I, part 2, we use the capital control index on outflows/inflows instead of the overall index. Results hold

[85] In annex I, part 3, we present the results of the latent model. Results hold

4.3.2 Policy shocks distortions vs liquidity: FXI and the allocations in the FC forward market

Now let us examine the possible distortive effects of FXI[86] on firms' hedging decisions. Table 7 illustrates the results for long positions in the FC forward market using the latent model[87]. Columns (1) to (3) do not include FXI nor its interactions with FC debt. Columns (4) to (6) include FXI. Columns (7) to (9) include the FXI and its interaction with FC debt.

As it is shown, is only in columns (7) to (9) where the different types of FC debt are statistically significant. Surprisingly, there is a negative relationship between FC debt and the FC forward long positions. The larger the shares of FC debt, the lower the shares hedged by firms (the higher the shares of uncovered FC debt). However, once the action of the CB is taken into account, strong non-linearities are found in this relationship. Irrespective of the FC debt type, for small sized FX sales, firms reduce the long positions in the derivatives market. For big interventions, firms increase them. In the case of total FC debt (column (7)), a firm switches a reduction for an increase of its hedging, when the FX sales carried by the CB in the sport market are equivalent to 0.3 percent of the total FX transacted[88].

Table 7: Second Stage - Impact of FXI on the long positions of the forward market - Tobit

Variables	(1) Long Position	(2) Long Position	(3) Long Position	(4) Long Position	(5) Long Position	(6) Long Position	(7) Long Position	(8) Long Position	(9) Long Position
Total FC debt	-0.167			-0.167			-3.801*		
	(0.698)			(0.698)			(2.083)		
Financial FC debt		0.72			0.72			-4.681**	
		(0.693)			(0.693)			(2.335)	
Trade Credit			-12.976***			-12.976***			-41.172***
			(2.943)			(2.943)			(10.912)
FXI Purchases				49.561***	49.413***	52.52***	46.777***	48.988***	41.126***
				(12.924)	(12.91)	(12.956)	(13.015)	(12.897)	(13.569)
FXI Sales				232.98***	230.627***	252.047***	185.837**	164.921**	167.828**
				(71.253)	(71.17)	(71.227)	(73.858)	(72.264)	(77.322)
Total FC Debt*FXI Purchases							83.16		
							(52.839)		
Total FC Debt*FXI Sales							1323.25**		
							(583.737)		
Financial FC Debt*FXI Purchases								58.463	
								(55.899)	
Financial FC Debt*FXI Sales								2542.68***	
								(672.485)	
Trade Credit*FXI Purchases									793.62***
									(292.459)
Trade Credit*FXI Sales									6704.288**
									(2848.06)
Other firm controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Other macro controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Other macro-firm interactions	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	114,497	114,495	114,497	114,497	114,495	114,497	114,497	114,495	114,497

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

[86]During this period, the CB sold FX through call options with the intent of diminishing exchange rate volatility. The CB purchased FX through four different mechanisms: i) Discretionary interventions; ii) Put options to accumulate reserves; iii) Put options to reduce exchange rate volatility; and iv) pre-announced day to day bids. Annex K shows the distribution of FXI across time. Because of perfect multicolinearity it is not possible to study the FXI separately.

[87]For complete results see Annex G.

[88]To calculate this we use the results of table 7, column 7. We take the partial derivative with respect to total FC debt and set it equal to zero. Then we solve for the FXI threshold.

Through the lens of the model, the sales of FX by the CB will have two opposite effects. On the one hand, firms will increase their uncovered FC debt, as they will expect a milder exchange rate depreciation, and the exchange rate volatility would be lower (equation 5). On the other hand, the FXI provides FC liquidity that can spill to the derivatives market (equation 6). Empirically, below the 0.3 percent threshold the former effect prevails[89], above this threshold, the latter effect dominates.

Another very important result that is worth to emphasize on, is the heterogeneity in the use of FC forwards by firms with different types of FC indebtedness. Everything else equal, in comparison to firms with trade credit, firms with financial FC debt do present longer positions in the FC derivatives market. Conditioned on a CB's sale of FX equivalent to 0.2 percent[90] of the volume transacted in the spot market, for each extra p.p of financial FC debt (trade credit), the firm's long position in the derivatives market increases (decreases) by 0.41 (-27.8[91]) p.p.

An alternative interpretation of the results is that firms with trade credit will switch a reduction for an increase in their long positions, after a threshold of FX sales that is 3 times bigger than the threshold of firms with financial FC debt (approximately 0.2 percent vs 0.6 percent of the volume transacted in the spot market).

We present two different explanations for this:

i) As shown in equation 9 and annex C, part 7, both the fixed cost of entry and aggregate liquidity of the covered FC debt market play a role in the firm's decision on whether to enter the market or not. While for big firms the increase in aggregate liquidity diminishes the variable costs and therefore increases the expected profits of using this market, it only does it marginally for small firms, for whom the fixed cost of entry is the most stringent component of the total cost. In consequence, the required change in the market's liquidity for smaller firms to start hedging is significantly greater than for larger firms.

ii) The effectiveness of the sterilized FXI in the short vs long run. As it is shown in Medellín (2018), FXI seem to influence the exchange rate behavior only over time horizons under six months. If this is the case, firms with short term transactions (e.g. trade credit) will feel protected by the CB's intervention, while firms with long term transactions

[89] This is suggestive evidence of the UIP not holding on average. An apparent contradiction emerges. While firms do not take into account the FXI in the decision of uncovered FC indebtedness (section 4.3), it does impact their decisions to hedge. This apparent contradiction helps us unravel the channel through which interventions affect firm decisions. If FXI were reducing the volatility of the exchange rate, firms that only have uncovered FC debt, as well as firms that have covered and uncovered FC debt, would change their indebtedness decisions. But this is not the case. The firms that change their indebtedness decisions are firms with both types of debt. This means that the CB's interventions are having and effect on the expectations of exchange rate depreciations. Moreover, the FXI effect is not homogenous across firms. This ultimately tells us that both types of firms have different sets of information (argueably, firms that have both types of debt have a broader set of information). The evidence provided is inconclusive about whether the UIP holds on average or not (see section 4.3).

[90] Average FX sales carried by the CB within the period of study.

[91] The large magnitude of this effect might be explained by the small number of firms with trade-credit and FC forwards. On average 1 percent of the sample per year. The tobit's likelihood function reflects the unequal sampling probability of each observation depending on whether the latent dependent variable fell above or below the determined threshold. In this case, the sampling probability for each non-limit observation (values above zero) is the height of the density function. For limit observations (values equal to zero) it is the cumulative distribution (e.g the integral below zero of the appropriate density function).

Table 8: Second Stage - Impact of FXI on the short positions of the forward market - Tobit

Variables	(1) Short Position	(2) Short Position	(3) Short Position	(4) Short Position	(5) Short Position	(6) Short Position	(7) Short Position	(8) Short Position	(9) Short Position
Total FC debt	-2.682***			-2.682***			-3.802***		
	(0.211)			(0.211)			(0.602)		
Financial FC debt		-2.727***			-2.727***			-3.046***	
		(0.209)			(0.209)			(0.624)	
Trade Credit			-6.551***			-6.551***			-10.612***
			(0.757)			(0.757)			(2.749)
FXI Purchases				-11.166***	-11.492***	-10.831***	-11.365***	-11.409***	-12.267***
				(2.887)	(2.886)	(2.885)	(2.911)	(2.894)	(2.987)
FXI Sales				-52.392***	-53.096***	-54.944***	-55.722***	-57.312***	-61.48***
				(15.272)	(15.267)	(15.245)	(15.917)	(15.657)	(16.271)
Total FC Debt*FXI Purchases							9.465		
							(14.346)		
Total FC Debt*FXI Sales							128.268		
							(177.05)		
Financial FC Debt*FXI Purchases								3.239	
								(14.57)	
Financial FC Debt*FXI Sales								233.618	
								(185.787)	
Trade Credit*FXI Purchases									116.871
									(72.367)
Trade Credit*FXI Sales									728.09
									(741.553)
Other firm controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Other macro controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Other macro-firm interactions	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	114,497	114,495	114,497	114,497	114,495	114,497	114,497	114,495	114,497

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

(e.g. financial FC debt) will not.

In regard to FX purchases carried by the CB, table 7 shows how the interactions between this type of interventions and total or financial FC debt are not statistically significant. The interaction with trade credit is statistically significant and positive. For an extra p.p of trade credit as share a of total liabilities, when the central bank purchases 3.1 percent of the FX transacted in the spot market[92], the firm will reduce its long position by 16.5 p.p. The accumulation of FX by the CB does not seem to distort the hedging decisions of firms with financial FC debt, while it has a negative impact on the hedging of firms with trade credit. Small firms in the margin of the entry condition to the hedging market are affected by decreases of FC liquidity caused by policy[93].

With respect to the short positions in the derivatives' market, table 8 shows that no matter the specification, all types of FC indebtedness present a hedging consistent behavior. The larger the shares of FC debt the smaller the short positions. A firm with a ratio of financial FC debt (trade credit) to liabilities ratio of 0.5 reduces its shares of short position FC forwards contracts by 1.5 (5.3) p.p. Another interesting result is that in this side of the market, the CB's intervention seems to not distort the behavior of firms with FC debt (the interaction between FC debt and FXI sales/purchases are not statistically significant).

To close this subsection, we will use the non-linear properties of the Tobit estimator, to

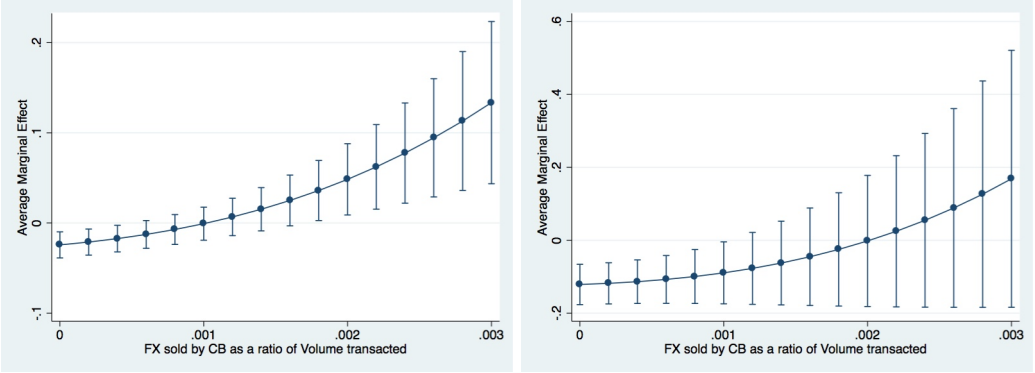
[92]The average of FX purchased by the CB during this time span, a period of exchange rate appreciation.
[93]Firms with trade credit would increase their long positions when the CB surpasses a threshold of FX purchases equivalent to 5.2 percent. In the data, the only year with a FX purchase beyond this threshold was 2013 with an intervention equivalent to 5.6 percent of the FX transacted in the spot market.

clarify the interpretation of the effect of FX sales carried by the CB on firms' behavior in the FC forward market. So far, the constant gradient of the AME of FC debt on FC forwards evaluated in different amounts of FX sold, might be interpreted as the change in the behaviour of firms, given the realized exchanged rate depreciation and not as the reaction towards the CB's intervention.

In figure 11, it is possible to see how the gradient of the AME is not longer linear for both financial FC debt (panel a) and trade credit (panel b). While firms with financial FC debt decrease their long positions for small sized interventions and increase their positions for large sized interventions; firms with trade credit decrease them for small sized interventions and, after a critical point of intervention, their behavior remains unchanged[94].

If FX sales are read as a proxy for ER depreciation, then, on average, both types of firms would be reducing their long positions amid an exchange rate depreciation. This interpretation does not make much sense. Therefore, we argue that this variable actually captures the influence of CB's interventions on firms' behavior. For moderate spot market interventions firms will feel protected, for big interventions they will not incur the exchange rate risk/they will profit from the increase of the aggregate FC liquidity.

Figure 11: AME of FC debt on FC forwards long positions for different amounts of FX sold by the CB



(a) Financial FC debt (b) Trade credit

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

5 Conclusions

In this paper we want to understand why non-financial firms of an EME such as Colombia present heterogeneous hedge of their exposure to exchange rate risk. We find two broad reasons for this behavior: i) Market imperfections embodied in financial frictions; and ii) Policy induced distortions.

[94]With respect to the relative importance of the extensive vs intensive margin on the AME, we find that the extensive margin is dominant, no matter the size of FXI or FC debt type. The CB's actions distort the decision of whether or not enter the market, and not the magnitudes of its use. The importance of the intensive margin ranges between 1 to 3.1 percent of the total AME for total FC debt, between 2.5 and 7.2 percent for financial FC debt, and between 2.7 and 24.2 percent for trade credit.

We first extend a theoretical model in order to depict the priors of the FC indebtedness strategies and hedging techniques of these firms. The main prediction of the model is that the lack of liquidity of the covered FC debt market will limit entry of firms and the extent of their optimal protection against exchange rate fluctuations.

In theory, because of high entry costs, only medium and large firms will use covered FC debt. Nonetheless, given the lack of relative liquidity of this market, larger firms who need a larger portion of the aggregate liquidity to hedge the same shares, will face higher prices, which will make them reduce their optimal hedges. Smaller, more productive, less risk averse, and more export-oriented firms will opt for uncovered FC debt. In expectation they will be able to reduce their funding costs at the expense of a larger exposure to exchange rate risk. Finally smaller and more risk averse firms will decide to acquire local currency debt.

Empirically and as predicted by the model, we find that larger firms have a higher probability of hedging their FC debt with FC forwards. Nonetheless, the bigger the firm the smaller the shares of FC liabilities that are hedged. Larger firms seem to face higher prices, which limit their hedging. We also find that when the aggregate level of liquidity of the covered FC debt market decreases, the shares hedged by medium and big firms also diminishes. Small firms' hedges are not changed.

Moreover, these hedging decisions are not independent of the CB's FXI in the spot market. Firms exhibit a non-linear behavior which depends on the size of the FX sales: For small size interventions, firms will reduce their long positions in the derivatives market, while for big interventions they will increase them.

The model depicts two opposite forces at play that can explain this anomaly. On the one hand, FXI may reduce the expectations of exchange rate depreciations and its volatility. On the other hand, FXI may provide FC liquidity that might spill to the covered FC debt market through the financial system. The former force is bigger when FXI is moderate, the latter force is stronger when FXI becomes large.

Furthermore, this non-linearities are heterogeneous in relation with the type of FC indebtedness. The threshold of FXI for which firms with trade credit switch from a reduction to an increase in their long positions is six times larger than the threshold for firms with financial FC debt.

This might be explained by the relative importance of the components of the cost function of covered FC debt for big firms (e.g. firms with financial FC debt) vis à vis small firms (e.g. firms with trade credit). While the most stringent component for big firms is the variable cost, given the lack of liquidity and higher forward rates; for small firms is the fixed entry cost which is closely related to the firms' financial sophistication.

The response of the BdR to the extreme exchange rate depreciation seen in Colombia in the first semester of 2020 as a result of the pandemic, was accurate according to the evidence provided by the paper. Instead of undertaking FXI in the spot market, the CB opted to provide FC liquidity in the derivatives' market. This with the objective of avoiding further spot exchange rate depreciation given the increase in the demand for FC. At the same time, this helped the non-financial Colombian firms to meet their FC obligations,

and to further hedge their FC debt.

This train of action could have reduced the increase in the policy rate that the monetary authority needed as an inflation targeting CB to contain inflation (given the exchange rate pass-through to prices), and could have implied a lower contractionary impact on economic activity. This strategy might also be more cost-effective than using other policy tools such as Sterelized FXI, and most importantly, it does not distort the optimal FC derivatives' decisions of firms.

In relation to structural implications, the CB could reassess the calibration of the bank's FC exposure's regulation which limits the liquidity and development of the derivatives market. There is a clear trade-off of this strict regulation: While the financial sector's vulnerability to exchange rate movements is low, the real sector remains exposed. An optimal calibration of this policy would allocate exchange rate risk more efficiently across the different agents of the economy, reducing the vulnerabilities of the economy as a whole.

References

Joshua Aizenman, Yin-Wong Cheung, and Xingwang Qian. International reserve management and firm investment in emerging market economies. *NBER Working Paper*, (29303), 2022.

Laura Alfaro, Gonzalo Asis, Anusha Chari, and Ugo Panizza. Corporate debt, firm size and financial fragility in emerging markets. *Journal of International Economics*, 19 (118):1–19, 2019.

Laura Alfaro, Mauricio Calani, and Liliana Varela. Granular corporate hedging under dominant currency. *Discussion Paper, CEPR*, DP(16232), 2023.

Banco de la República. Informe de la junta directiva al congreso de la república. Technical report, 2008.

Adolfo Barajas, Sergio Restrepo, Roberto Steiner, Juan Camilo Medellín, and César Pabón. Currency mismatches and vulnerability to exchange rate shocks: Nonfinancial firms in colombia. *IMF Working Paper*, 17(263), 2017.

Mr. Fabiano Rodrigues Rodrigues Bastos, Herman Kamil, and Mr. Bennett W Sutton. Corporate Financing Trends and Balance Sheet Risks in Latin America. IMF Working Papers 2015/010, International Monetary Fund, January 2015. URL `https://ideas.repec.org/p/imf/imfwpa/2015-010.html`.

Kirill Borusyak, Peter Hull, and Xavier Jaravel. Quasi-experimental shift-share research designs. *Review of Economic Studies*, 89:181–213, 2022.

Carlos Cantu. Effects of capital controls on foreign exchange liquidity. *Journal of Intenational Money and Finance*, 93:201–222, 2019.

Nathali Cardozo-Alvarado, Juan Sebastián Rassa-Robayo, and Juan Sebastián Rojas-Moreno. Caracterización del mercado de derivados cambiarios en colombia. *Borradores de Economía*, (860), 2014.

Luis Felipe Céspedes, Roberto Chang, and Andres Velasco. Balance sheets and exchange rate policy. *American Economic Review*, 94(4):1183–1193, 2004.

Barry Eichengreen, Ricardo Hausmann, and Ugo Panizza. *The Mystery of Original Sin*. University of Chicago Press, 2003. Debt Denomination and Financial Instability in Emerging-Market Economies.

Andrés Fernández, Michael W Klein, Alessandro Rebucci, Martin Schindler, and Martin Uribe. Capital control measures: A new dataset. *IMF Economic Review*, 64(3):548–574, 2016.

A Froot, Kenneth, S Sharfstein, David, and C Stein, Jereym. Risk management: Coordinating corporate investment and financing policies. *Journal of Finance*, 48(5):1629–1658, 1993.

Xavier Gabaix and Rustam Ibragimov. Rank — 1/2: A simple way to improve the ols estimation of tail exponents. *Journal of Business Economic Statistics*, 29(1):24–39, 2011. ISSN 07350015. URL `http://www.jstor.org/stable/25800776`.

Xavier Gabaix, Parameswaran Gopikrishnan, Vasiliki Plerou, and H. Eugene Stanley. A theory of power-law distributions in financial market fluctuations. *Nature*, 423(6937):267–270, May 2003. doi: 10.1038/nature01624. URL https://ideas.repec.org/a/nat/nature/v423y2003i6937d10.1038$_n$ature01624.*html*.

Xavier Gabaix, Parameswaran Gopikrishnan, Vasiliki Plerou, and H. Eugene Stanley. Institutional investors and stock market volatility. *The Quarterly Journal of Economics*, 121(2):461–504, 2006. ISSN 00335533, 15314650. URL http://www.jstor.org/stable/25098798.

Paul Goldsmith-Pinkham, Isaac Sorkin, and Henry Swift. Bartik instruments: What, when, why and how. *American Economic Review*, 8(110):2586–2624, 2020.

Bryan Gutierrez, Victoria Ivashina, and Juliana Salomao. Why is dollar debt cheaper? evidence from peru. Unpublished, 2020.

Sebnem Kalemli-Ozcan and Liliana Varela. Five facts about the uip premium. *NBER Working Paper*, (28910), 2022.

Graciela Kaminsky and Carmen Reinhart. The twin crises: The causes of banking and balance-of-payments problems. *American Economic Review*, 89(3):473–500, 1999.

Minsuk Kim. Financial development, exchange rate fluctuations, and debt dollarization: A firm-level evidence. *IMF Working Paper*, 19(168), 2019.

Minsuk Kim, Rui Mano, and Mico Mrkaic. Do fx interventions lead to higher fx debt? evidence from firm-level data. *IMF Working Paper*, 20(197), 2020.

Loriano Mancini, Angelo Ranaldo, and Jan Wrampelmeyer. Liquidity in the foreign exchange market: Measurement, commonality, and risk premiums. *Journal of Finance*, 68(5):1805–1841, 2013.

John McDonald and Robert Moffitt. The uses of tobit analysis. *The Review of Economics and Statistics*, 62(2):318–321, 1980.

Juan Camilo Medellín. Public savings and the effectiveness of sterilized foreign exchange intervention. *Revista ESPE - Ensayos sobre Política Económica, Banco de la República de Colombia*, 36(85):117–136, 2018.

Franco Modigliani and H Miller, Merton. The cost of capital, corporation finance and the theory of investment. *The American Economics Review*, 48(3):261–297, 1958.

Tatiana Mora-Arbelaez, Andres Garcia-Bernal, Jose Gomez-Gonzales, and Mauricio Villamizar-Villegas. Una historia exhaustiva de la regulacion financiera en colombia. *Borradores de Economía*, (887), 2015.

Emi Nakamura and Jón Steinsson. Identification in macroeconomics. *Journal of Economic Perspectives*, 32(3):59–86, 2018.

David Perez-Reyna and Mauricio Villamizar-Villegas. Exchange rate effects of financial regulations. *Journal of International Money and Finance*, 96:228–245, 2019.

A Rampini, Adriano and S. Viswanathan. Collateral, risk management, and the distribution of debt capacity. *Journal of Finance*, 65(6):2293–2322, 2010.

Juliana Salomao and Liliana Varela. Exchange rate exposure and firm dynamics. *The Review of Economics Studies*, 89(1):481/514, 2022.

Dimitri Vayanos and Jiang Wang. Market liquidity - theory and empirical evidence. *Handbook of the Economics of Finance*, (Chapter 19), 2013.

Annex A: Variables' definitions and sources

Variable	Definition	Source
Investment	Capital in t minus capital in t-1. Capital is the addition of physical properties as equipment, edifications, on going constructions, and othr assets.	Superintendicia financiera & Superintendencia de sociedades
Exports	FOB value of exports of goods and services	DANE-DIAN
Imports	CIF value of goods imported plus imports of services	DANE-DIAN
FC debt	FC bonds, FC financial debt, trade credit	Banco de la República
Long forward	Value of the active long COP/USD forwards at December 31st of the corresponding year at the firm level	Banco de la República
Short forward	Value of the active short COP/USD forwards at December 31st of the corresponding year at the firm level	Superintendicia financiera & Superintendencia de sociedades
Size	Logarithm of real value assets	Banco de la República
Leverage	Long term debt as a ratio of total assets	Banco de la República
FC assets		Superintendicia financiera & Superintendencia de sociedades
Net forwards	Long forwards - Short forwards	
Cash flow	A revenue or expense stream that changes a cash account oer a given period	Banco de la República
Tradable	Takes the value of 1 if the firm belongs to any of the following sectors: agriculture, mining or industry. Zero otherwise	DANE
Foreign	Takes the value of 1 if foreigners owne 50 percent of more of the firm's shares	Fernandez, Klein, Rebucci, Schindelr & Uribe
Trade Openness	Export plus imports as a share of GDP	Superintendicia financiera
Financial Openness	Financial Openes Index	Banco de la República's survey
Private credit	Private Credit as a ratio of GDP	Banco de la República's survey and Bloomberg
Expected Real Exchange Rate depreciation	The average of the colombian analysts expectations about the RER.	Banco de la República
Expected spread	Expected deposit interst rate minues 3 months libor overnight, corrected by the RER depreciation's volatility	Banco de la República
Forward Premium	The average of the different maturity FC forwards.	

Source: Elaborated by the authors based on SS, DIAN-DANE, SFC and BdR.

Annex B: Descriptive statistics, stylized facts, and a description of the supply side of the derivatives market

Part 1: Total assets and liabilities of the median firm 2005-2013

In 2013, the median firm had the equivalent to 1.8 million USD of total assets and the equivalent to 0.6 million USD of total liabilities. Total assets are not equivalent to total liabilities, as shareholder's equity is not included in total liabilities.

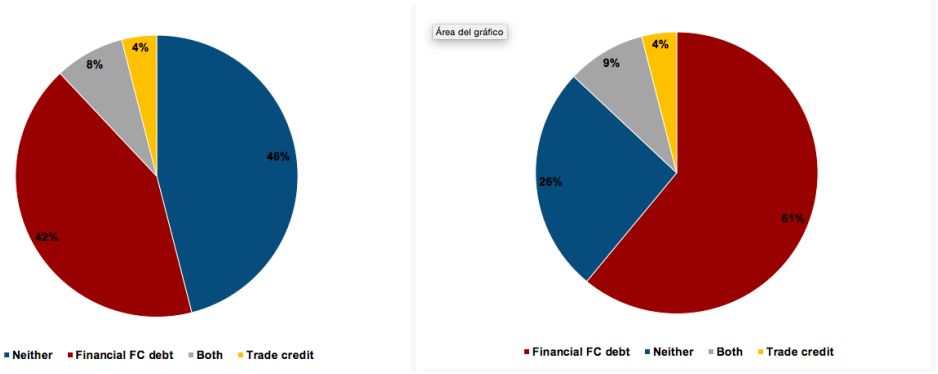
Total assets and liabilities

Year	Number of Firms	Number of Foreign Owned Firms	Number of Firms of a Tradable Sector	Assets in USD Millions (Median)	Liabilities in USD Millions (Median)
2005	19744	2063	5748	0.8	0.3
2006	23633	2506	6728	1.0	0.4
2007	21746	2488	6285	1.2	0.5
2008	22355	2652	6372	1.1	0.4
2009	24689	2925	6804	1.4	0.5
2010	23831	2659	6605	1.6	0.6
2011	27210	5485	7038	1.4	0.6
2012	25472	5109	6728	1.8	0.7
2013	26636	1691	6640	1.8	0.6

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Part 2: Decomposition of firms in the derivatives market with respect to their FC debt instruments

FC debt type and use of FC forwards (2005-2013)



(a) Long positions in the FC forward market (b) Short positions in the FC forward market

Source: Authors' estimations based on SS, DIAN-DANE, SFC and BdR.

Number of firms in the forwards market by types of FC debt

Year	Long Position	Short Position	Long Position & Financial	Long Position & Trade Credit	Short Position & Financial	Short Position & Trade Credit
2005	106	345	42	9	225	9
2006	146	424	48	8	210	28
2007	214	426	88	11	206	21
2008	291	397	139	8	176	35
2009	268	596	101	15	260	52
2010	323	789	133	13	500	39
2011	371	787	162	13	572	26
2012	245	805	99	4	558	16
2013	273	799	119	6	555	13

Part 3: Firms with FC debt vs Firms without FC debt

On average, firms without FC debt do not have FC assets, and their net forwards are equal to 0. As a share of total assets, the FC debt of indebted firms is on average 25 percent, FC assets are barely 1 percent and their balance sheet exposure is equivalent to 24 percent. On average, both types of firms import more than what they export[95].

FC indebted firms vs Non - FC indebted Firms (2005-2013)

	Non FC indebted Firms Averages	FC of indebted Firms Averages	Dif of (percentage points)	St Error (percentage points)	T Value	p Value
FC debt / liabilities	0%	28%	-28.1	1.0	-28.5	0.0000
FC debt / assets	0%	25%	-24.7	3.5	-7	0.0000
FC assets / assets	0%	1%	-0.7	0.1	-8.85	0.0000
Net Forwards / assets	0%	-1%	0.7	0.2	3.2	0.002
Balance Sheet Exposure / assets	0%	24%	-24.5	3.5	-6.95	0.0000
Net exports / assets	-2%	-2%	0.3	1.3	0.25	0.821
Total number of non-FC indebted firms' observations 189,744						
Total number of FC indebted firms' observations 25,227						
Two-sample t-test with equal variances						

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Part 4: Proxy for Balance Sheet Exposure

Balance sheet exposure is defined as the difference between FC liabilities, FC assets and net forwards. Net forwards is defined as the difference between long and short positions in the derivatives' market. Net exports are not included in the balance sheet exposure definition as they are not part of the balance sheet. Balance sheet exposure defined above is only a proxy because: i) The maturities between FC debt, FC assets and FC derivatives are not the same. ii) Data limitation do not allow to perfectly match the FC derivatives with the FC liabilities that they hedge.

Overall, aggregate FC liabilities grew faster than aggregate FC assets or income. Total FC debt of non-financial firms increased by 126 percent between 2005 and 2013, while total

[95]While on average firms exhibit larger imports than exports, on the aggregate level net exports are positive. This is due to one firm, Ecopetrol, the national oil company which accounts for a large share of all exports.

FC assets increase by 50 percent. The aggregate net forwards were negative along the whole period. As a result, aggregate balance sheet exposure increased by 139 percent. On the other hand, aggregate net exports (the economy's natural hedging) increased by 89 percent. When compared with the economy's macroeconomic aggregates, the aggregate behavior of the firms in this data-set is very similar.

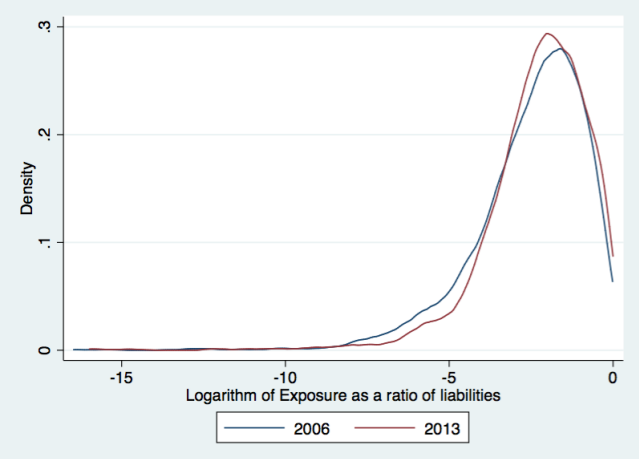
Aggregate Foreign Currency Balance-Sheet Exposure (in USD Millions)

Year	FC Debt (1)	FC Assets (2)	Net Forwards (3)	Balance Sheet Exposure (4) = (1)-(2)-(3)	Net Exports
2005	8617	2153	-915	7379	3276
2006	7538	2406	-488	5620	1796
2007	8917	1944	-360	7333	1188
2008	9077	752	-258	8583	1565
2009	11543	917	-544	11171	3522
2010	12696	776	-5954	17874	4994
2011	19905	1118	-1321	20108	9549
2012	18329	2265	-1918	17982	9337
2013	19508	3221	-1331	17618	6194

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Balance sheet exposure did not only grow in the aggregate but also as a share of firm level liabilities. As it is shown, the distribution shifted right between 2006 and 2013. More over, the median firm of 2013 presents a larger FC balance sheet exposure share than the median firm of 2006 (13 percent vs 12 percent).

FC Balance Sheet Exposure as a ratio of liabilities: 2006 vs 2013



FC Balance-Sheet Exposure = FC debt - FC assets - Net forwards.

Source: Authors' calculations based on BdR.

Part 5: Operational hedge - Robust to non-introduction of firm FE

Operational hedging (without fixed effects) (2005-2013): Correlations of

Panel a. Exports with

Variables (in logs)	(1) Imports	(2) Total FC debt	(3) Financial FC debt	(4) Trade credit	(5) Exposure
Exports	0.229***	0.323***	0.349***	0.051***	0.33***
	(0.006)	(0.007)	(0.008)	(0.011)	(0.007)
Observations	25,508	12,371	9,687	4,795	11,497
Firm FE	No	No	No	No	No
R-squared:	0.06	0.14	0.16	0.004	0.15

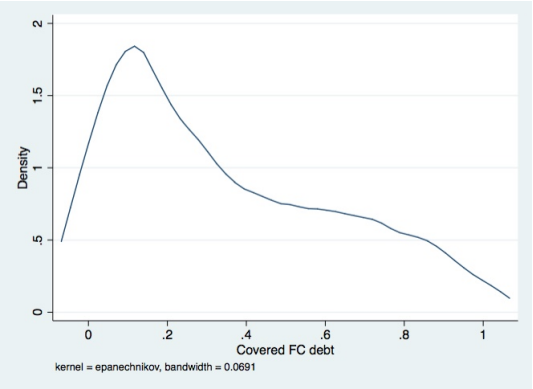
Panel b. Net exports with

Variables (in logs)	(1) Total FC debt	(2) Financial FC debt	(3) Trade credit	(4) Exposure
Net Exports	0.559***	0.589***	0.1***	0.583***
	(0.012)	(0.013)	(0.021)	(0.012)
Observations	5,577	4,891	1,540	4,844
Firm FE	No	No	No	No
R-squared:	0.28	0.3	0.02	0.32

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Part 6: Distribution of Covered FC debt

Share of Covered FC debt (2005-2013)

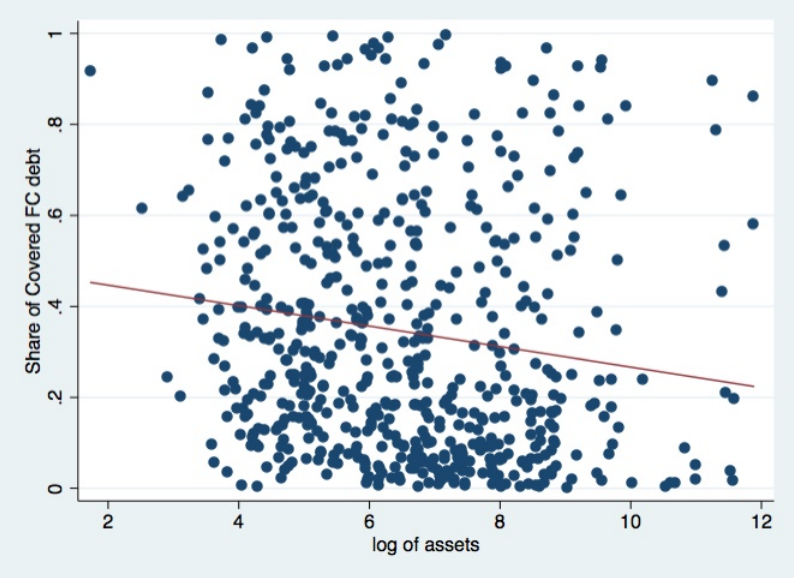


Covered FC debt = long position in the forward market/FC debt.

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

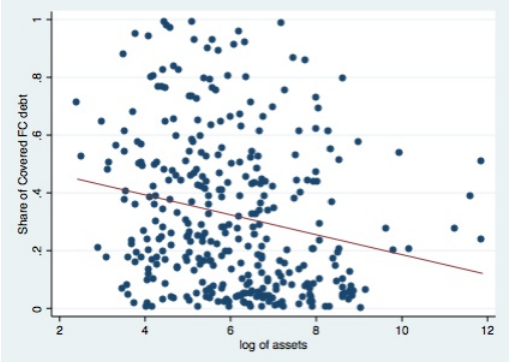
Part 7: Relationship between size, long positions in the Forward market and shares of covered FC debt - Robust to outliers and other robustness checks

Unconditional relationship between shares of covered FC debt and firm size (2005-2013) - intensive margin. $R^2 = 0.043, t - statistic = -4.03$.



Source: Authors' estimations based on SS, DIAN-DANE, SFC and BdR.

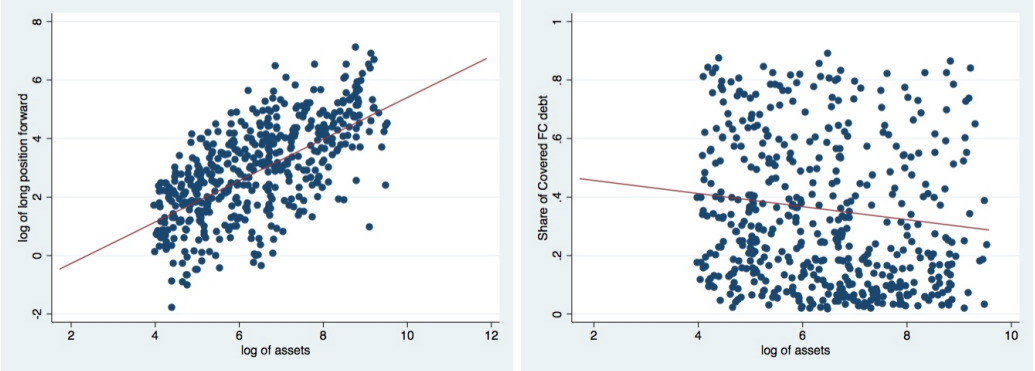
Relationship between shares of financial covered FC debt and firm size (2005-2013) - intensive margin. $R^2 = 0.02, t - statistic = -3.65$.



Source: Authors' estimations based on SS, DIAN-DANE, SFC and BdR.

Firms below the 5 percentile and above the 95 percentile in terms of size, amounts of FC forwads and shares of covered FC debt are not taken into consideration.

Firm size, FC debt type and use of FC forwards (2005-2013) - intensive margin



(a) Long positions in the FC forward market vs firm size (both in logs)

(b) Shares of covered FC debt vs firm size. $R^2 = 0.02, t - statistic = -3.31$.

Source: Authors' estimations based on SS, DIAN-DANE, SFC and BdR.

Part 8: Counterpart of intermediation - Importance of FDI

Between 2005 and 2013, the lion share of FC forward contracts was intermediated by banks[96] with foreign investors. Cardozo-Alvarado et al. (2014) show how 54 percent of trades were done between banks and offshore agents; 25 percent amongst banks; and only 15 percent between banks and local pension funds. This tell us that FC liquidity during this time span was closely tied to FDI flows and not so much to the pension funds operations (as it was the Chilean case: a much more liquid FC derivatives market).

[96]Local or foreign banks with registered operations in Colombia.

Annex C: A theoretical framework

Part 0: Glossary

- Firm i's parameters and variables:
  - Ψ_i: degree of risk aversion
  - z_i: productivity shifter ($z_i > 1$)
  - m_i: normalized firm size ($0 < m_i \leq 1$)
  - θ_i: domestic currency share of revenue
  - $1 - \theta_i$: FC share of revenue
  - γ_i: share of principal in domestic currency (domestic currency debt)
  - α_i: share of principal in uncovered FC (FC debt)
  - δ_i: share of principal in covered FC (FC forwards contracts)
- Macro variables:
  - K: fixed cost of covered FC (as share of principal)
  - ϵ: semi-elasticity of profits to covered FC debt/inverse of the market imperfections faced by the representative investor ($\epsilon > 1$)
  - R^l: domestic currency gross interest rate
  - R^{FC}: FC gross interest rate
  - s: spot exchange rate (equal to 1 in first period. Unknown in second period $s \sim \mathcal{N}(E[s], \sigma_s^2)$)
  - F: forward interest rate
- Short side of the market
  - Δ_i: FC procured in the short side of the forward market
  - B_i: Benefits of the representative investor from the intermediation of FC
  - I_t: intermediation technology for future FC
  - F_i: price charged to firm i by the representative investor from procuring Δ_i
  - $S(\Delta_i)$: search effort done by representative investor in the short side of the market to procure Δ_i
  - θ: normalizing constant
  - NA^{FC}: net FC assets of representative investor
  - ϕ: indicator function that takes the value of 1 if net FC assets are below a regulatory limit
  - $RegLim$: regulatory limit for net FC assets
  - P: penalty paid by the representative investor in case net FC assets are below a the regulatory limit

Part 1: Microfoundation for F_i^m

Part a: F_i as a power law

Lets explicitly assume that the search effort is inversely proportional to the probability density function of short positions, which in the data fits a power law: $S(\Delta_i) = \frac{1}{p(\Delta_i)}$ and the probability density function $p(\Delta_i) = k\Delta_i^{-(\beta+1)}$. Then the forward exchange rate charged to firm i will also follow a power law:

$$\rightarrow F_i = c(2+\beta)\Delta_i^{\beta+1}$$

$$\rightarrow \frac{dF_i}{d\Delta_i} = c(2+\beta)(1+\beta)\Delta_i^{\beta} > 0.$$

With k and c normalizing constants.

Part b: Intermediation cost as a function of search efforts and regulatory funding constraints

If we instead define I_i to include the provision of Δ_i through sales of the representative investor's most liquid FC assets we get:

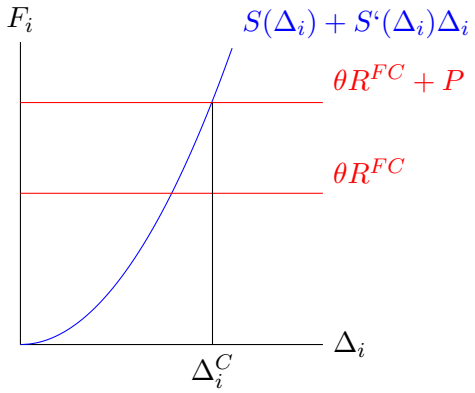
$$I_i = \Delta_i F_i - min[\Delta_i S(\Delta_i), \theta(R^{FC}(NA^{FC} - \Delta_i) - P\phi_{NA^{FC}-\Delta_i<RegLim})].$$

Where θ is a normalizing constant, NA^{FC} is the FC net assets of the representative investor, ϕ a indicator function that takes the value of 1 if the net FC assets are below a regulatory limit, $RegLim$ is the regulatory limit and P is a penalty paid if net FC assets are below the regulatory limit. In this case, I_i is the minimum between the cost of procuring Δ_i in the short side of the market and reducing the net FC asset position subject to the regulatory limit. The the pricing schedule is:

$$F_i = \begin{cases} min[S(\Delta_i) + S`(\Delta_i)\Delta_i, \theta R^{FC}] & if \quad NA^{FC} - \Delta_i \geq RegLim \\ min[S(\Delta_i) + S`(\Delta_i)\Delta_i, \theta R^{FC} + P] & if \quad NA^{FC} - \Delta_i < RegLim. \end{cases}$$

The following figure depicts the price schedule. In this case, F_i is not longer a monotonic and increasing function of size. Nevertheless, it shows that there is room for policy captured by parameters P and $RegLim$. The bigger P the larger the discontinuity in the pricing schedule. The smaller $RegLim$, the bigger the maximum FC Δ_i^c provided through the sales of FC assets at a constant price $F_i = \theta R^{FC}$: the larger the liquidity provided by the use of the representative investor's balance sheet.

This intermediation cost might also be able to rationalize a bunching behavior on either of the intersections of the blue line with the red lines. Nevertheless, this bunching does not seem to happen in practice given the conservative use of FC balance sheets exposures by banks. Apparently, the penalty paid is prohibitive in comparison to the gain of intermediation.



Part 2: ϵ Elasticity of substitution between debt types

First take the FOC of the expected profits of firm i with respect to each type of debt. Then equalize them and take the log:

$$\frac{dE_i[\pi_i]}{d\delta_i} = \frac{dE_i[\pi_i]}{d\alpha_i} \iff \epsilon R^{FC} F^{m_i} \delta_i^{\epsilon-1} = R^{FC} E_i[s]$$

$$\iff \delta_i^{\epsilon-1} = \frac{E_i[s]}{\epsilon F^{m_i}} \iff (\epsilon - 1) log(\delta_i) = log(\frac{E_i[s]}{F^{m_i}}) - log(\epsilon)$$

$$\iff \frac{dlog(\delta_i)}{dlog(\frac{E_i[s]}{F^{m_i}})} = \frac{1}{\epsilon - 1}$$

And analogously:

$$\frac{dlog(\delta_i)}{dlog(\frac{R^l}{R^{FC} F^{m_i}})} = \frac{1}{\epsilon - 1}.$$

Lets remember that the higher ϵ, the lower the market imperfections faced by the representative investor, the larger the covered FC debt market's liquidity. Then, for a 1 percent decrease in the relative cost of uncovered FC debt/local currency debt with respect to covered FC debt, and the larger the covered FC debt market's liquidity, the lower the percent decrease in covered FC debt. From the point of view of firm i's cost function, the larger the covered FC market's liquidity, the lower the increase in firm i's total cost per 1 p.p increase in covered FC debt. Therefore, the larger the liquidity, the more inelastic the demand of firm i for shares of covered FC debt, the lower the substitution between debt types.

Part 3: Derivation of first order conditions

First introduce principal constraint and then apply the expectation operator to utility function of firm i:

$$E_i[U(\pi_i)] = E_i[-e^{-\psi_i[z_i[\theta_i + (1-\theta_i)E_i[s]] - R^l(1-\alpha_i-\delta_i) - R^{FC}\alpha_i s - R^{FC}\delta_i^{\epsilon} F^{m_i} - \frac{K}{m_i}]}$$

$$= -e^{-\psi_i[z_i\theta_i - R^l(1-\alpha_i-\delta_i) - R^{FC}\delta_i^{\epsilon} F^{m_i} - \frac{K}{m_i}]}$$

$$.e^{-\psi_i E_i[s][z_i(1-\theta_i) - R^{FC}\alpha_i] + \frac{\psi_i^2}{2}\sigma_s^2[z_i(1-\theta_i) - R^{FC}\alpha_i]^2}.$$

Where I used the fact that s is a random variable derived from a normal distribution. If x is a random variable $x \sim \mathcal{N}(\mu_x, \sigma_x^2)$, then given a constant a: $E[e^{ax}] = e^{a\mu_x + \frac{1}{2}a^2\sigma_x^2}$.

Then take the FOC with respect to α_i and δ_i :

$$\frac{\partial E_i[U]}{\partial \alpha_i} = [-\psi_i R^l + \psi_i R^{FC} E_i[s] + \psi_i^2 \sigma_s^2 [z_i(1-\theta_i) - R^{FC}\alpha_i](-R^{FC})]$$

$$.E_i[-e^{-\psi_i \pi_i}] = 0$$

$$\frac{\partial E_i[U]}{\partial \delta_i} = [-\psi_i R^l + \epsilon \psi_i R^{FC} \delta_i^{\epsilon-1} F^{m_i}].E_i[-e^{-\psi_i \pi_i}] = 0$$

Then after some algebra you find:

$$\alpha_i^* = \frac{R^l - R^{FC} E_i[s]}{\Psi_i {R^{FC}}^2 \sigma_s^2} + \frac{z_i(1-\theta_i)}{R^{FC}}$$

$$\delta_i^* = \left(\frac{R^l}{\epsilon R^{FC} F^{m_i}}\right)^{\frac{1}{\epsilon-1}}$$

$$\gamma_i^* = 1 - \alpha_i^* - \delta_i^*$$

Part 4: Comparative Statics

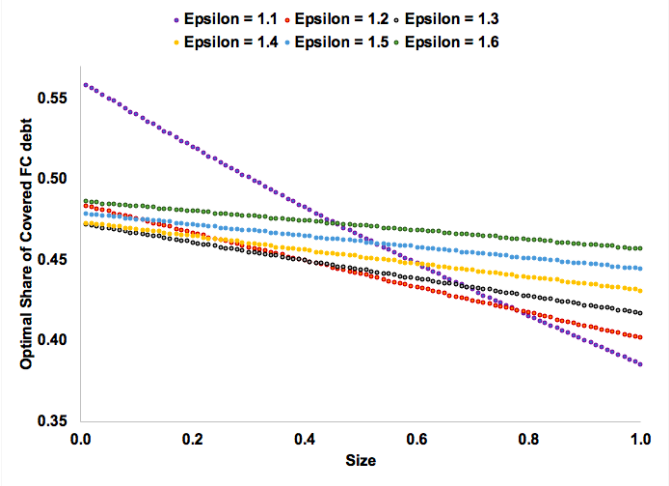
The derivatives of the optimal shares of covered FC debt with respect to the forward exchange rate, ϵ and size:

$\frac{d\delta_i^*}{dF} = (\frac{1-m_i}{\epsilon-1})(\frac{1}{\epsilon})^{\frac{1}{\epsilon-1}} F^{\frac{1-m_i}{\epsilon-1}-1} \geq 0$

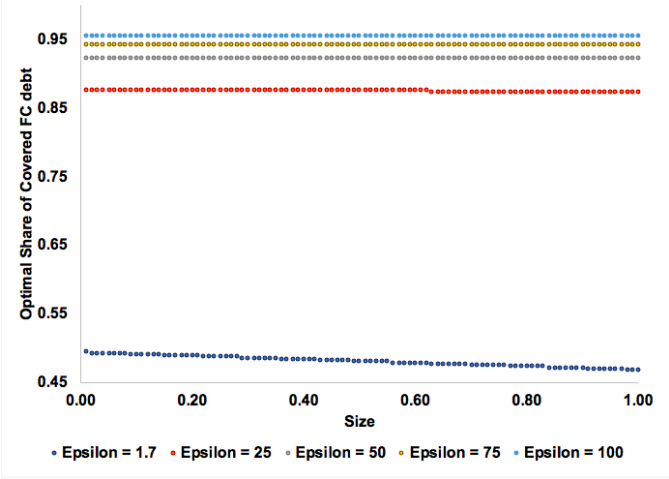
$\frac{d\delta_i^*}{d\epsilon} = \frac{-\left(\frac{1}{\epsilon}\right)^{\frac{1}{\epsilon-1}} (\epsilon(m_i-1)log(F) - \epsilon - \epsilon log(\frac{1}{\epsilon}) + 1) F^{\frac{1-m_i}{\epsilon-1}}}{(\epsilon-1)^2}$

$\frac{d\delta_i^*}{dm_i} = -\frac{(\frac{1}{\epsilon})^{\frac{1}{\epsilon-1}} log(F) F^{\frac{1-m_i}{\epsilon-1}}}{\epsilon-1} < 0$

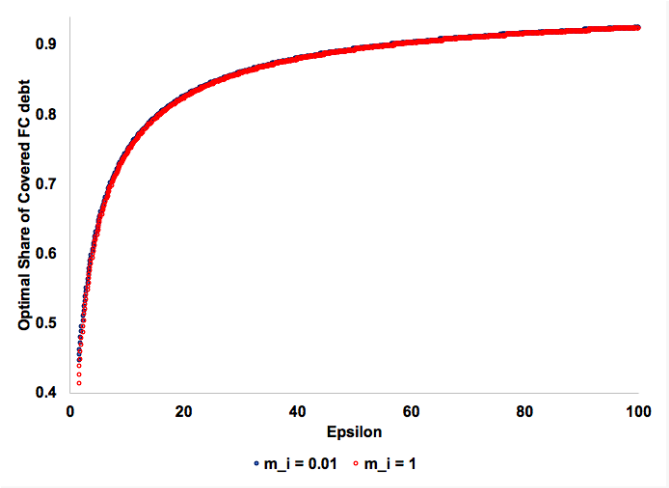
Part 4: Comparative Statics - Optimal Shares of Covered FC debt vs firm size and ϵ



(a) $\epsilon \leq 1.6$; $\frac{d\delta_i^*}{d\epsilon}$ ambiguous



(b) Arbitraty and big ϵ; $lim_{\epsilon \to \infty} \frac{d\delta_i^*}{dm_i} = 0$;



(c) $lim_{\epsilon \to \infty} \delta_i^* = 1$

Part 5: Marginal cost, optimal condition, arbitrage and equilibrium relationships

Part a: Equilibrium relationship between domestic currency and covered FC debt - A comment on the incentives to hedge

After taking the partial derivative of the total financial cost of firm i with respect to covered FC debt we get: $MC_i = \epsilon R^{FC} F^{m_i} \delta_i^{\epsilon-1}$.

If we evaluate the marginal cost of firm i in the optimal share of covered FC debt we get: $MC_i = \epsilon R^{FC} F^{m_i} \delta_i^{*\epsilon-1} \iff MC_i = \epsilon R^{FC} F^{m_i} \left(\frac{R^l}{\epsilon R^{FC} F^{m_i}}\right)^{\frac{\epsilon-1}{\epsilon-1}}$. Irrespective of size, firm i will choose δ_i^* such that $MC_i = R^l$.

In equilibrium, irrespective of size, for the marginal unit, firm i will be indifferent between domestic and covered FC debt. For a given liquidity of the covered FC debt market the representative investor will allocate the shares of covered FC debt such that in the margin firms are indifferent between domestic currency and covered FC debt irrespective of their size.

With respect to the incentive to hedge, we have that given the concavity of the marginal cost of covered FC debt (thanks to the ϵ), irrespective of firm size, for shares of covered FC debt below the optimal, the cost of the marginal unit of covered FC debt will always be below the cost of the marginal unit of domestic currency debt. For shares above the optimal share of covered FC debt, the marginal cost of covered FC debt is larger than the marginal cost of domestic currency debt. Therefore the firm will always have the incentive to increase the share of the principal allocated in covered FC debt until she reaches the optimal allocation.

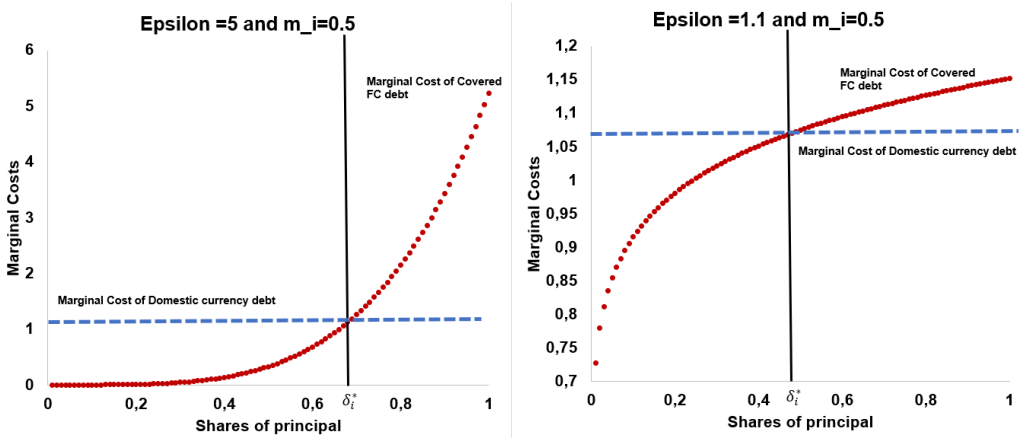
In figure A we show examples of the indifference points and marginal costs. Panel (a) shows an economy with a high liquidity ($\epsilon = 5$) in the covered FC debt market, while panel (b) depicts an economy with a low liquidity ($\epsilon = 1.1$). We do both examples for the median firm of the economy ($m_i = 0.5$). The red line is the marginal cost for covered FC debt while the blue line is the marginal cost for domestic currency debt. The black line shows the optimal share of the principal taken as covered FC debt. In both cases, for shares of covered FC debt below the optimal share, the marginal cost of covered FC debt is always below the marginal cost of domestic currency debt. After this critical point, the marginal cost of covered FC debt is above the marginal cost of domestic currency debt.

Part b: No arbitrage of covered FC debt between firms

Given that all firms irrespective of size face the same price for the marginal unit in equilibrium ($MC_i = R^l$) they do not have incentives to arbitrage in equilibrium.

Outside of equilibrium arbitrage is difficult because: i) The same share for firms of different size is not equivalent in levels; ii) Firms are constrained by their principal and aggregate liquidity (liquidity is not enough for all firms to use the whole principal as covered FC debt); iii) The shares arbitraged are not enough to fulfill the demand of the largest firm in levels; and iv) there is a search cost that is increasing in the size of the firm.

Figure A. Incentives to hedge and marginal costs



(a) High liquidity (b) Low liquidity

Part c: No arbitrage of uncovered FC debt between firms

The dimensions of heterogeneity of firms in this economy would imply a more complex search function in the spot market. It is a search function that not only needs to consider firm size but also other dimensions such as risk aversion and exchange rate expectations. Given this, the search cost for the same share of FC in the spot market would be even higher in comparison to the forward market.

Part 6: Special case when $\alpha_i^* > 0.5$, $\delta_i^* > 0.5$ and $\gamma_i^* = 0$

In the case for which firm characteristics make α_i^* from equation (5) and δ_i^* from equation (6) larger than 0.5, the firm will equate the marginal cost of each type of debt:

$$MC_i^{uncoveredFC} = R^{FC} E_i[s]$$
$$MC_i^{coveredFC} = \epsilon R^{FC} F^{m_i} \delta_i^{*\epsilon-1}$$
$$\rightarrow \epsilon R^{FC} F^{m_i} \delta_i^{*\epsilon-1} = R^{FC} E_i[s].$$

From this condition and the principal constraint we can find the optimal shares of covered and uncovered FC debt:

$$\delta_i^* = \left(\frac{E_i[s]}{\epsilon F^{m_i}} \right)^{\frac{1}{\epsilon-1}}$$

$$\alpha_i^* = 1 - \delta_i^*.$$

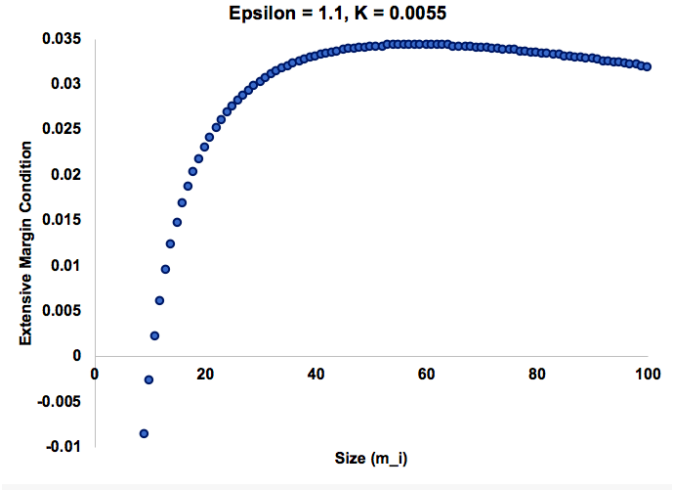
Firm i will choose the share of covered FC debt that in the margin makes her indifferent between both types of debt. In this case, the optimal share of covered FC debt will be a function of the aggregate liquidity and the ratio of her expectations about tomorrow's spot exchange rate and the idiosyncratic forward exchange rate charged by the representative investor. The remainder of the principal will be uncovered FC debt.

Part 7: Derivation of Extensive margin condition

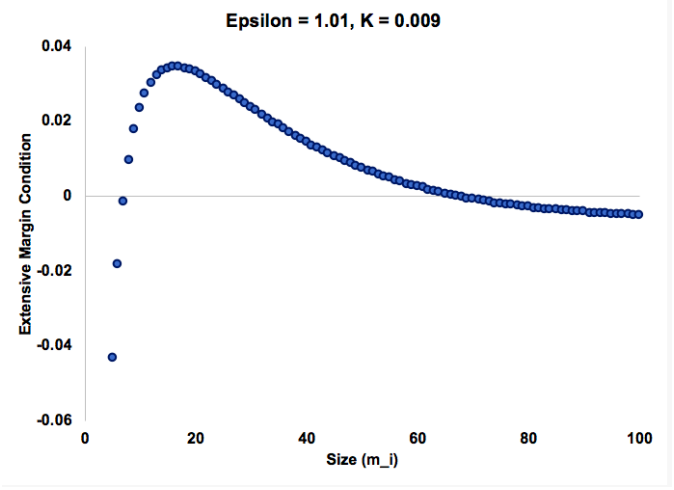
$$E_i[\pi_i|\alpha_i^*, \delta_i^*, \gamma_i^*] \geq E_i[\pi_i|\alpha_i^*, \gamma_i = 1 - \alpha_i^* = \gamma_i^* + \delta_i^*] \iff$$
$$z_i[\theta_i + (1-\theta_i)E_i[s]] - R^l \gamma_i^* - R^{FC} \alpha_i^* E_i[s] - R^{FC} \delta_i^{*\epsilon} F^{m_i} - \frac{K}{m_i} \geq$$
$$z_i[\theta_i + (1-\theta_i)E_i[s]] - R^l \gamma_i - R^{FC} \alpha_i^* E_i[s] \iff$$
$$-R^l \gamma_i^* - R^{FC} \delta_i^{*\epsilon} F^{m_i} - \frac{K}{m_i} \geq -R^l \gamma_i$$
$$-R^{FC} \delta_i^{*\epsilon} F^{m_i} - \frac{K}{m_i} \geq -R^l \delta_i^* \iff$$
$$R^l \delta_i^* - [R^{FC} \delta_i^{*\epsilon} F^{m_i} + \frac{K}{m_i}] \geq 0$$

Part 8: Extensive margin condition of Covered FC debt shares

Entry condition, concave and non-monotonic in firm size: Example with enough liquidity for big firms to enter covered FC debt market



Entry condition, concave and non-monotonic in firm size: Example with not enough liquidity for big firms to enter covered FC debt market



Annex D: Econometric Robustness checks - Drivers of FC debt

Annex D, Part 0 - Changes in the Reserve Requirements coefficients by banks' liability type

Reserve Requirement Coefficient (RRC)

	Dec 2000	May 2007	May 2007	June 2007	June 2007	June 2008	October 2008
	RRC	Marginal RRC	RRC	Marginal RRC	RRC	Marginal RRC	RRC
Checking Account Deposits	13	13	27	8.3	27	11.5	11
Fiduciary liabilities	13	13	27	8.3	27	11.5	11
Bank acceptances after deadline	13	13	27	8.3	27	11.5	11
Fixed term certificate of deposit (less of six months to 18 months)	2.5	2.5	5	2.5	5	6	4.5
Fixed term certificate of deposit (more than 18 months)	0	0	0	0	0	0	0
Investment mortgage certificates (less of six months to 18 months)	2.5	2.5	5	2.5	5		
Investment mortgage certificates (more than 18 months)	0	0	0	0	0		
Saving accounts	6	6	12.5	8.3	27	11.5	11
Bonds (less of six months to 18 months)	2.5	2.5	5	2.5	5	6	4.5
Bonds (more than 18 months)	0	0	0	0	0	0	0
Negotiated portfolio repurchase commitments	0	0	0	0	0		
Requirements for repurchase commitments (with non financial entities)	6	6	12.5	8.3	27	11.5	11
Requirements for repurchase commitments (with financial entities)	0	0	0	0	0	0	0

Source: Authors' summary based on BdR.

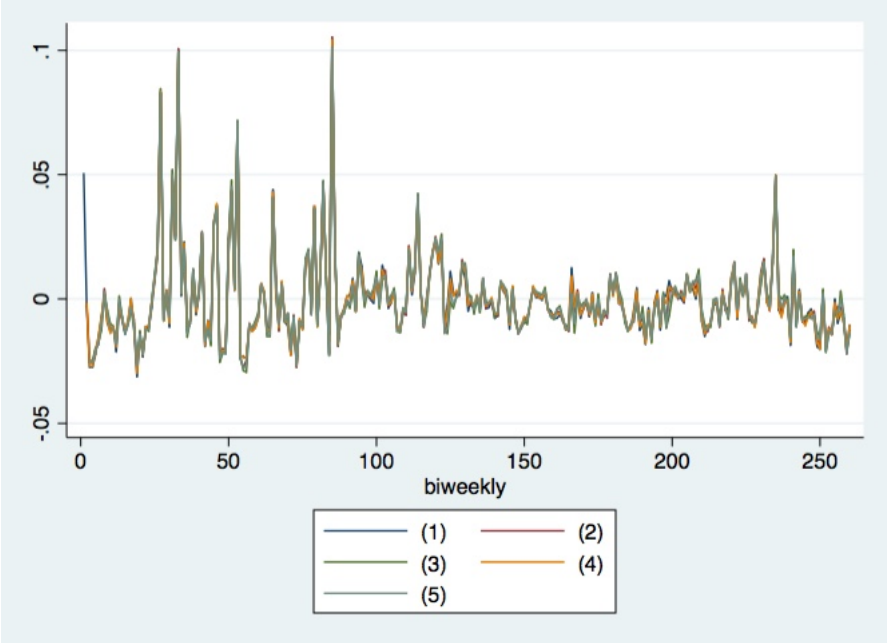
Annex D, Part 1 - IV filtered by shifts in risk perception

Excess Reserves filtered by Colombian EMBI and VIX

Variables	(1)	(2)	(3)	(4)	(5)
	Excess Reserves	Excess Reserves	Excess Reserves	Excess Reserves	Excess Reserves
$log(embi_t)$	0.031***			0.038	
	(0.007)			(0.034)	
$log(Vix_t)$	-0.059***			-0.044	
	(0.006)			(0.027)	
$log(embi_{t-1})$		0.029***		-0.007	0.025
		(0.006)		(0.034)	(0.034)
$log(Vix_{t-1})$		-0.057***		-0.015	-0.031
		(0.007)		0.026	0.027
$log(embi_{t-2})$			0.03***		0.005
			(0.006)		(0.034)
$log(Vix_{t-2})$			-0.057***		-0.027
			(0.007)		(0.027)
Constant	0.034**	0.036**	0.034**	0.038**	0.036**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Observations	260	259	258	259	258
R-squared	0.23	0.22	0.22	0.23	0.22

Robust Standard error in parenthesis *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' calculations based on BdR and FRED.

Excess Reserves Filterd by Vix and Colombian EMBI



Source: Authors' calculations based on BdR and FRED.

First Stage - Tobit with filtered Excess Reserves

	(1)	(2)	(3)
Variables	Total FC debt	Financial FC debt	Trade Credit
Size	0.052***	0.06***	0.026***
	(0.0007)	(0.0007)	(0.0008)
Leverage	0.208***	0.219***	0.092***
	(0.006)	(0.007)	(0.008)
FC Assets	0.012***	0.012***	0.008
	(0.004)	(0.004)	(0.005)
Exports	0.022***	0.025***	0.006***
	(0.002)	(0.017)	(0.002)
Exports*Excess Reserves	9.348***	10.667***	2.174**
	(0.74)	(0.75)	(1.007)
Tradable	0.055***	0.079***	0.005*
	(0.0021)	(0.022)	(0.002)
Foreign	0.098***	0.044***	0.146***
	(0.0025)	(0.003)	(0.003)
Other firm controls	YES	YES	YES
Year Fixed Effects	YES	YES	YES
Partial F-Statistic	29.9	41	16.7
Observations	163,927	163,927	163,927

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex D, Part 2 - First Stage with FXI as a driver for FC debt

First stage with FXI as driver for FC debt

Variables	(1) Total FC Debt	(2) Financial FC Debt	(3) Trade Credit
Size	0.07***	0.095***	0.048***
	(0.004)	(0.004)	(0.005)
Leverage	0.21***	0.221***	0.09***
	(0.024)	(0.028)	(0.017)
FC Assets	0.018***	0.018***	0.01**
	(0.136)	(0.006)	(0.005)
Exports	-0.387***	-0.466***	-0.147***
	(0.102)	(0.104)	(0.047)
Foreign	0.136***	-0.023	0.17***
	(0.018)	(0.02)	(0.002)
FXI Purchases	0.271	0.705	0.098
	(0.675)	(0.712)	(0.95)
FXI Sales	0.548	7.75	-18.7***
	(4.92)	(5.47)	(6.48)
Excess Reserves	-1.93***	-3.33***	-0.753
	(0.74)	(0.76)	(0.881)
Exports*Excess Reserves	5.8***	13.34***	1.91***
	(1.47)	(1.93)	(0.504)
Observations	146,954	146,954	146,954
Other firm controls:	Yes	Yes	Yes
Other macro controls:	Yes	Yes	Yes
Other firm-macro interactions:	Yes	Yes	Yes
Partial F-statistic	24.2	24.82	15.35

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

First stage with FXI as driver for FC debt without IV

Variables	(1) Total FC Debt	(2) Financial FC Debt	(3) Trade Credit
Size	1.326**	1.975**	0.298***
	(0.601)	(0.914)	(0.0742)
Leverage	2.664**	3.317**	0.449***
	(1.182)	(1.528)	(0.135)
FC Assets	0.264*	0.306*	0.0626**
	(0.136)	(0.160)	(0.0304)
Net Forwards	-0.880	-0.866	-0.726***
	(0.565)	(0.635)	(0.254)
Exports	-0.156	0.396	-0.130
	(0.370)	(0.421)	(0.279)
Foreign	1.873**	-0.304	0.693***
	(0.809)	(0.437)	(0.256)
FXI Purchases	2.745	6.896*	-0.975
	(2.382)	(4.140)	(0.917)
FXI Sales	-158.0**	-121.8*	-125.0***
	(72.77)	(64.84)	(34.97)
E[Spread]	-0.082	-0.0806	-0.0197
	(0.0636)	(0.0718)	(0.0244)
E[Spread]*Size	0.0190	0.0225	0.0010
	(0.0190)	(0.0225)	(0.00491)
E[Spread]*Foreign	-0.0567	-0.0492	-0.0141
	(0.0609)	(0.0685)	(0.0203)
E[Spread]*Exports	-0.0104	0.0402	-0.0106
	(0.0374)	(0.0441)	(0.0255)
Constant	-9.126**	-15.42**	-0.137
	(4.303)	(7.237)	(0.463)
Observations	146,758	146,758	146,758
Other firm controls:	Yes	Yes	Yes
Other macro controls:	Yes	Yes	Yes
Other firm-macro interactions:	Yes	Yes	Yes

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex D, Part 3 - Pooled Logit - FC indebtedness (Average Marginal Effects evaluated in the variables' averages)

The probability to have FC debt - Pooled Logit

Variables	(1) Total FC Debt	(2) Financial FC Debt	(3) Trade Credit	(4) Total FC Debt	(5) Financial FC Debt	(6) Trade Credit
Size	0.0416***	0.0331***	0.00986***	0.0617***	0.0570*	0.0162***
	(0.000451)	(0.000351)	(0.000216)	(0.00290)	(0.00262)	(0.00151)
Leverage	0.137***	0.105***	0.0299***	0.145***	0.111***	0.0305***
	(0.0062)	(0.00488)	(0.00375)	(0.00653)	(0.00554)	(0.00417)
FC Assets	0.0111	0.00759	0.00210	0.218***	0.130**	0.00329
	(0.0184)	(0.00998)	(0.00130)	(0.0543)	(0.0593)	(0.00205)
Net Forwards	-0.0857*	-0.0561**	-0.0324***	-0.0948*	-0.103	-0.0360***
	(0.0449)	(0.0248)	(0.0109)	(0.0563)	(0.0690)	(0.0127)
Exports	0.00540	0.000662	0.000147*	0.00680	-0.0469	-0.00396
	(0.0520)	(0.00128)	(8.47e-05)	(0.0609)	(0.163)	(0.0152)
Tradable	0.0504***	0.0475***	0.00637***	0.0502***	0.0429***	0.00603***
	(0.00447)	(0.00108)	(0.000825)	(0.00469)	(0.00859)	0.000890
Foreign	0.0513***	0.00933***	0.0408***	0.0811***	-0.0256	0.0403***
	(0.00290)	(0.00151)	(0.000939)	(0.0126)	(0.0187)	(0.00649)
E[RER depreciation]				-0.00746	0.0112	-0.0268***
				(0.0105)	(0.00918)	(0.00535)
E[Spread]				0.000565	-0.000583	0.00258**
				(0.00229)	(0.00340)	(0.00117)
E[Spread] * Size				1.44e-05	-3.14e-05	1.48e-05
				(0.000481)	(0.000428)	(0.000247)
E[Spread] * Foreign				-0.000530	-0.000797	0.000187
				(0.00243)	(0.00226)	(0.00101)
E[Spread] * Exports				0.0190	0.0259	-0.000319
				(0.0441)	(0.0399)	(0.00139)
Other firm controls	YES	YES	YES	YES	YES	YES
Other macro controls	NO	NO	NO	YES	YES	YES
Other macro-firm interactions	NO	NO	NO	YES	YES	YES
Year Fixed-effects	YES	YES	YES	NO	NO	NO
Observations	163,927	163,927	163,927	146,954	146,954	146,954

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex D, Part 4 - Random Effects Logit - FC indebtedness (Average Marginal Effects evaluated in the variables' averages)

The Probability of issuing FC debt: Random Effects Logit

VARIABLES	(1) Total FC Debt	(2) Financial FC Debt	(3) Trade Credit	(4) Total FC Debt	(5) Financial FC Debt	(6) Trade Credit
Size	0.00303***	0.00201***	9.00e-05***	0.0617***	0.00746***	0.0162***
	(0.000126)	(8.66e-05)	(5.67e-06)	(0.00421)	(0.000438)	(0.00132)
Leverage	0.00438***	0.00319***	0.000117***	0.145***	0.00898***	0.0305***
	(0.000401)	(0.000277)	(2.64e-05)	(0.0145)	(0.00143)	(0.00599)
FC Assets	2.95e-05	3.09e-05	1.89e-05	0.218**	0.0590***	0.00329*
	(0.000115)	(7.54e-05)	(1.27e-05)	(0.100)	(0.0151)	(0.00186)
Net Forwards	-0.00185***	-0.00121***	-9.81e-05**	-0.0948*	-0.00294*	-0.0360***
	(0.000428)	(0.000291)	(4.17e-05)	(0.0543)	(0.00158)	(0.0107)
Exports	4.57e-05***	2.76e-05***	7.90e-07	0.00680	0.00565	-0.00396
	(1.13e-05)	(7.30e-06)	(8.50e-07)	(0.226)	(0.00953)	(0.0102)
Cash Flow	-4.64e-07	-2.93e-07	-1.22e-08	-5.30e-06***	-8.52e-07***	-1.09e-06*
	(1.31e-06)	(1.35e-06)	(7.01e-08)	(1.51e-06)	(8.98e-08)	(5.71e-07)
Tradable	0.00359***	0.00301***	5.71e-05***	0.0556***	0.00727***	0.00626***
	(0.000297)	(0.000228)	(1.45e-05)	(0.00688)	(0.000550)	(0.00132)
Foreign	0.00367***	0.000754***	0.000509***	0.106***	0.00298	0.0630***
	(0.000404)	(0.000158)	(5.26e-05)	(0.0285)	(0.00240)	(0.0139)
Trade Openness				-0.0358	0.00496	-0.164***
				(0.0525)	(0.00530)	(0.0195)
Financial Openness				0.00108	0.000296	0.00332
				(0.0111)	(0.00115)	(0.00386)
Private Credit				0.252***	0.0460***	-0.0647***
				(0.0284)	(0.00349)	(0.0113)
E[RER Depreciation]	-			-0.00746	0.000986	-0.0268***
				(0.00794)	(0.000800)	(0.00290)
E[Spread]				0.000565	-7.68e-05	0.00258***
				(0.00157)	(0.000133)	(0.000429)
E[Spread] * Size				1.44e-05	4.54e-05*	1.48e-05
				(0.000376)	(2.75e-05)	(9.88e-05)
E[Spread] * Foreign				-0.000530	-0.000142	0.000187
				(0.00216)	(0.000113)	(0.000385)
E[Spread]* Exports				0.0190	-0.000138	-0.000319
				(0.0510)	(0.000436)	(0.000930)
Private Credit * Size				-0.0421***	-0.00600***	-0.0145***
				(0.00901)	(0.000750)	(0.00286)
Private Credit * Foreign				-0.0654*	-0.00113	0.000167
				(0.0352)	(0.00315)	(0.0119)
Private Credit * Exports				-0.0200	-0.0126	0.0102
				(0.636)	(0.0222)	(0.0253)
Year Fixed Effects	YES	YES	YES	NO	NO	NO
Observations	163,927	163,927	163,927	146,954	146,954	146,954
Number of Firms	32,907	32,097	32,097	31,907	31,907	31,907

Robust Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex D, Part 5: Fixed Effects Logit - FC indebtedness

The probability to have FC debt - Fixed Effects Logit

Variables	(1) Total FC Debt	(2) Financial FC Debt	(3) Trade Credit	(4) Total FC Debt	(5) Financial FC Debt	(6) Trade Credit
Size	1.142***	1.130***	0.693***	1.340***	1.753***	0.221
	(0.0480)	(0.0535)	(0.0778)	(0.0878)	(0.0951)	(0.145)
Leverage	0.766***	0.901***	0.384	0.682***	0.953***	0.321
	(0.184)	(0.198)	(0.309)	(0.203)	(0.219)	(0.347)
FC Assets	-0.00336	0.000144	1.237**	0.0659	0.0636	0.892
	(0.0422)	(0.0425)	(0.616)	(0.0914)	(0.0892)	(0.751)
Net Forwards	-0.554***	-0.579***	-0.556	-0.525***	-0.653***	-0.431
	(0.152)	(0.161)	(0.347)	(0.166)	(0.179)	(0.390)
Exports	0.108	0.102	0.137	1.998***	3.606***	-0.942
	(0.0755)	(0.0722)	(0.219)	(0.406)	(0.462)	(0.655)
Foreign	-0.0840	-0.0886	-0.148	1.936***	0.205	0.814*
	(0.106)	(0.109)	(0.182)	(0.301)	(0.328)	(0.485)
E[RER Depreciation]				-0.362*	0.304	-2.820***
				(0.193)	(0.212)	(0.317)
E[Spread]				-0.0441	-0.0753	0.234***
				(0.0445)	(0.0462)	(0.0834)
E[Spread] * Size				0.0190**	0.0195**	-0.00344
				(0.00956)	(0.00975)	(0.0169)
E[Spread] * Foreign				-0.0653*	-0.0839**	0.0658
				(0.0342)	(0.0355)	(0.0606)
E[Spread]* Exports				0.121**	0.212***	0.000444
				(0.0599)	(0.0574)	(0.103)
Observations	28,404	25,942	9,776	23,942	22,100	7,927
Number of Firms	4,298	3,919	1,455	3,998	3,687	1,307
Other firm level and macro controls:	NO	NO	NO	YES	YES	YES
Other firm level and Year Fixed Effects:	YES	YES	YES	NO	NO	NO

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex D, Part 6: FC indebtedness without excess reserves as a driver

The drivers of FC debt shares - Tobit

Variables	(1) Total FC Debt	(2) Financial FC Debt	(3) Trade Credit
Size	1.323**	1.966**	0.297***
	(0.599)	(0.910)	(0.0735)
Leverage	2.667**	3.318**	0.452***
	(1.183)	(1.528)	(0.136)
FC Assets	0.263*	0.305*	0.0618**
	(0.135)	(0.160)	(0.0303)
Net Forwards	-0.879	-0.865	-0.727***
	(0.564)	(0.635)	(0.254)
Exports	-0.214	0.363	-0.173
	(0.381)	(0.412)	(0.255)
Tradable	1.066**	1.576**	0.0692**
	(0.437)	(0.710)	(0.0329)
Foreign	1.931**	-0.261	0.796***
	(0.831)	(0.426)	(0.273)
E[RER Depreciation]	-0.149	0.502	-0.487***
	(0.233)	(0.387)	(0.166)
E[Spread]	-0.0244	-0.0618	0.0381*
	(0.0488)	(0.0668)	(0.0217)
E[Spread]*Size	0.0191	0.0224	0.00115
	(0.0183)	(0.0212)	(0.00464)
E[Spread]*Foreign	-0.0537	-0.0473	-0.00753
	(0.0597)	(0.0677)	(0.0190)
E[Spread]*Exports	-0.0157	0.0371	-0.0146
	(0.0381)	(0.0433)	(0.0233)
Constant	-12.19**	-19.47**	-1.606***
	(5.554)	(8.989)	(0.414)
Other firm controls	YES	YES	YES
Other macro controls	YES	YES	YES
Other macro-firm interactions	YES	YES	YES
Observations	146,758	146,758	146,758

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex D, Part 7: FC debt drivers excluding the oil and mining sectors

The drivers of FC debt - Tobit excluding oil and mining sectors

Variables	(1) Total FC Debt	(2) Financial FC Debt	(3) Trade Credit
Size	1.347**	2.001**	0.301***
	(0.616)	(0.937)	(0.0744)
Leverage	2.558**	3.202**	0.435***
	(1.151)	(1.497)	(0.131)
FC Assets	0.250*	0.293*	0.0534**
	(0.128)	(0.153)	(0.0302)
Net Forwards	-0.992*	-0.983	-0.736***
	(0.596)	(0.666)	(0.253)
Exports	-0.153	0.848	-0.207
	(0.512)	(0.712)	(0.260)
Foreign	2.228**	0.0443	0.863***
	(0.984)	(0.372)	(0.289)
E[RER Depreciation]	-0.175	0.478	-0.497***
	(0.239)	(0.376)	(0.169)
E[Spread]	-0.0298	-0.0714	0.0399*
	(0.0506)	(0.0705)	(0.0224)
E[Spread]*Size	0.0195	0.0233	0.00751
	(0.0188)	(0.0219)	(0.00474)
E[Spread]*Foreign	-0.0679	-0.0649	-0.0116
	(0.0646)	(0.0738)	(0.0195)
E[Spread]*Exports	0.150	0.257	0.00789
	(0.116)	(0.161)	(0.0290)
Constant	-12.21**	-19.60**	-1.590***
	(5.644)	(9.186)	(0.412)
Observations	144,337	144,337	144,337
Other firm controls	YES	YES	YES
Other macro controls	YES	YES	YES
Other macro-firm interactions	YES	YES	YES
Observations	146,758	146,758	146,758

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex D, Part 8: First stage with year fixed effects and constant share of exports (first observation per firm)

First Stage - Tobit

	(1)	(2)	(3)
Variables	Total FC debt	Financial FC debt	Trade Credit
Size	0.053***	0.06***	0.027***
	(0.0007)	(0.0007)	(0.0008)
Leverage	0.147***	0.148***	0.064***
	(0.001)	(0.001)	(0.006)
FC Assets	0.011	0.012***	0.007
	(0.004)	(0.004)	(0.005)
Exports	0.16***	0.168***	0.05***
	(0.009)	(0.011)	(0.012)
Exports*Excess Reserves	1.36**	1.9***	0.069
	(0.52)	(0.53)	(0.75)
Tradable	0.059***	0.084***	0.005*
	(0.0021)	(0.022)	(0.003)
Foreign	0.099***	0.045***	0.146***
	(0.0025)	(0.003)	(0.003)
Other firm controls	YES	YES	YES
Year Fixed Effects	YES	YES	YES
Partial F-Statistic	20	22.8	9.28
Observations	163,927	163,927	163,927

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex E: Complete Results First Stage

VARIABLES	(1) Total FC Debt	(2) Financial FC Debt	(3) Trade Credit
Size	0.0701***	0.0955***	0.0473***
	(0.00409)	(0.00436)	(0.00530)
Leverage	0.210***	0.221***	0.0897***
	(0.0245)	(0.0275)	(0.0165)
FC Assets	0.0178***	0.0175***	0.0105**
	(0.00587)	(0.00561)	(0.00449)
Exports	-0.387***	-0.466***	-0.147***
	(0.103)	(0.104)	(0.0468)
Cash Flow	-7.29e-06***	-9.61e-06***	-3.17e-06**
	(1.39e-06)	(1.27e-06)	(1.29e-06)
Tradable	0.0481***	0.0708***	0.00154
	(0.00245)	(0.00262)	(0.00273)
Foreign	0.136***	-0.0238	0.168***
	(0.0185)	(0.0204)	(0.0226)
Excess Reserves	-1.747***	-1.896***	-3.400***
	(0.279)	(0.300)	(0.394)
Trade Openness	0.374***	0.451***	0.299**
	(0.110)	(0.121)	(0.142)
Financial Openness	0.0601**	0.0464	0.0747**
	(0.0256)	(0.0287)	(0.0313)
Private Credit	0.137***	0.481***	-0.401***
	(0.0438)	(0.0471)	(0.0628)
E[RER Depreciation]	-0.000233	0.0410**	-0.0791***
	(0.0143)	(0.0162)	(0.0175)
Exports*Excess Reserves	5.806***	13.34***	1.902***
	(1.470)	(1.929)	(0.500)
E[Spread]	-0.00134	-0.00428	0.00196
	(0.00284)	(0.00298)	(0.00401)
E[Spread]*Size	0.000181	0.000341	-2.76e-05
	(0.000614)	(0.000632)	(0.000855)
E[Spread]*Foreign	-0.00164	-0.000871	-0.00147
	(0.00257)	(0.00274)	(0.00336)
E[Spread]*Exports	-0.0298***	-0.0103	-0.0117***
	(0.00910)	(0.00959)	(0.00405)
Private Credit*Size	-0.0410***	-0.0789***	-0.0489***
	(0.00956)	(0.00993)	(0.0129)
Private Credit*Foreign	-0.0808*	0.143***	-0.0505
	(0.0419)	(0.0456)	(0.0532)
Private Credit*Exports	0.922***	0.914***	0.353***
	(0.251)	(0.241)	(0.114)
Constant	-0.747***	-0.993***	-0.466***
	(0.0479)	(0.0543)	(0.0595)
Observations	146,954	146,954	146,954

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F: Econometric Robusness checks - Drivers of FC Forwards

Annex F, Part 1: Firm level variables, year FE and squared FC debt

Second Stage - Tobit - Long positions

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Long position	Long position	Long position	Long position	Long position	Long position
Size	0.282***	0.274***	0.259***	0.259***	0.277***	0.239***
	(0.0130)	(0.0126)	(0.0101)	(0.0168)	(0.0144)	(0.0116)
Leverage	0.359***	0.328***	0.272***	0.295***	0.332***	0.229**
	(0.0887)	(0.0888)	(0.0887)	(0.0941)	(0.0842)	(0.0912)
FC Assets	0.0459**	0.0440**	0.0425**	0.0497**	0.0434**	0.0450**
	(0.0220)	(0.0213)	(0.0206)	(0.0250)	(0.0211)	(0.0220)
Exports	0.00640*	0.00640*	0.00637*	0.00641*	0.00640*	0.00638*
	(0.00361)	(0.00360)	(0.00360)	(0.00360)	(0.00360)	(0.00358)
Foreign	0.598***	0.516***	0.733***	0.551***	0.519***	0.591***
	(0.0426)	(0.0373)	(0.0552)	(0.0486)	(0.0381)	(0.0704)
Total FC Debt (IV)	-5.143***			-1.325		
	(0.772)			(2.028)		
Financial FC Debt (IV)		-4.744***			-5.165***	
		(0.773)			(1.272)	
Trade Credit (IV)			-18.66***			3.904
			(2.635)			(7.727)
Squared Total FC Debt (IV)				-16.72**		
				(8.311)		
Squared Financial FC Debt (IV)					1.943	
					(4.036)	
Squared Trade Credit (IV)						-394.9***
						(133.6)
Constant	-4.444***	-4.410***	-4.417***	-4.392***	-4.416***	-4.374***
	(0.134)	(0.132)	(0.133)	(0.135)	(0.134)	(0.133)
Observations	130,378	130,378	130,378	130,378	130,378	130,378
Year Fixed Effects and other firm level controls:	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Second Stage - Tobit - Short positions

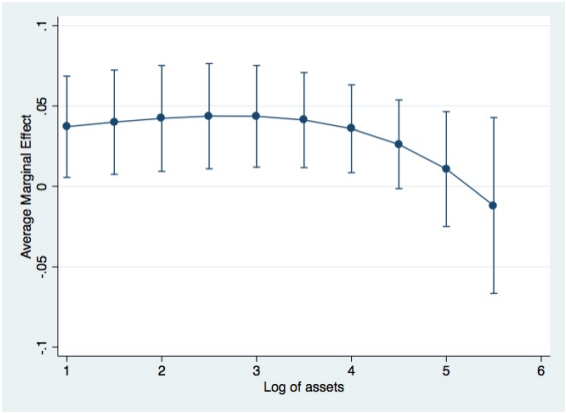
Variables	(1) Short position	(2) Short position	(3) Short position	(4) Short position	(5) Short position	(6) Short position
Size	0.144***	0.146***	0.123***	0.137***	0.143***	0.120***
	(0.00378)	(0.00382)	(0.00289)	(0.00439)	(0.00437)	(0.00314)
Leverage	0.122***	0.120***	0.0582***	0.103***	0.113***	0.0520**
	(0.0208)	(0.0206)	(0.0208)	(0.0223)	(0.0216)	(0.0212)
FC Assets	-0.00409	-0.00549	-0.00631	-0.00571	-0.00596	-0.00767
	(0.0169)	(0.0194)	(0.0163)	(0.0199)	(0.0204)	(0.0206)
Exports	1.16e-05	7.47e-06	-4.74e-05	1.78e-05	1.04e-05	-4.46e-05
	(0.000275)	(0.000276)	(0.000271)	(0.000273)	(0.000275)	(0.000270)
Foreign	0.0642***	0.0240***	0.0751***	0.0507***	0.0215***	0.0561***
	(0.00898)	(0.00785)	(0.0119)	(0.00998)	(0.00805)	(0.0148)
Total FC Debt (IV)	-2.925***			-1.709***		
	(0.212)			(0.501)		
Financial FC Debt (IV)		-3.220***			-2.698***	
		(0.217)			(0.476)	
Trade Credit (IV)			-5.881***			-2.663
			(0.689)			(1.701)
Squared Total FC Debt (IV)				-5.720***		
				(2.217)		
Squared Financial FC Debt (IV)					-2.710	
					(2.233)	
Squared Trade Credit (IV)						-57.71**
						(27.32)
Constant	-1.318***	-1.322***	-1.259***	-1.303***	-1.315***	-1.253***
	(0.0275)	(0.0276)	(0.0258)	(0.0274)	(0.0278)	(0.0257)
Observations	130,378	130,378	130,378	130,378	130,378	130,378
Year Fixed Effects and other firm level controls:	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$

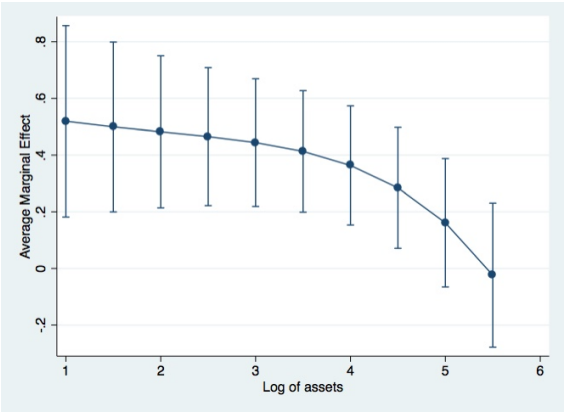
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F, Part 2: AME of FC debt on FC forwards long positions for different firm size - Without outliers in terms of size (below the 5th percentile and above the 95th percentile)

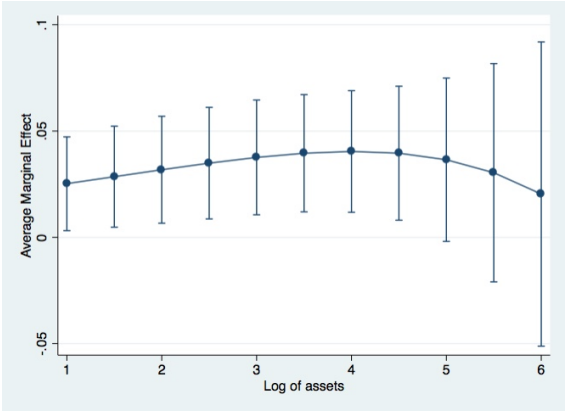
AME of FC debt on FC forwards long positions for different firm size



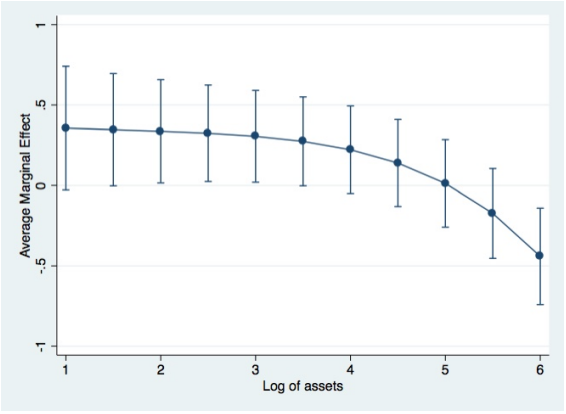
(a) Financial FC debt with macro controls and firm-macro interactions



(b) Trade credit with macro controls and firm-macro interactions



(c) Financial FC debt with year FE



(d) Trade credit with year FE

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F, Part 3: Latent model with firm level characteristics, interaction of FC debt and firm size, and year fixed effects

Second Stage - Tobit - Long positions

	(1)	(2)	(3)
Variables	Long Position	Long Position	Long Position
Size	0.246***	0.229***	0.26***
	(0.15)	(0.012)	(0.012)
Total FC debt	8.61***		
	(3.25)		
Financial FC debt		6.9***	
		(2.06)	
Trade Credit			-4.374
			(3.511)
Size*Total FC debt	-1.111***		
	(0.29)		
Size*Financial FC debt		-0.82***	
		(0.195)	
Size*Trade Credit			-0.238**
			(0.095)
Observations	114,497	114,495	114,497
Firm controls:	Yes	Yes	Yes
Year fixed effects:	Yes	Yes	Yes

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F, Part 4: Latent model with firm level characteristics, firm size squared, and year fixed effects

Second Stage - Tobit - Long positions

	(1)	(2)	(3)
Variables	Long Position	Long Position	Long Position
Size	0.423***	0.448***	0.381***
	(0.345)	(0.036)	(0.032)
Size squared	-0.023***	-0.0264***	-0.014***
	(0.0039)	(0.0041)	(0.0031)
Total FC debt	3.15***		
	(0.999)		
Financial FC debt		4.21***	
		(1.052)	
Trade Credit			-5.27*
			(2.81)
Observations	114,497	114,495	114,497
Firm controls:	Yes	Yes	Yes
Year fixed effects:	Yes	Yes	Yes

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F, Part 5: Latent model with firm level characteristics, firm size squared, year FE and covered FC debt as dependent variable

Covered FC debt = long position FC forward/FC debt

Covered FC debt - Tobit

Variables	(1) Total FC debt	(2) Financial FC debt	(3) Trade Credit
Size	0.652***	0.532***	5.322*
	(0.100)	(0.095)	(2.876)
Size squared	-0.019**	-0.016**	0.019
	(0.008)	(0.007)	(0.2133)
Observations	21,152	16,094	7,656
Firm controls:	Yes	Yes	Yes
Year fixed effects:	Yes	Yes	Yes

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F, Part 6: Is FC debt a driver of FC forwards after controlling for trade-credit and short Positions? Do the non-linearities hold? As shown below, the answer is yes for both questions

FC debt is a driver of long position forwards after controlling for trade credit and short position forwards

Variables	(1) Long Position	(2) Long Position
Size	0.21***	0.2***
	(0.007)	(0.007)
Leverage	0.15**	0.16***
	(0.07)	(0.07)
FC Assets	0.025	0.022
	(0.017)	(0.016)
Financial FC debt	0.16**	0.15**
	(0.077)	(0.071)
Trade Credit	-5.5***	-5.71***
	(1.47)	(1.5)
Short Position		2.59***
		(0.29)
Exports	0.0056****	0.006**
	(0.003)	(0.003)
Foreign	0.47***	0.46***
	(0.003)	(0.033)
Observations	163703	163703
Pseudo R-squared	0.18	0.18
Year Fixed Effects and other firm level controls:	Yes	Yes

Robust Standard error in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

The non-linearities with respect to size hold after controlling for trade-credit and short position forwards

Variables	(1) Long Position	(2) Long Position	(3) Long Position	(4) Long Position
Size	0.22***	0.21***	0.22***	0.22***
	(0.008)	(0.008)	(0.008)	(0.009)
Leverage	0.18**	0.19***	0.18**	0.18**
	(0.07)	(0.071)	(0.07)	(0.07)
FC Assets	0.033	0.026	0.025	0.025
	(0.03)	(0.028)	(0.027)	(0.028)
Instrumented Financial FC debt	-0.5	-.44	3.21***	3.22***
	(0.5)	(0.5)	(0.88)	(0.88)
Instrumented Financial FC debt*Size			-0.56***	-0.56***
			(0.13)	(0.13)
Trade Credit	-6.49***	-6.77***	-6.84***	-2.65
	(1.62)	(1.65)	(1.67)	(4.08)
Trade Credit*Size				-0.79
				(0.84)
Short Position		2.87***	2.86***	2.87***
		(0.36)	(1.66)	(0.354)
Exports	0.006**	0.006**	0.0058*	0.0058**
	(0.003)	(0.003)	(0.003)	(0.0032)
Foreign	0.49***	0.48***	0.48***	0.48***
	(0.04)	(0.039)	(0.039)	(0.039)
Observations	121194	121194	121194	121194
Pseudo R-squared	0.175	0.176	0.186	0.187
Year Fixed Effects and other firm level controls:	Yes	Yes	Yes	Yes

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

The non-linearities hold after using covered financial FC debt as dependent variable and controlling for trade credit and short position forwards

Variables	(1) Covered FC debt	(2) Covered FC debt	(3) Covered FC debt
Size	0.53***	0.54***	0.47***
	(0.094)	(0.094)	(0.093)
Size Squared	-0.016**	-0.018**	-0.013*
	(0.007)	(0.007)	(0.007)
Leverage	-0.68**	-0.71***	-0.57**
	(0.29)	(0.288)	(0.283)
FC Assets	0.012	0.018	0.018
	(0.04)	(0.045)	(0.044)
Trade Credit		-19.188***	-18.55***
		(5.07)	(5.02)
Short position			3.68***
			(0.513)
Exports	0.012	0.012	0.013
	(0.009)	(0.009)	(0.009)
Foreign	0.014	0.08	0.08
	(0.08)	(0.084)	(0.084)
Observations	16094	16094	16094
Pseudo R-squared	0.075	0.08	0.09
Year Fixed Effects and other firm level controls:	Yes	Yes	Yes

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F, Part 7: Latent model - Price effects - Forward premium effects on hedging

Forward Premium effects on hedging - Tobit

Variables	(1) Long Position	(2) Long Position	(3) Long Position
Size	0.457***	0.424***	0.492***
	(0.084)	(0.089)	(0.074)
Total FC debt	1.474		
	(2.593)		
Financial FC debt		-10.04262*	
		(5.7286)	
Trade Credit			10.938
			(12.29)
Size*Total FC debt	-0.825***		
	(0.234)		
Size*Financial FC debt		0.349	
		(0.451)	
Size*Trade Credit			-4.278***
			(1.037)
Forward Premium	5.508*	7.391**	4.391
	(3.133)	(3.15)	(3.13)
Size*Forward Premium	-0.782	-1.444**	-0.565
	(0.526)	(0.573)	(0.496)
Total FC debt*Forward Premium	216.311***		
	(64.651)		
Financial FC debt*Forward Premium		364.033***	
		(94.285)	
Trade Credit*Forward Premium			670.676**
			(283.4)
Size*Total FC debt*Forward Premium	-19.449***		
	(6.536)		
Size*Financial FC debt*Forward Premium		-29.699***	
		(8.581)	
Size*Trade Credit*Forward Premium			-59.079**
			(28.933)
Observations	114,497	114,495	114,497
Firm controls:	Yes	Yes	Yes
Other macro variables and firm-macro interactions:	Yes	Yes	Yes

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F, Part 8: Latent model - Price effects - Forward premium effects on hedging - Without outliers

Forward Premium effects on hedging - Tobit

Variables	(1) Long Position	(2) Long Position	(3) Long Position
Size	0.764***	0.69***	0.773***
	(0.154)	(0.149)	(0.147)
Total FC debt	-2.578		
	(7.824)		
Financial FC debt		6.02	
		(5.119)	
Trade Credit			27.240
			(40.303)
Size*Total FC debt	-3.107**		
	(1.348)		
Size*Financial FC debt		-5.841***	
		(1.553)	
Size*Trade Credit			-16.0701***
			(4.85)
Forward Premium	2.351	15.185***	-1.902
	(5.912)	(5.528)	(5.743)
Size*Forward Premium	0.371	-3.203***	0.837
	(1.14)	(1.125)	(1.076)
Total FC debt*Forward Premium	695.663***		
	(248.443)		
Financial FC debt*Forward Premium		74.307	
		(236.8211)	
Trade Credit*Forward Premium			2412.734***
			(856.474)
Size*Total FC debt*Forward Premium	-116.471***		
	(42.998)		
Size*Financial FC debt*Forward Premium		55.451	
		(47.281)	
Size*Trade Credit*Forward Premium			-412.071***
			(127.597)
Observations	104,591	104,591	104,593
Firm controls:	Yes	Yes	Yes
Other macro variables and firm-macro interactions:	Yes	Yes	Yes

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F, Part 9: Pooled Logit (Average Marginal Effects evaluated in the variables' averages)

The probability of contracting FC forwards - Pooled Logit

Variables	(1) Long or Short Position	(2) Long Position	(3) Short Position	(4) Long or Short Position	(5) Long Position	(6) Short Position
Size	0.0122***	0.00225***	0.00995***	0.0131***	0.00254***	0.0105***
	(0.000233)	(9.04e-05)	(0.000183)	(0.000848)	(0.000407)	(0.000665)
Leverage	0.00544*	0.00249***	0.00357*	0.00597**	0.00195	0.00380**
	(0.00287)	(0.000499)	(0.00207)	(0.00276)	(0.00133)	(0.00187)
FC Assets	-6.91e-05	0.000217*	5.28e-05	-9.11e-05	0.000194	4.95e-05
	(0.000608)	(0.000129)	(0.000554)	(0.000637)	(0.000143)	(0.000515)
Financial FC Debt	0.0353**	0.00233	0.0140	0.0337*	0.0137**	0.0133
	(0.0173)	(0.00178)	(0.0123)	(0.0177)	(0.00686)	(0.0117)
Trade Credit	-0.00138	-0.0603***	0.0132***	-0.00422	-0.0492	0.0130***
	(0.00804)	(0.0142)	(0.00395)	(0.00942)	(0.0483)	(0.00358)
Exports	3.16e-05	3.05e-05*	-0.000172	-0.00745	-0.00641	-0.00379
	(0.000145)	(1.59e-05)	(0.000147)	(0.00972)	(0.0189)	(0.00553)
Tradable	0.0144***	0.00854***	0.00458***	0.0140***	0.00862***	0.00425***
	(0.000595)	(0.000282)	(0.000534)	(0.000901)	(0.00109)	(0.000503)
Foreign	0.00215***	0.00400***	-0.00286***	0.00975**	0.00318	-0.00169
	(0.000855)	(0.000323)	(0.000733)	(0.00433)	(0.00285)	(0.00358)
Forward Premium				-0.0338	0.0403	-0.0915***
				(0.0450)	(0.0376)	(0.0336)
Forward Premium Volatility				0.739***	0.411***	0.221**
				(0.122)	(0.0677)	(0.0953)
Forward Premium * Size				0.00641	0.00287	0.00473
				(0.00738)	(0.00487)	(0.00551)
Forward Premium * Foreign				0.0333	-0.0324	0.0946***
				(0.0425)	(0.0384)	(0.0320)
Forward Premium * Exports				0.164	0.0550	0.0259
				(0.234)	(0.378)	(0.0462)
Other firm controls	YES	YES	YES	YES	YES	YES
Other macro controls	NO	NO	NO	YES	YES	YES
Other macro-firm interactions	NO	NO	NO	YES	YES	YES
Year Fixed-effects	YES	YES	YES	NO	NO	NO
Observations	163,927	163,927	163,927	163,927	163,927	163,927

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F, Part 10: RE Logit (Average Marginal Effects evaluated in the variables' averages)

The Probability of contracting FC forwards: Random Effects Logit

VARIABLES	(1) FC Purchases or Sales	(2) FC Purchases	(3) FC Sales	(4) FC Purchases or Sales	(5) FC Purchases	(6) FC Sales
Size	0.000505***	3.56e-06***	0.000465***	0.000559***	5.51e-06	0.000524***
	(6.72e-05)	(9.39e-07)	(5.86e-05)	(7.97e-05)	(4.38e-06)	(7.04e-05)
Leverage	0.000122	-5.74e-07	0.000128	0.000133	-5.39e-07	0.000131
	(0.000100)	(1.25e-06)	(0.000101)	(0.000102)	(2.09e-06)	(9.60e-05)
FC Assets	-0.000106	1.29e-07	-5.35e-05	-0.000109	1.85e-07	-5.04e-05
	(0.000144)	(3.58e-07)	(0.000121)	(0.000147)	(6.27e-07)	(0.000114)
Financial FC Debt	0.000233***	1.32e-06**	0.000188***	0.000234***	2.14e-06	0.000179***
	(5.89e-05)	(5.17e-07)	(4.86e-05)	(5.96e-05)	(1.62e-06)	(4.63e-05)
Trade Credit	-0.000509	-2.25e-05*	-0.000170	-0.000548	-3.60e-05	-0.000165
	(0.000413)	(1.23e-05)	(0.000379)	(0.000421)	(3.30e-05)	(0.000360)
Exports	2.93e-06	4.20e-08	-2.14e-09	-8.83e-06	-1.99e-07	-0.000146
	(2.88e-06)	(2.93e-08)	(5.63e-06)	(1.76e-05)	(3.09e-07)	(0.000166)
Cash Flow	0.000143***	-4.82e-10	0.000182***	0.000142***	-8.74e-10	0.000172***
	(5.38e-05)	(6.51e-09)	(4.75e-05)	(5.51e-05)	(1.13e-08)	(4.53e-05)
Tradable	0.000593***	2.18e-05***	0.000221***	0.000597***	3.62e-05	0.000213***
	(9.71e-05)	(5.96e-06)	(5.04e-05)	(9.76e-05)	(2.72e-05)	(4.83e-05)
Foreign	6.94e-06	5.28e-06***	-0.000127***	0.000288	2.61e-06	-0.000107
	(3.95e-05)	(1.83e-06)	(3.52e-05)	(0.000206)	(3.80e-06)	(0.000113)
Trade Openness				-6.72e-05	8.39e-05	-0.00248***
				(0.000754)	(6.41e-05)	(0.000820)
Financial Openness				0.000702**	3.94e-05	-0.000212
				(0.000280)	(3.25e-05)	(0.000262)
Private Credit				0.00202***	8.83e-06	0.00208***
				(0.000441)	(1.45e-05)	(0.000415)
Forward Premium				-0.000851	6.66e-05	-0.00293**
				(0.00143)	(7.06e-05)	(0.00147)
Forward Premium Volatility				0.0268***	0.000722	0.0101***
				(0.00509)	(0.000578)	(0.00352)
Forward Premium * Size				0.000208	8.56e-06	6.97e-06
				(0.000249)	(6.33e-06)	(0.000243)
Forward Premium * Foreign				0.00123	-6.03e-05	0.00410***
				(0.00107)	(4.71e-05)	(0.00121)
Forward Premium * Exports				0.000573**	9.20e-06	0.00199
				(0.000270)	(7.20e-06)	(0.00190)
Private Credit * Size				-0.000117*	2.22e-07	-0.000179***
				(6.37e-05)	(1.23e-06)	(6.23e-05)
Private Credit * Foreign				-0.000543**	1.04e-05	-0.000267
				(0.000271)	(9.23e-06)	(0.000260)
Private Credit * Exports				1.33e-05	4.19e-07	0.000125
				(4.47e-05)	(7.20e-07)	(0.000236)
Year Fixed Effects	YES	YES	YES	NO	NO	NO
Observations	163,927	163,927	163,927	163,927	163,927	163,927
Number of firms	32,907	32,907	32,907	32,907	32,907	32,907

Robust Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex F, Part 11: Fixed Effects Logit - FC forwards

The probability of contracting FC forwards - FE Logit

Variables	(1) Short or long Position	(2) Long Position	(3) Short Position	(4) Short or long Position	(5) Long Position	(6) Short Position
Size	0.800***	0.774***	0.728***	0.876***	0.584***	0.926***
	(0.0719)	(0.121)	(0.0798)	(0.0997)	(0.165)	(0.108)
Leverage	-0.534*	-1.221**	-0.304	-0.508*	-1.185**	-0.258
	(0.280)	(0.483)	(0.314)	(0.280)	(0.478)	(0.315)
FC Assets	-0.406	0.00994	-0.258	-0.406	-0.000950	-0.245
	(0.318)	(0.122)	(0.305)	(0.321)	(0.128)	(0.306)
Financial FC Debt	1.019***	0.282	1.004***	0.990***	0.361	1.004***
	(0.311)	(0.405)	(0.365)	(0.311)	(0.404)	(0.367)
Trade Credit	-2.593**	-3.346	-2.606**	-2.674**	-2.393	-2.631**
	(1.163)	(3.472)	(1.183)	(1.160)	(3.348)	(1.170)
Exports	-0.00213	0.0879	-0.494	-0.0783	-0.333	-1.632**
	(0.0219)	(0.0780)	(0.336)	(0.190)	(0.464)	(0.650)
Foreign	-0.281**	0.242	-0.440***	0.146	-0.559	-0.288
	(0.135)	(0.233)	(0.139)	(0.344)	(0.533)	(0.378)
Forward Premium				-3.612	5.265	-7.182**
				(3.251)	(5.797)	(3.555)
Forward Premium * Size				0.697	2.392***	-0.0195
				(0.560)	(0.875)	(0.607)
Forward Premium * Foreign				1.366	-10.85***	8.399***
				(2.291)	(3.408)	(2.591)
Forward Premium * Exports				5.036*	3.953	13.51***
				(2.865)	(3.546)	(4.816)
Observations	15,737	4,761	13,878	15,737	4,761	13,878
Number of Firms	2,257	673	1,985	2,257	673	1,985
Other firm level and macro controls:	NO	NO	NO	YES	YES	YES
Other firm level and Year Fixed Effects:	YES	YES	YES	NO	NO	NO

Robust standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex G: Second Stage's complete results

Part 1: Second stage's complete results (Long Positions)

VARIABLES	(1) FC Purchases	(2) FC Purchases	(3) FC Purchases	(4) FC Purchases	(5) FC Purchases	(6) FC Purchases	(7) FC Purchases	(8) FC Purchases	(9) FC Purchases
Size	0.340***	0.330***	0.414***	0.343***	0.332***	0.424***	0.389***	0.292***	0.529***
	(0.0548)	(0.0542)	(0.0576)	(0.0564)	(0.0558)	(0.0596)	(0.0792)	(0.0786)	(0.0730)
Leverage	0.232***	0.195**	0.312***	0.237***	0.196**	0.321***	0.258***	0.272***	0.328***
	(0.0789)	(0.0784)	(0.0801)	(0.0792)	(0.0785)	(0.0815)	(0.0862)	(0.0916)	(0.0911)
FC Assets	0.984**	0.983**	0.996***	0.983**	0.982**	0.997***	0.980**	0.980**	0.982**
	(0.388)	(0.389)	(0.385)	(0.386)	(0.388)	(0.384)	(0.387)	(0.385)	(0.384)
Total FC debt (IV)	-0.117			-0.167			-3.807*		
	(0.695)			(0.698)			(2.083)		
Financial FC Debt (IV)		0.696			0.720			-4.681**	
		(0.695)			(0.693)			(2.335)	
Trade Credit (IV)			-11.97***			-12.98***			-41.17***
			(2.893)			(2.943)			(10.91)
Exports	-0.0688	-0.0701	-0.0673	-0.0685	-0.0699	-0.0668	-0.0684	-0.0719	-0.0660
	(0.112)	(0.111)	(0.112)	(0.112)	(0.111)	(0.112)	(0.111)	(0.110)	(0.112)
Cash Flow	-2.79e-05***	-2.54e-05***	-3.49e-05***	-2.69e-05***	-2.41e-05***	-3.43e-05***	-2.39e-05***	-1.75e-05**	-3.42e-05***
	(7.09e-06)	(7.09e-06)	(7.07e-06)	(7.02e-06)	(7.01e-06)	(6.99e-06)	(7.30e-06)	(7.13e-06)	(7.21e-06)
Tradable	0.876***	0.865***	0.883***	0.876***	0.864***	0.884***	0.876***	0.882***	0.883***
	(0.0421)	(0.0419)	(0.0420)	(0.0420)	(0.0418)	(0.0420)	(0.0421)	(0.0426)	(0.0420)
Foreign	0.110	0.0979	0.645**	0.0883	0.0727	0.666**	0.155	0.0333	1.219***
	(0.247)	(0.241)	(0.277)	(0.253)	(0.247)	(0.284)	(0.263)	(0.246)	(0.361)
Private Credit	-0.325	-0.337	0.0389	-4.875***	-4.890***	-4.802***	-4.543***	-5.847***	-3.124**
	(0.541)	(0.537)	(0.554)	(1.278)	(1.274)	(1.278)	(1.398)	(1.367)	(1.432)
Forward Premium	-3.449*	-3.392*	-2.856	3.909	3.992	5.187*	6.775**	8.768***	6.579**
	(1.838)	(1.824)	(1.881)	(2.618)	(2.600)	(2.669)	(2.907)	(2.964)	(2.837)
Forward Premium Volatility	-3.371	-3.348	-1.638	71.66***	71.48***	78.29***	72.33***	73.58***	67.44***
	(4.998)	(5.005)	(5.010)	(20.04)	(20.02)	(20.13)	(20.01)	(20.00)	(20.54)
Forward Premium*Size	0.0253	0.00592	-0.0833	0.00159	-0.0181	-0.120	-0.499	-0.881**	-0.587
	(0.333)	(0.331)	(0.337)	(0.327)	(0.324)	(0.330)	(0.401)	(0.418)	(0.389)
Forward Premium*Foreign	-1.551	-1.558	-2.580*	-1.351	-1.354	-2.466	-2.315	-1.802	-4.971**
	(1.547)	(1.551)	(1.534)	(1.519)	(1.522)	(1.501)	(1.583)	(1.517)	(1.962)
Forward Premium*Exports	0.824**	0.818**	0.833**	0.830**	0.823**	0.839**	0.826**	0.793**	0.840**
	(0.410)	(0.406)	(0.412)	(0.410)	(0.406)	(0.412)	(0.407)	(0.390)	(0.412)
Private Credit*Size	-0.258**	-0.259**	-0.348***	-0.262**	-0.263**	-0.361***	-0.324**	-0.0768	-0.553***
	(0.105)	(0.104)	(0.107)	(0.107)	(0.107)	(0.110)	(0.156)	(0.155)	(0.137)
Private Credit*Foreign	0.941**	0.949**	0.234	0.985**	0.997**	0.222	0.913*	1.129**	-0.762
	(0.470)	(0.465)	(0.494)	(0.480)	(0.476)	(0.505)	(0.501)	(0.475)	(0.656)
Private Credit*Exports	0.155	0.158	0.152	0.154	0.158	0.150	0.154	0.163	0.149
	(0.257)	(0.256)	(0.258)	(0.257)	(0.256)	(0.258)	(0.256)	(0.253)	(0.257)
FXI Purchases				49.56***	49.41***	52.62***	46.78***	48.99***	41.13***
				(12.92)	(12.91)	(12.96)	(13.01)	(12.90)	(13.57)
FXI Sales				233.0***	230.6***	242.0***	185.8**	164.9**	167.8**
				(71.25)	(71.17)	(71.23)	(73.86)	(72.26)	(77.32)
FXI Purchases*Total FC Debt (IV)							83.16		
							(52.84)		
FXI Sales*Total FC Debt (IV)							1,323**		
							(583.7)		
FXI Purchases*Financial FC Debt (IV)								58.46	
								(55.90)	
FXI Sales*Financial FC Debt (IV)								2,543***	
								(672.5)	
FXI Purchases*Trade Credit (IV)									793.6***
									(292.5)
FXI Sales*Trade Credit (IV)									6,704**
									(2,848)
Constant	-3.978***	-3.932***	-4.275***	-4.746***	-4.687***	-5.097***	-4.880***	-4.420***	-5.378***
	(0.343)	(0.342)	(0.355)	(0.435)	(0.433)	(0.449)	(0.494)	(0.487)	(0.472)
Observations	114,497	114,495	114,497	114,497	114,495	114,497	114,497	114,495	114,497

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Part 2: Second stage's complete results (Short Positions)

VARIABLES	(1) FC Sales	(2) FC Sales	(3) FC Sales	(4) FC Sales	(5) FC Sales	(6) FC Sales	(7) FC Sales	(8) FC Sales	(9) FC Sales
Size	0.168***	0.165***	0.171***	0.168***	0.165***	0.170***	0.173***	0.158***	0.185***
	(0.0126)	(0.0126)	(0.0126)	(0.0124)	(0.0125)	(0.0124)	(0.0178)	(0.0173)	(0.0153)
Leverage	0.131***	0.124***	0.0755***	0.130***	0.123***	0.0751***	0.130***	0.125***	0.0750***
	(0.0213)	(0.0210)	(0.0212)	(0.0213)	(0.0210)	(0.0212)	(0.0213)	(0.0211)	(0.0213)
FC Assets	-0.00210	-0.00957	-0.00337	-0.00165	-0.00886	-0.00235	-0.00337	-0.00982	-0.00633
	(0.0799)	(0.0809)	(0.0805)	(0.0799)	(0.0809)	(0.0805)	(0.0800)	(0.0810)	(0.0808)
Total FC debt (IV)	-2.704***			-2.682***			-3.081***		
	(0.211)			(0.211)			(0.602)		
Financial FC Debt (IV)		-2.739***			-2.727***			-3.046***	
		(0.209)			(0.209)			(0.624)	
Trade Credit (IV)			-6.718***			-6.551***			-10.61***
			(0.759)			(0.757)			(2.749)
Exports	-0.00258	-0.0100	-0.00679	-0.00276	-0.0124	-0.00746	-0.00269	-0.00954	-0.00640
	(0.00858)	(0.0319)	(0.01000)	(0.00860)	(0.0330)	(0.0151)	(0.00856)	(0.0314)	(0.0118)
Cash Flow	0.0685***	0.0682***	0.0645***	0.0695***	0.0693***	0.0653***	0.0692***	0.0684***	0.0657***
	(0.0187)	(0.0189)	(0.0186)	(0.0188)	(0.0190)	(0.0187)	(0.0188)	(0.0191)	(0.0186)
Tradable	0.0629***	0.0679***	0.0359***	0.0627***	0.0678***	0.0359***	0.0628***	0.0683***	0.0359***
	(0.00654)	(0.00665)	(0.00618)	(0.00654)	(0.00666)	(0.00618)	(0.00655)	(0.00667)	(0.00618)
Foreign	0.120**	-0.0291	0.275***	0.121**	-0.0255	0.270***	0.132**	-0.0301	0.370***
	(0.0562)	(0.0559)	(0.0648)	(0.0555)	(0.0552)	(0.0641)	(0.0602)	(0.0560)	(0.0849)
Private Credit	0.583***	0.567***	0.673***	1.604***	1.627***	1.618***	1.643***	1.514***	1.862***
	(0.126)	(0.127)	(0.122)	(0.293)	(0.293)	(0.289)	(0.323)	(0.316)	(0.319)
Forward Premium	-0.214	-0.361	0.0222	-1.974***	-2.194***	-1.577**	-1.730**	-1.768**	-1.588**
	(0.428)	(0.433)	(0.412)	(0.633)	(0.637)	(0.620)	(0.713)	(0.711)	(0.665)
Forward Premium Volatility	2.936***	2.502**	3.441***	-13.98***	-14.91***	-13.00***	-13.86***	-14.67***	-14.45***
	(1.022)	(1.021)	(1.026)	(4.483)	(4.482)	(4.488)	(4.488)	(4.485)	(4.552)
Forward Premium*Size	-0.0894	-0.0638	-0.151**	-0.0795	-0.0537	-0.141*	-0.123	-0.132	-0.177**
	(0.0743)	(0.0760)	(0.0717)	(0.0754)	(0.0772)	(0.0724)	(0.0956)	(0.0967)	(0.0860)
Forward Premium*Foreign	1.015***	1.287***	0.622*	1.038***	1.306***	0.658*	0.949**	1.264***	0.416
	(0.363)	(0.370)	(0.375)	(0.369)	(0.377)	(0.379)	(0.389)	(0.378)	(0.487)
Forward Premium*Exports	0.0873**	0.254	0.0702	0.0891*	0.287	0.0828	0.0870**	0.230	0.0821
	(0.0421)	(0.455)	(0.103)	(0.0458)	(0.472)	(0.213)	(0.0431)	(0.449)	(0.156)
Private Credit*Size	-0.0538**	-0.0496**	-0.0928***	-0.0531**	-0.0490**	-0.0909***	-0.0616*	-0.0284	-0.121***
	(0.0227)	(0.0231)	(0.0226)	(0.0225)	(0.0228)	(0.0224)	(0.0340)	(0.0334)	(0.0281)
Private Credit*Foreign	-0.192*	0.00777	-0.430***	-0.199*	-0.00240	-0.428***	-0.215*	0.0107	-0.615***
	(0.104)	(0.105)	(0.113)	(0.103)	(0.104)	(0.112)	(0.114)	(0.106)	(0.156)
Private Credit*Exports	0.00295	0.00278	0.0118	0.00307	0.00451	0.0119	0.00308	0.00383	0.00992
	(0.0199)	(0.0280)	(0.0226)	(0.0199)	(0.0285)	(0.0226)	(0.0198)	(0.0276)	(0.0208)
FXI Purchases				-11.17***	-11.49***	-10.83***	-11.37***	-11.41***	-12.27***
				(2.887)	(2.886)	(2.885)	(2.911)	(2.894)	(2.987)
FXI Sales				-52.39***	-53.10***	-54.94***	-55.72***	-57.31***	-61.48***
				(15.27)	(15.27)	(15.24)	(15.92)	(15.66)	(16.27)
FXI Purchases*Total FC Debt (IV)							9.465		
							(14.35)		
FXI Sales*Total FC Debt (IV)							128.3		
							(177.0)		
FXI Purchases*Financial FC Debt (IV)								3.239	
								(14.57)	
FXI Sales*Financial FC Debt (IV)								233.6	
								(185.8)	
FXI Purchases*Trade Credit (IV)									116.9
									(72.37)
FXI Sales*Trade Credit (IV)									728.1
									(741.6)
Constant	-1.607***	-1.597***	-1.596***	-1.429***	-1.418***	-1.401***	-1.448***	-1.381***	-1.449***
	(0.0806)	(0.0810)	(0.0787)	(0.0965)	(0.0967)	(0.0948)	(0.111)	(0.109)	(0.0997)
Observations	114,497	114,495	114,497	114,497	114,495	114,497	114,497	114,495	114,497

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex H: Decomposition of Tobit coefficient

- Following Kim et al. (2020) and McDonald and Moffitt (1980):

$$\frac{\partial E[y]}{\partial x} = P(0 < y < 1)\frac{\partial E[y|0 < y < 1]}{\partial x} + E[y|0 < y < 1]\frac{\partial P(0 < y < 1)}{\partial x} + \frac{\partial P(y = 1)}{\partial x}$$

- The first term on the rhs captures the effects of independent variable of interest on the intensive margin of the dependent variable: effects of FC debt on FC forwards conditional on already contracting forwards.
- The second and third terms capture the effects on the extensive margin: effects of FC debt on the probability of having FC forwards.
- I compute the share that each part contributes to the overall effect by dividing by $\frac{\partial E[y]}{\partial x}$.

Annex I: Fernández et al. (2016) Capital Control Index as a proxy for illiquidity

Part 1: Fernández et al. (2016) Capital Control Index and a brief cross-country comparison

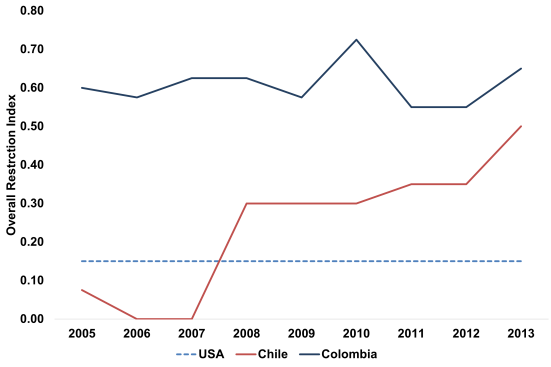
As an empirical measure for the market imperfections that limit the supply of FC in the derivatives market we use the Fernández et al. (2016) Capital Control overall restrictions index. This index is based on the analysis of the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). It comprises de jure controls on capital inflows and outflows of 10 different types of assets between 1995 and 2013 for 100 countries. The ten categories of assets are: money market instruments, bonds or other debt securities, equity and shares, collective investment securities, finanacial credits, derivatives, commercial credits, guarantees, real estate transactions, and FDI.

The authors use narrative information to construct indicator variables that take a value of 1 if there was a restriction on outflows/inflows for each asset category. The overall restriction index is the simple average of these indicators.

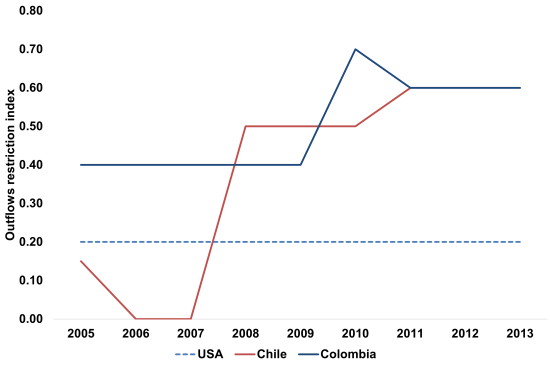
The figure below plots the overall restriction index, the inflows and outflows restrictions index and the index for the derivatives market for the US, Chile and Colombia. As it is shown, capital controls have been far more restricted in Colombia when compared to more efficient economies such as Chile.

Although these strict regulations can protect economies against external shocks, the comparison with the development/sophistication of the Chilean financial market is quite telling. While in Colombia the firms that use the forwards market the most are the firms with financial credit, in Chile it is the firms with commercial credit that take advantage of this market. Then, the Chilean firms with financial credit use more sophisticated instruments such as swaps and options. For more see Alfaro et al. (2023).

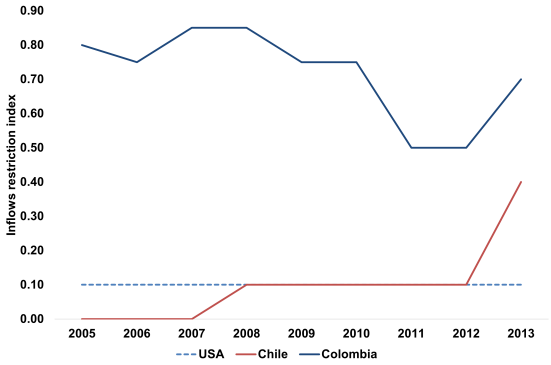
Capital Control index: US, Chile, Colombia 2005-2013



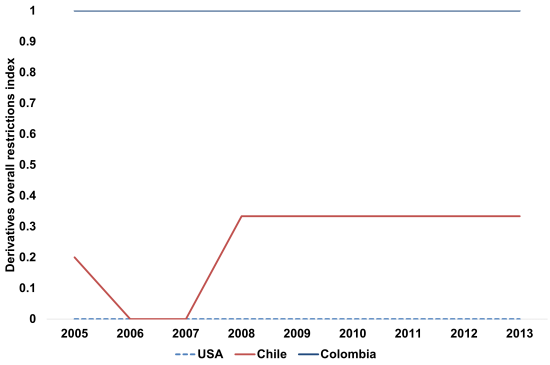
(a) Overall



(b) Outflows



(c) Inflows

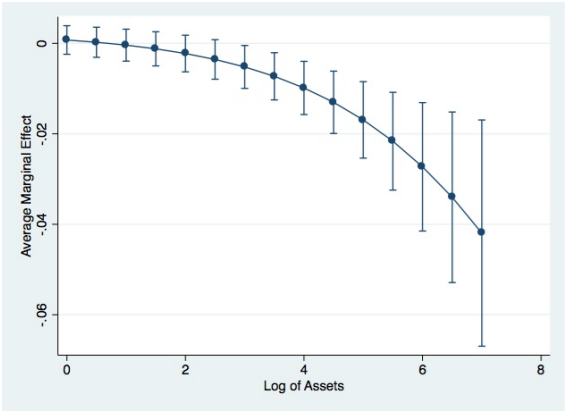


(d) Derivatives

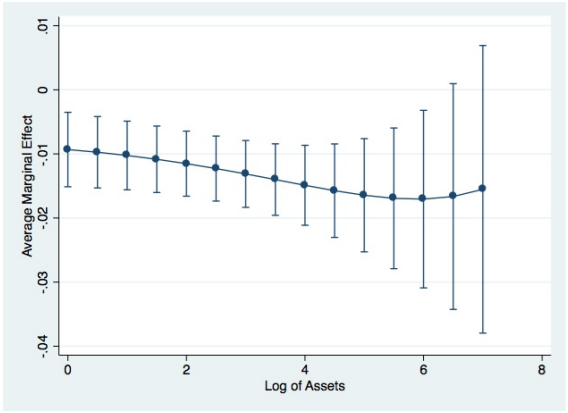
Source: Authors' calculations based on Fernández et al. (2016).

Part 2: Robustness check of Capital Control index on inflows/outflows

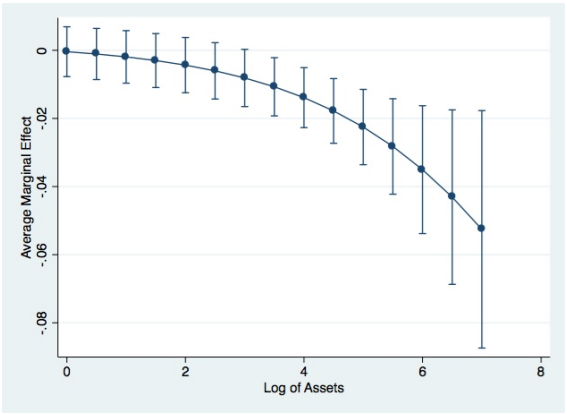
Capital Control index on Inflows/Outflows



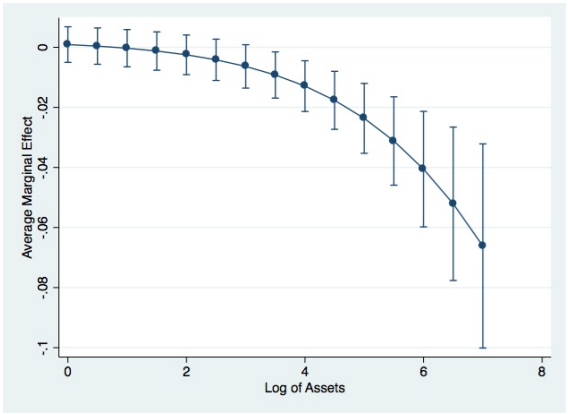
(a) Financial FC debt - Inflows



(b) Trade Credit - Inflows



(c) Financial FC debt - Outflows



(d) Trade Credit - Outflows

Source: Authors' calculations based on SS, DIAN-DANE, SFC, BdR and Fernández et al. (2016).

Part 3: Robustness checks of Capital Control index - Latent models

Financial FC debt

Variables	(1) LP Fwd	(2) LP Fwd
Size	0.25*	0.23*
	(0.13)	(0.13)
Financial FC debt	-51.7**	-50.7**
	(23.3)	(23.5)
CC Index	-2.15**	-2.23***
	(0.84)	(0.83)
Size*Financial FC debt	4.67**	4.53**
	(2.2)	(2.22)
Size*CC Index	0.05	0.07
	(0.2)	(0.2)
Financial FC debt*CC Index	70.5**	68.8**
	(31.4)	(31.7)
Size*CC Index*Financial FC debt	-6.99**	-6.75**
	(3.08)	(3.1)
Trade Credit		-5.85***
		(1.82)
SP Fwd		3.02***
		(0.4)
Observations	114495	114495
Pseudo R-squared	0.173	0.186
Other macro and firm controls:	Yes	Yes

Robust Standard error in parenthesis *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' calculations based on SS, DIAN-DANE, SFC, BdR and Fernández et al. (2016).

Trade Credit

Variables	(1) LP Fwd	(2) LP Fwd
Size	0.11	0.09
	(0.11)	(0.11)
Trade Credit	108.03**	112.5**
	(48.7)	(49.1)
CC Index	-1.82**	-1.9**
	(0.86)	(0.86)
Size*Trade Credit	-11.73*	-12.07*
	(6.7)	(6.73)
Size*CC Index	0.23	0.26
	(0.18)	(0.18)
Trade Credit*CC Index	-110.7	-117.6
	(71.2)	(71.45)
Size*CC Index*Trade Credit	10.27	10.89
	(9.94)	(9.93)
SP Fwd		2.97***
		(0.4)
Observations	114497	114497
Pseudo R-squared	0.173	0.183
Other macro and firm controls:	Yes	Yes

Robust Standard error in parenthesis *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' calculations based on SS, DIAN-DANE, SFC, BdR and Fernández et al. (2016).

Annex J: Is the negative relationship between firm size and hedging driven by firm's risk aversion?

In this paper, we claim that the negative relationship between hedging and firm size is driven by an external constraint introduced by the supply side of the market as a consequence of the lack of liquidity. Nevertheless, the negative relationship between the shares of covered FC debt and firm size might be driven by a negative correlation between the risk aversion of firms and their size. The bigger the firm, the lower her risk aversion, and therefore, the lower her shares of covered FC debt. In this annex, we test for this alternative hypothesis.

In order to test this hypothesis we must do a fundamental assumption: Firms' idiosyncratic risk aversion did not change during the period of study (2005-2013). From a macroeconomic perspective, we find this assumption plausible as: i) Colombia did not face any idiosyncratic shock and; ii) the Colombian economy was an example of resilience during the GFC.

Given this assumption, the ideal estimator to test this hypothesis would be a FE Tobit. Nonetheless, the incidental parameters problem makes this estimation implausible. Therefore, we will proceed as follows. First we will use a RE Tobit, that will acknowledge the presence of an idiosyncratic and unobservable characteristic (risk aversion) and compare its results with those of the Tobit. Second, we will use a linear probability model with both RE and FE and compare them with the results of both Tobit and RE Tobit.

Part 1: Tobit vs RE Tobit

In order to use the RE Tobit we must do two extra assumptions. The first assumption is that risk aversion is independent of firm characteristics. The second assumption is that risk aversion is normally distributed.

While it is true that these assumptions are not enough to control for firms' risk aversion, they acknowledge risk aversion and use it to improve the efficiency of the estimation: This technique weights the regression by the cross-sectional variation of risk aversion. We will therefore, compare the results of the unweighted and weighted latent and censored Tobit.

Table 1) presents the results for the latent models. Columns (3) and (4) compare the results of the Tobit and RE Tobit using the long position forward as a share of liabilities as the dependent variable (our benchmark specification). As shown, the sign of the coefficients and their significance remain the same in both estimations. Nonetheless, the coefficients of the RE Tobit in absolute value are smaller. This might show that once we take into account firm risk aversion, the effects of the lack liquidity on firm level hedging are less economically sizable.

Columns (1) and (2) compare the results of the Tobit and RE Tobit using covered FC debt as dependent variable. As shown, the variables of interest, size and size squared are statistically significant in both specifications. Nevertheless, the signs for size and size squared flip. The non-linearities are kept but the RE specification provides an opposite result. While firms below a threshold of size present on average smaller shares of covered FC debt, firms above a threshold have larger shares. This result might provide some evidence about the importance of the effects of risk aversion on the shares of covered FC debt as a function of size.

However, the results are not necessarily at odds with story about the lack of liquidity of the hedging market. This specification might be capturing more strongly the effects of the fixed cost of entry on the extensive margin of hedging, than the liquidity constraints of the intensive margin. To better clarify, it is imperative to take a look at the censored Tobit results.

Figure 1 presents the censored Tobit results. Panel (a) uses the specification of Table 1) Column (1), panel (b) uses column (2), panel (c) column (3), and panel (d) uses the specification of column (4).

Lets first compare the results of the AME of size on covered FC debt. Panel (a), shows that the magnitude of the AME effect increases until a critical threshold of size, after which, it starts decreasing. The precision of the estimation after this threshold is poor for the biggest firms of the economy; as they are not many, the confidence intervals for the AME are much wider. Panel (b) shows a similar shape, with more precisely estimated coefficients all along the distribution of firm size; an advantage of accounting for the distribution of risk aversion.

Panel (b) is evidence that the lack of liquidity hypothesis cannot be rejected even when taking into account the risk aversion of firms. If these results where driven by risk aversion, then one would expect a monotonic and increasing function of size, which is not the case. After a certain threshold of size, the biggest firms of the economy present smaller

Table 1): Latent models - Tobit vs RE Tobit

Variables	(1) Covered FC debt	(2) Covered FC debt	(3) Long Position Fwd	(4) Long Position Fwd
Size	0.652***	-3.169***	0.246***	0.269***
	(0.11)	(0.32)	(0.015)	(0.013)
Size Squared	-.019**	0.389***		
	(0.009)	(0.026)		
Total FC debt (IV)			8.605***	6.263***
			(3.252)	(1.298)
Size*Total FC debt (IV)			-1.111***	-0.807***
			(0.286)	(0.182)
Observations	21152	21152	114497	114497
Pseudo R-squared	0.09		0.17	
Year Fixed Effects:	YES	YES	YES	YES
Firm controls:	YES	YES	YES	YES
Random Effects	NO	YES	NO	YES

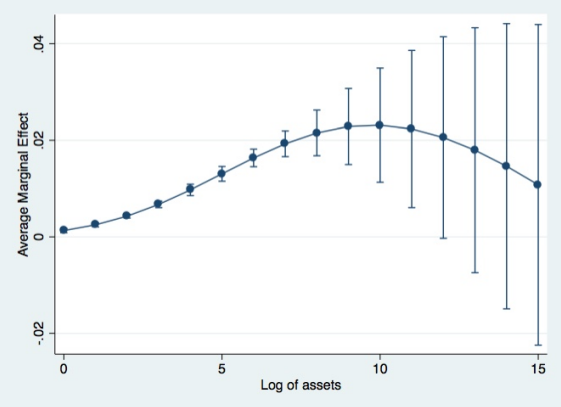
Standard errors in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

shares of covered FC debt on average.

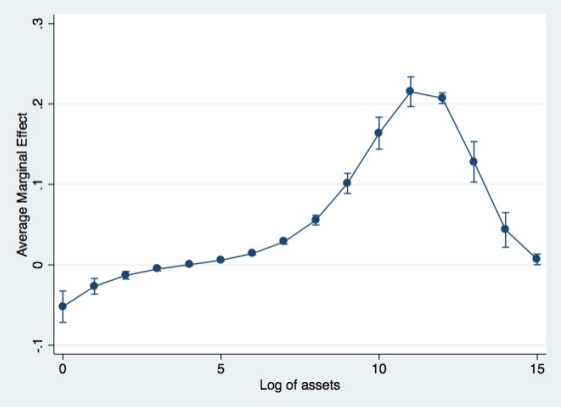
Moreover, the shape of the distribution plotted in Panel (b) reinforces our story. For small firms there is a negative AME as the fixed cost precludes them from entry. Then, after a critical threshold of size, the AME becomes positive. Finally, when the firm is big enough, the lack of liquidity of the market becomes a binding restriction which constraints her shares of hedging; after this critical size (log of assets=11) the AME becomes smaller and smaller.

In regard to the AME of FC debt on long position forwards, panel (c) and (d), show the same shape along the size distribution of firms: Taking into account the RE of risk aversion does not change the result for our benchmark specification.

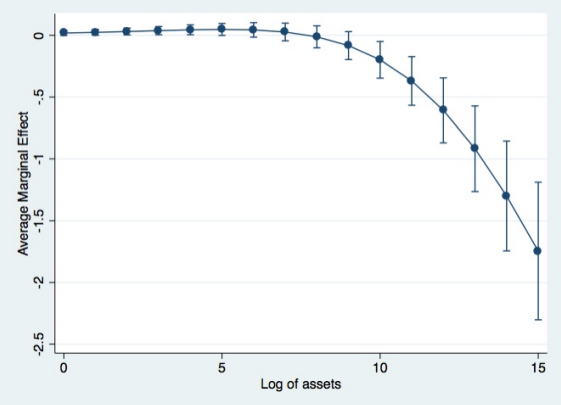
Figure 1): Censored - Tobit vs RE Tobit



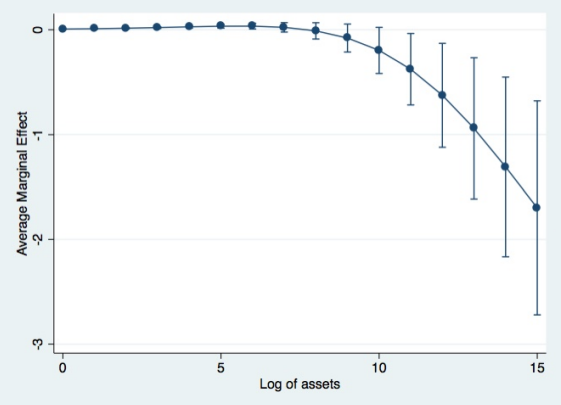
(a) AME of size on Covered FC debt - Tobit



(b) AME of size on Covered FC debt - RE Tobit



(c) AME of FC debt on Long Position Fwd - Tobit



(d) AME of FC debt on Long Position Fwd - RE Tobit

Source: Authors' calculations based on SS, DIAN-DANE, SFC, BdR and Fernández et al. (2016).

Part 2: Risk aversion and Fixed Effects

The previous exercise is not enough to reject the alternative hypothesis related to risk aversion. Therefore, we opt to run a linear probability model with RE and FE, where the dependent variable is the probability of firm i having a long position forward.

The idea is to compare the results of the RE linear probability model with those of the RE Tobit, and then, compare the results of the RE linear probability model with those of the FE linear probability model. If the results remain similar we would claim that we have some tentative evidence to reject the risk aversion hypothesis[97].

Table 2 presents the results. In column (1) we have the results of the linear probability model with RE. The results are very similar to those of the RE Tobit. Size and size squared are both significant, and the non-linearity is preserved. Column (2) presents the results for the linear probability model with FE. This specification controls for firm level

[97]It is not a definite evidence as the estimations are not totally comparable. The Tobit comprises both the extensive and intensive margin of hedging, while the linear probability model only captures the extensive margin.

fixed effects. After controlling for firm risk aversion, the non-linearity is preserved. If risk aversion was driving our results, one would expect that after controlling for it, size would have a positive linear effect on the probability of hedging, which is not the case. This is tentative evidence for firm level risk aversion not driving our results.

Table 2): Linear Probability Model - RE vs FE

Variables	(1) P(Long Position Fwd)	(2) P(Long Position Fwd)
Size	-0.004***	-0.005**
	(0.001)	(0.002)
Size Squared	0.001**	0.001***
	(0.0003)	(0.0004)
Total FC debt (IV)	0.491***	0.034
	(0.123)	(0.088)
Observations	114615	114615
R-squared	0.04	0.00
Year Fixed Effects:	YES	YES
Firm controls:	YES	YES
Panel structure	RE	FE

Clustered standard errors at the firm level in parenthesis $***p < 0.01, **p < 0.05, *p < 0.1$
Source: Authors' calculations based on SS, DIAN-DANE, SFC and BdR.

Annex K: Types of FXI

Distribution across time of FXI by CB (% of volume in spot market)

Purchases of FX	2005	2006	2007	2008	2009	2010	2011	2012	2013
Discretionary	4.0	1.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0
Pre-announced day to day bids	0.0	0.0	0.0	1.2	0.0	2.6	3.2	4.2	5.8
Put options to reduce volatility	0.0	0.5	0.5	0.4	0.5	0.0	0.0	0.0	0.0
Put options to accumulate reserves	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Total	4.0	1.5	4.4	2.0	0.5	2.6	3.2	4.2	5.8
As a % of FX purchased by CB	2005	2006	2007	2008	2009	2010	2011	2012	2013
Discretionary	100.0	67.2	89.1	0.0	0.0	0.0	0.0	0.0	0.0
Pre-announced day to day bids	0.0	0.0	0.0	59.5	0.0	100.0	100.0	100.0	100.0
Put options to reduce volatility	0.0	32.8	10.9	21.6	100.0	0.0	0.0	0.0	0.0
Put options to accumulate reserves	0.0	0.0	0.0	18.9	0.0	0.0	0.0	0.0	0.0
Sales of FX	2005	2006	2007	2008	2009	2010	2011	2012	2013
Call options to reduce volatility	0.0	0.8	0.3	0.2	0.3	0.0	0.0	0.0	0.0