

Firm size, liquidity and optimal heterogeneous hedging

Juan Camilo Medellín ¹ & Sergio Restrepo ²

¹Paris School of Economics/Universidad del Rosario

²Banco de la República de Colombia (BdR)

EEA-ESEM Congress
August 26, 2024

- Emerging Market economies benefited from easy access to FC liquidity markets (2000-2014):

- Emerging Market economies benefited from easy access to FC liquidity markets (2000-2014):
 - Strong macro fundamentals

- Emerging Market economies benefited from easy access to FC liquidity markets (2000-2014):
 - Strong macro fundamentals
 - Favorable terms of trade

- Emerging Market economies benefited from easy access to FC liquidity markets (2000-2014):
 - Strong macro fundamentals
 - Favorable terms of trade
 - Low yields and ample liquidity in mature markets

Covered Foreign Currency debt market has underdeveloped

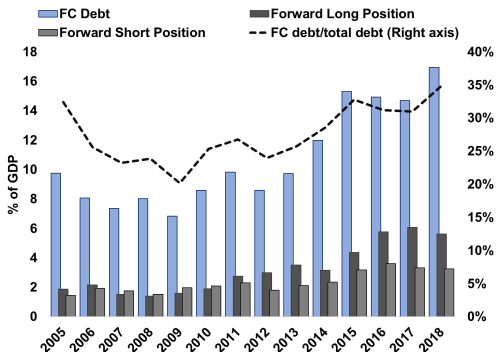


Figure: FC debt and FC forward aggregates of non-financial corporate private sector in Colombia

Why is it important?

- Collapse of commodities' prices: fall in oil prices was detrimental for Colombia

Why is it important?

- Collapse of commodities' prices: fall in oil prices was detrimental for Colombia
- Current account deficit spiked from 3.2% of GDP in 2012 to 6.5% of GDP in 2015; the peso depreciated by 53% against USD

Why is it important?

- Collapse of commodities' prices: fall in oil prices was detrimental for Colombia
- Current account deficit spiked from 3.2% of GDP in 2012 to 6.5% of GDP in 2015; the peso depreciated by 53% against USD
- **The build-up of uncovered FC debt with a volatile and weakening currency is a source of risk and vulnerability:** Eichengreen et al. (2003), Kaminsky and Reinhart (1999), Céspedes et al. (2004)

- What are the reasons behind the heterogeneous hedging of non-financial firms in an Emerging Market Economy such as Colombia?

- What are the reasons behind the heterogeneous hedging of non-financial firms in an Emerging Market Economy such as Colombia?
 - i) Larger firms present smaller shares of covered FC debt (intensive margin)

- What are the reasons behind the heterogeneous hedging of non-financial firms in an Emerging Market Economy such as Colombia?
 - i) Larger firms present smaller shares of covered FC debt (intensive margin)
 - a) Market imperfections: Lack of Liquidity

- What are the reasons behind the heterogeneous hedging of non-financial firms in an Emerging Market Economy such as Colombia?
 - i) Larger firms present smaller shares of covered FC debt (intensive margin)
 - a) Market imperfections: Lack of Liquidity
 - ii) Large firms are prevalent in the derivatives market (extensive margin)

- What are the reasons behind the heterogeneous hedging of non-financial firms in an Emerging Market Economy such as Colombia?
 - i) Larger firms present smaller shares of covered FC debt (intensive margin)
 - a) **Market imperfections: Lack of Liquidity**
 - ii) Large firms are prevalent in the derivatives market (extensive margin)
 - b) **Policy distortions: Foreign Exchange Intervention's Threshold**

Table of Contents

- 1 Introduction
- 2 Data-set, descriptive statistics and stylized facts**
- 3 A theoretical framework
- 4 Econometric Specifications and Results
- 5 Conclusions and Policy Recommendations

The firm level data-set and macro-expectations

- 2005-2013; 215,106 observations; firms from all sectors and sizes
- 40% of formal firms
- Information on:
 - FC liability side of the Balance Sheets, in particular, bonds, loans and trade credit (BdR)
 - FC assets (BdR)
 - FC Forward derivatives at the firm level (BdR)
 - Firm level FDI (BdR)
 - Exports/imports at the firm level: FC revenue/costs (DANE/DIAN)
- Expectations on domestic/international macroeconomic variables come from the Banco de la Republica's survey to analysts and Reuters

- Almost 100% of FC transactions are denominated in USD

Market structure, regulation, illiquidity

Descriptive Statistics

- Almost 100% of FC transactions are denominated in USD
- FC forwards account for 95 (99) percent of the value (number) of operations

Market structure, regulation, illiquidity

Descriptive Statistics

- Almost 100% of FC transactions are denominated in USD
- FC forwards account for 95 (99) percent of the value (number) of operations
- 11.7% of the observations have some type of FC debt and 3.3% have a FC forward contract

Market structure, regulation, illiquidity

Descriptive Statistics

- Almost 100% of FC transactions are denominated in USD
- FC forwards account for 95 (99) percent of the value (number) of operations
- 11.7% of the observations have some type of FC debt and 3.3% have a FC forward contract
- There is limited operational (natural) hedging [Link](#)

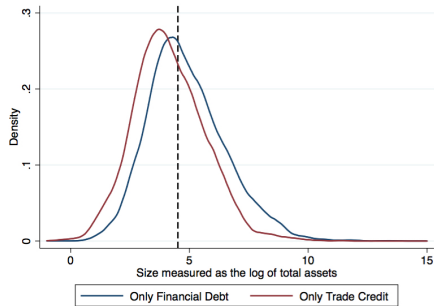
Market structure, regulation, illiquidity

Descriptive Statistics

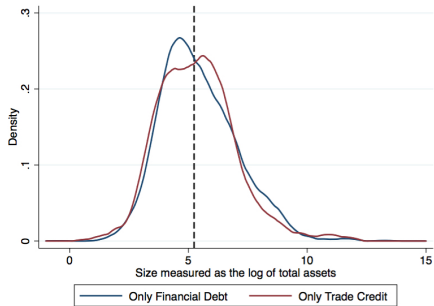
- Almost 100% of FC transactions are denominated in USD
- FC forwards account for 95 (99) percent of the value (number) of operations
- 11.7% of the observations have some type of FC debt and 3.3% have a FC forward contract
- There is limited operational (natural) hedging [Link](#)
- Short positions fit a power law [Link](#)

Market structure, regulation, illiquidity

Size and the extensive margin: Fixed cost



(a) Size by type of FC debt



(b) With FC forwards

Size and the intensive margin: Big firms hedge smaller shares?

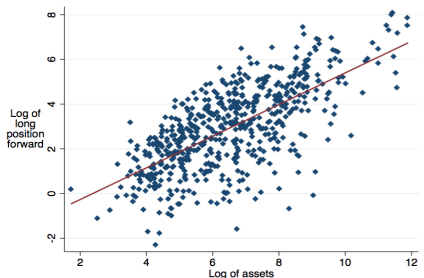


Figure: Long position in the forward market vs firm size

[Link](#)

[Link](#)

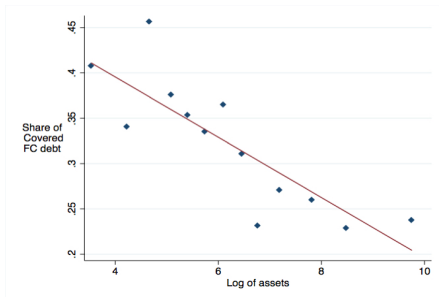
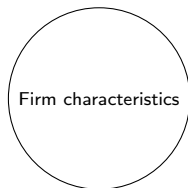


Figure: Share of Covered FC debt vs firm size (controlling for firm FE)(Binscatter, 13 bins); Covered FC debt = long position forward/FC Debt

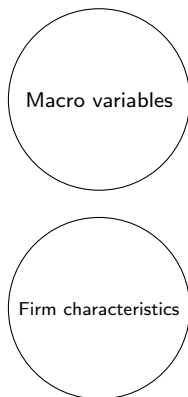
Table of Contents

- 1 Introduction
- 2 Data-set, descriptive statistics and stylized facts
- 3 A theoretical framework**
- 4 Econometric Specifications and Results
- 5 Conclusions and Policy Recommendations

- Partial equilibrium model with reduced form for supply
- Continuum of firms: $i \in [0, 1]$
- Firms are heterogeneous in characteristics
- Two periods

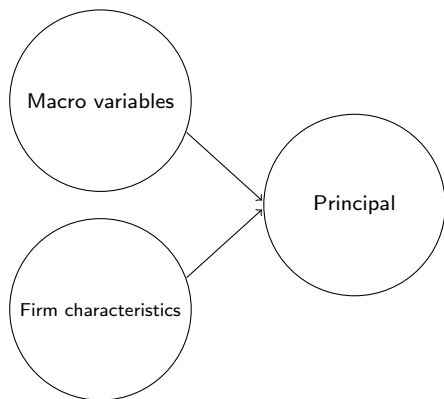


Productivity z_i , risk aversion Ψ_i , share of FC revenue $1 - \theta_i$, firm size m_i , and $E_i[s]$ expectation about second period's exchange rate



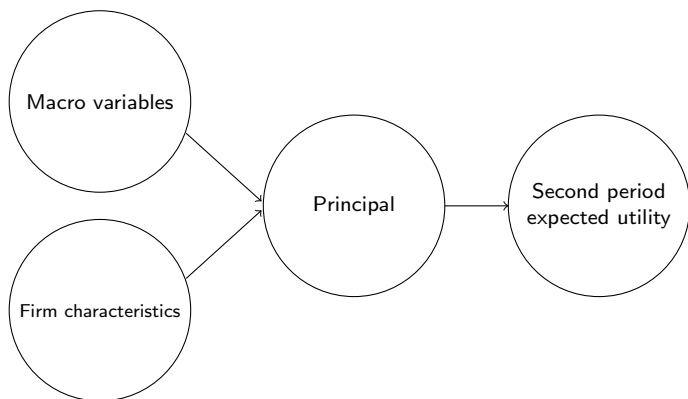
$R^I, R^{FC}, F, K, s \sim \mathcal{N}(E[s], \sigma_s^2)$, in first period equal to one

The model



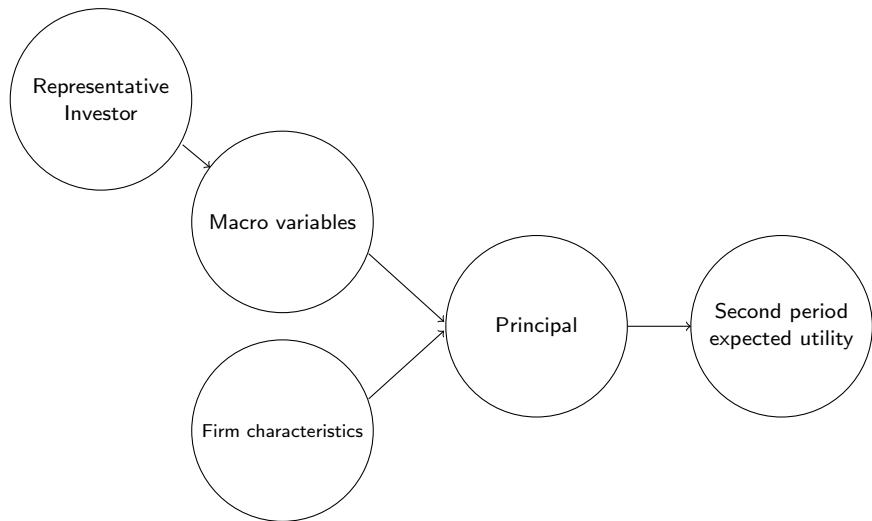
In the first period they choose the currency composition of the principal: $\gamma_i + \alpha_i + \delta_i = 1$

The model



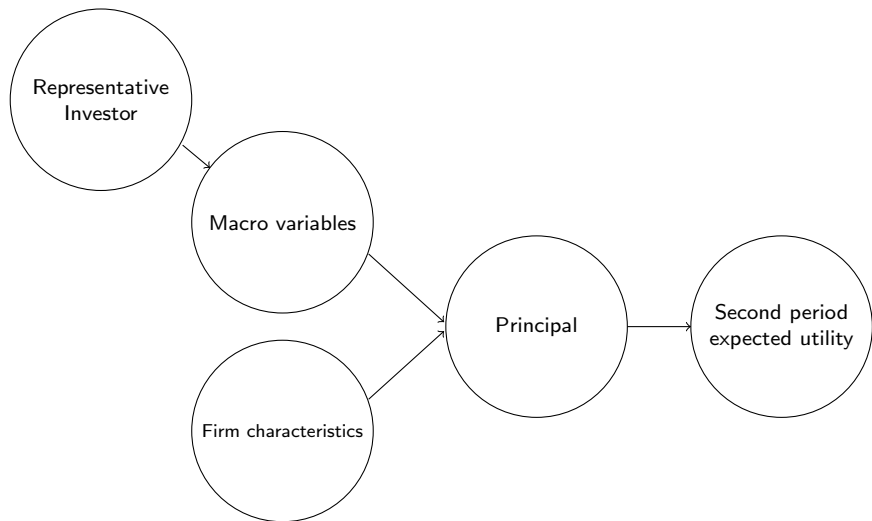
To maximize the second period utility: $E_i[U(\pi_i)] = E_i[-e^{-\Psi_i\pi_i}]$

The model



Representative investor faces ϵ the inverse of market imperfections, and charges F^m ; [Microfoundation](#)

The model



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

The maximization problem: Firm i 's second period expected utility

$$\begin{aligned} \max_{\alpha_i \geq 0, \gamma_i \geq 0, \delta_i \geq 0} E_i[U(\pi_i)] &= E_i[-e^{-\Psi_i \pi_i}] \\ \text{s.t.} & \\ \alpha_i + \delta_i + \gamma_i &= 1 \end{aligned} \tag{1}$$

$$\alpha_i^* = \frac{R^I - R^{FC} E_i[s]}{\Psi_i R^{FC2} \sigma_s^2} + \frac{z_i(1 - \theta_i)}{R^{FC}} \quad (2)$$

$$\delta_i^* = \left(\frac{R^I}{\epsilon R^{FC} F m_i} \right)^{\frac{1}{\epsilon-1}} \quad (3)$$

$$\gamma_i^* = 1 - \alpha_i^* - \delta_i^* \quad (4)$$

[Link](#)[Back](#)[Comparative Statics](#)

Decision to enter the covered FC debt market: Extensive Margin

$$E_i[\pi_i | \alpha_i^*, \delta_i^*, \gamma_i^*] \geq E_i[\pi_i | \alpha_i^*, \gamma_i = 1 - \alpha_i^*] \iff$$
$$R^I \delta_i^* - \left[R^{FC} \delta_i^{*\epsilon} F^{m_i} + \frac{K}{m_i} \right] \geq 0 \quad (5)$$

- Indirect profit function that maps from the set of firm's idiosyncratic parameters and macro variables to a discontinuity region

[Link](#)

[Link](#)

Table of Contents

- 1 Introduction
- 2 Data-set, descriptive statistics and stylized facts
- 3 A theoretical framework
- 4 Econometric Specifications and Results**
- 5 Conclusions and Policy Recommendations

The relationship of FC debt and FC forwards: IV

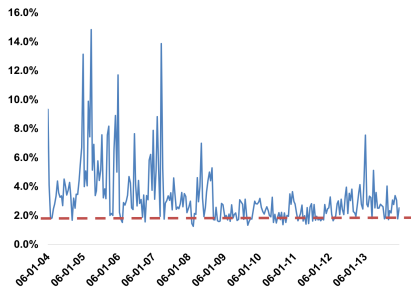


Figure: Excess Reserves

$$\text{Excess Reserves} = \frac{\text{Available Reserves} - \text{Required Reserves}}{\text{Required Reserves}}$$

- Interacted with the share of firm's exports in sales

The relationship of FC debt and FC forwards: IV

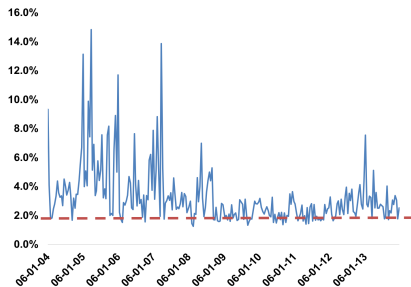


Figure: Excess Reserves

$$\text{Excess Reserves} = \frac{\text{Available Reserves} - \text{Required Reserves}}{\text{Required Reserves}}$$

- Interacted with the share of firm's exports in sales
- The IV does not respect the exclusion restriction given that the CB sterilized the FXI with the bank reserves

[Link](#)

Two Stage Tobit-IV: The drivers of FC debt and forwards

$$FCS_{it} = \beta_1 Exports_{it-1} + \beta_2 Exports_{it-1} * ExcessReserves_t + \beta_3 ExcessReserves_t + \Theta X_{it-1} + \Phi Z_t + \gamma I_{it} + \epsilon_{it}. \quad (6)$$

$$FWDS_{it} = \gamma_1 \hat{FCS}_{it-1} + \gamma_2 Size_{it-1} + \gamma_3 \hat{FCS}_{it-1} * Size_{it-1} + \gamma_4 FXI_t + \gamma_5 \hat{FCS}_{it-1} * FXI_t + \nu X_{it-1} + \psi Z_t + \Omega I_{it} + u_{it}. \quad (7)$$

- $FCS_{it} = FCS_{it}^* 1[FCS_{it}^* \geq 0]$: ratio of FC debt to assets of firm i in year t
- $Exports_{it-1}$: ratio of exports to sales of firm i in year $t - 1$
- X_{it-1} : vector of firm level characteristics
- Z_t : vector of other macroeconomic variables
- I_{it} : vector of interactions of firm characteristics in $t - 1$ and macroeconomic
- $FWDS_{it} = FWDS_{it}^* 1[FWDS_{it}^* \geq 0]$: ratio of FC forwards to liabilities of firm i in year t
- \hat{FCS}_{it-1} : predicted ratio of FC debt to assets of firm i in year $t - 1$
- $Size_{t-1}$: size of firm i in year $t - 1$, defined as the log of assets
- FXI_t : Sterilized FXI as a percentage of the volume transacted in the ER spot market in t

For the average firm foreign and domestic currency debt are complements, while export-oriented firms see them as substitutes

Table: First Stage - Tobit

Variables	(1) Total FC debt	(2) Financial FC debt	(3) Trade Credit
Exports	-0.387*** (0.103)	-0.466*** (0.103)	-0.147*** (0.047)
Excess Reserves	-1.747*** (0.279)	-1.896*** (0.3)	-3.4*** (0.394)
Exports*Excess Reserves	5.806*** (1.47)	13.344*** (1.92)	1.902*** (0.5)
Other firm controls	YES	YES	YES
Other macro controls	YES	YES	YES
Other macro-firm interactions	YES	YES	YES
Partial F-Statistic	24.37	24.81	16.02
Observations	146,954	146,954	146,954

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

Negative relationship between firm size and hedging

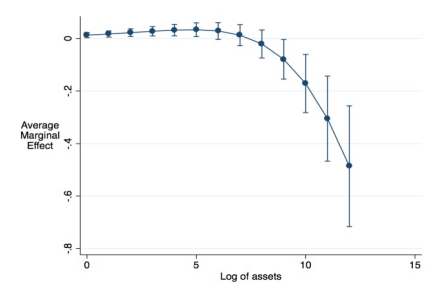


Figure: Average Marginal Effect of FC debt on FC forwards

- Firm log-size distribution of firms with covered financial FC debt: median = 6.4, P75 = 7.8, P90 = 8.8, P99 = 11.5

Bins

Specification and type of debt

link

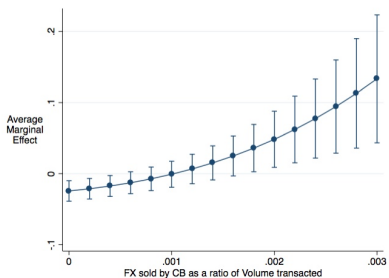
Forward Premium

Liquidity

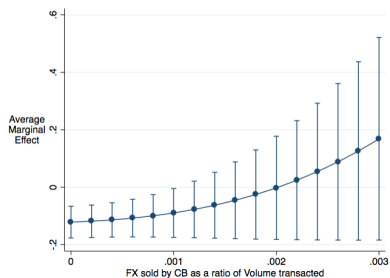
Risk Aversion

Relative small FXI distorts firms' behavior in forward's market

Figure: Average Marginal Effect of FC debt on FC forwards



(a) Financial FC debt



(b) Trade Credit

● FXI: average = 0.002, min = 0, max = 0.008, 5/9 years without FXI

[Link](#)

[link](#)

[Model](#)

[Bins](#)

Table of Contents

- 1 Introduction
- 2 Data-set, descriptive statistics and stylized facts
- 3 A theoretical framework
- 4 Econometric Specifications and Results
- 5 Conclusions and Policy Recommendations**

- We find that the heterogeneous hedging in an EME comes from two sources:
 - Market distortions: The lack of liquidity in the FC forwards market and a high entry cost limits the entrance of small firms and the hedges of big firms
 - Policy induced distortions: Given FXI, firms in the margin opt not to hedge → they feel implicitly protected by the Central Bank
 - More so firms with trade credit

Policy Recommendations

- When an extreme ER depreciation hits the economy:
 - The CB should provide ample liquidity in the derivatives market to avoid higher demand pressures on the spot ER
 - This might reduce the increase in the policy rate and would imply a lower contractionary impact on economic activity
 - This strategy might be more cost-effective than using other policy tools such as Sterilized FXI
 - And most importantly it would not distort the optimal FC derivatives' decisions of firms
- The CB could reassess the calibration of the banks' FC exposure regulation → trade-off between the ER risk faced by banks vs ER risk faced by the real sector

Robustness checks I

- First Stage (Tobit - latent model)
 - With year FE instead of macro variables [link](#)
 - With year FE + filtered Excess Reserves [link](#)
 - With year FE + constant share of exports [link](#)
- Policy distortion
 - Non-linear effect of FXI with Tobit latent model [link](#) [link](#)
- Market imperfections (Tobit - latent model)
 - Firm level variables, year FE + size interacted with FC debt [link](#)
 - Firm level variables, year FE + squared FC debt [link](#) [link](#)
 - Firm level variables, year FE and size squared [link](#)
 - Dependent variable definition closest to the model [link](#)
 - Tobit censored model without outliers [link](#)
 - Price channel (censored, latent and latent without outliers) [link](#)
- Others
 - With FXI as a driver of FC debt [link](#)
 - FE logit + year FE or macro variables [link](#) [link](#)
 - Tobit with firm level variables and year fixed effects [link](#)
 - Tobit with Exclusion of the oil & mining sector [link](#) [link](#)
 - Tobit with time varying coefficients [link](#) [link](#)

- Liquidity
 - Infows/outflows [Link](#)
 - Latent Model [Link](#)
- Financial FC debt as a driver of FC forwards after controlling for trade credit and short positions
 - Latent model without IV [Link](#)
 - Latent model with IV [Link](#)
 - Covered FC debt [Link](#)

References

noframenumbering

- 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.
- 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, Rui Mano, and Mico Mrkaic. Do fx interventions lead to higher fx debt? evidence from firm-level data. *IMF Working Paper*, 20(197), 2020.
- John McDonald and Robert Moffitt. The uses of tobit analysis. *The Review of Economics and Statistics*, 62(2):318–321, 1980.
- 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.
- David Perez-Reyna and Mauricio Villamizar-Villegas. Exchange rate effects of financial regulations. *Journal of International Money and Finance*, 96:228–245, 2019.
- Dimitri Vayanos and Jiang Wang. Market liquidity - theory and empirical evidence. *Handbook of the Economics of Finance*, (Chapter 19), 2013.

- 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 ($\epsilon > 1$)
 - R^I : 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 exchange rate

Microfoundation for F^{m_i}

- Lets define the benefits derived by the representative investor of the intermediation of future FC Δ_i :

$$B_i = I_i + K$$

- Where I_i is the intermediation net income and K is the fixed cost paid by firm i in order to hedge
- I_i is defined as:

$$I_i = \Delta_i(F_i - S(\Delta_i))$$

- Where F_i is the forward exchange rate charged to firm i
- $S(\Delta_i)$ is the search effort done by representative investor in the short side of the market to procure Δ_i FC

Microfoundation for F^{m_i}

- The first order condition with respect to Δ_i is:

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

$$\rightarrow F_i = S(\Delta_i) + S'(\Delta_i)\Delta_i$$

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

- We assume that the search effort is an increasing and convex function of the size of the amount of FC demanded
- Plausible assumption given that Colombia is a granular economy: short positions fit a power law
- In consequence, F_i will be increasing in Δ_i which as we saw in stylized fact 1, maps on a monotonic fashion with respect to size
- Given this, we assume for simplicity and without loss of generality that:
 $F_i = F^{m_i}$

- If we assume that the search effort is inversely proportional to the probability density function of short positions (which fits a power law) $S(\Delta_i) = \frac{1}{\rho(\Delta_i)}$; where $\rho(\Delta_i) = k\Delta_i^{-(\beta+1)}$:

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

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

- With k and c normalizing constants.

Microfoundation for F^{m_i} : extension

- 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:

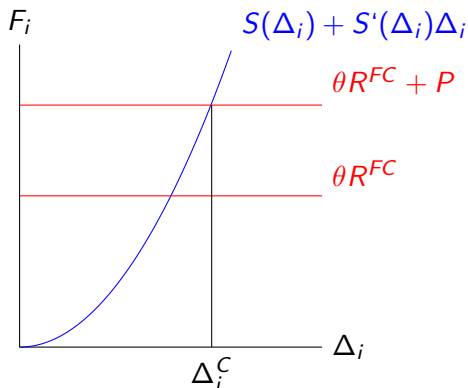
$$I_i = \Delta_i F_i - \min[\Delta_i S(\Delta_i), \theta(R^{FC}(NA^{FC} - \Delta_i) - P\phi_{NA^{FC} - \Delta_i < RegLim})]$$

- 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
- Then, I_i is the minimum between the cost of procuring Δ_i in the short side of the market and reducing the FC net asset position subject to the regulatory limit

- Then the pricing schedule will be:

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

Microfoundation for F^{m_i} : extension



- F_i is not longer a monotonic increasing function of size
- But room for policy: P and $RegLim$

Back

Derivation of results I: Applying expectation operator to utility function and introduction of principal constraint

$$\begin{aligned} E_i[U(\pi_i)] &= E_i[-e^{-\psi_i[z_i[\theta_i+(1-\theta_i)E_i[s]]-R^l(1-\alpha_i-\delta_i)-R^{FC}\alpha_i s-R^{FC}\delta_i^\epsilon F^m i-\frac{K}{m_i}}]} \\ &= -e^{-\psi_i[z_i\theta_i-R^l(1-\alpha_i-\delta_i)-R^{FC}\delta_i^\epsilon F^m i-\frac{K}{m_i}]} \\ &\quad \cdot e^{-\psi_i E_i[s][z_i(1-\theta_i)-R^{FC}\alpha_i]+\frac{\psi_i^2}{2}\sigma_s^2[z_i(1-\theta_i)-R^{FC}\alpha_i]^2} \end{aligned}$$

- 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 :
 $E[e^{ax}] = e^{a\mu_x + \frac{1}{2}a^2\sigma_x^2}$

Derivation of results II: FOC

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

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

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

Back

Comparative statics: $\lim_{\epsilon \rightarrow \infty} \delta_i^* = 1$

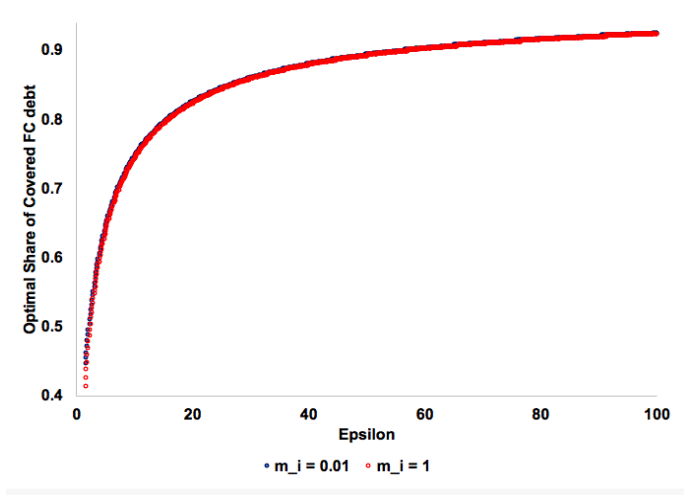


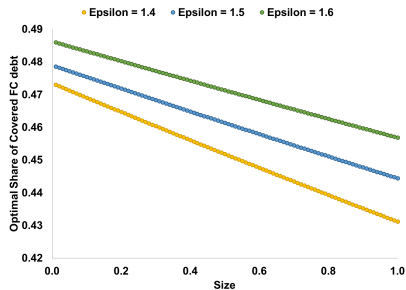
Figure: Optimal Covered FC debt when ϵ gets huge

Optimal covered FC debt comparative statics

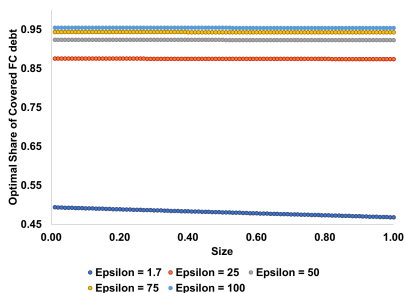
- $\frac{d\delta_i^*}{dF} = \left(\frac{1-m_i}{\epsilon-1}\right)\left(\frac{1}{\epsilon}\right)^{\frac{1}{\epsilon-1}} F^{\frac{1-m_i}{\epsilon-1}-1} \geq 0$
- $\frac{d\delta_i^*}{d\epsilon} = \frac{-\left(\frac{1}{\epsilon}\right)^{\frac{1}{\epsilon-1}} (\epsilon(m_i-1)\log(F) - \epsilon - \epsilon\log(\frac{1}{\epsilon}) + 1) F^{\frac{1-m_i}{\epsilon-1}}}{(\epsilon-1)^2}$
- $\frac{d\delta_i^*}{dm_i} = -\frac{\left(\frac{1}{\epsilon}\right)^{\frac{1}{\epsilon-1}} \log(F) F^{\frac{1-m_i}{\epsilon-1}}}{\epsilon-1} < 0$

Back

Figure: Optimal share of covered FC debt vs ϵ and firm size



(a) $\epsilon \leq 1.6$



(b) Arbitrary and Big ϵ

- 1a) $\frac{d\delta_i^*}{dm_j} < 0$. 1b) $\lim_{\epsilon \rightarrow \infty} \frac{d\delta_i^*}{dm_j} = 0$. 2a) $\frac{d\delta_i^*}{d\epsilon} > 0$. 2b) $\lim_{\epsilon \rightarrow \infty} \delta_i^* = 1$.

[Link](#)

[Link](#)

[Elasticity](#)

[A](#)

[Back](#)

Extensive Margin condition: Concave and non-monotonic in size

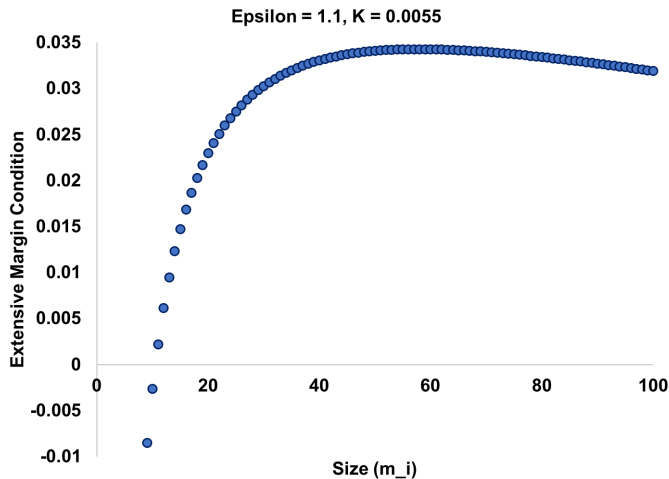


Figure: Extensive margin condition vs size

Extensive Margin condition: Concave and non-monotonic in size

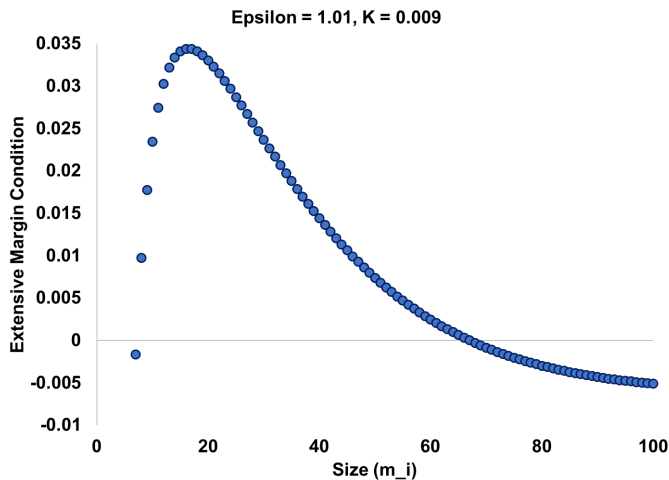


Figure: Extensive margin condition vs size

Derivation of extensive margin results

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

ϵ is part of the elasticity of substitution between debt types

- $$\frac{dE_i[\pi_i]}{d\delta_i} = \frac{dE_i[\pi_i]}{d\alpha_i} \iff \epsilon R^{FC} F^{m_i} \delta_i^{\epsilon-1} = R^{FC} E_i[s] \iff \delta_i^{\epsilon-1} = \frac{E_i[s]}{\epsilon F^{m_i}} \iff (\epsilon - 1) \log(\delta_i) = \log\left(\frac{E_i[s]}{F^{m_i}}\right) - \log(\epsilon) \iff \frac{d\log(\delta_i)}{d\log\left(\frac{E_i[s]}{F^{m_i}}\right)} = \frac{1}{\epsilon-1}$$
- And analogously:
$$\frac{d\log(\delta_i)}{d\log\left(\frac{R^I}{R^{FC} F^{m_i}}\right)} = \frac{1}{\epsilon-1}$$
- The higher ϵ the the more inelastic the demand of firm i for shares of covered FC debt

Back

Marginal cost, optimal condition, arbitrage and equilibrium relationships

- $MC_i = \epsilon R^{FC} F^{m_i} \delta_i^{*\epsilon-1} \iff MC_i = \epsilon R^{FC} F^{m_i} \left(\frac{R^l}{\epsilon R^{FC} F^{m_i}} \right)^{\frac{\epsilon-1}{\epsilon}}$
- Irrespective of size, firm i will choose δ_i^* such that $MC_i = R^l$: **No room for arbitrage in equilibrium**
- Outside of equilibrium arbitrage is difficult:
 - The same share for firms of different size is not equivalent in levels
 - Firms are constrained by their principal and aggregate liquidity
 - \rightarrow Liquidity is not enough for all firms to use the whole principal as covered FC debt
 - \rightarrow The shares arbitrated are not enough to hedge the largest firm in levels
- In equilibrium, irrespective of size, for the marginal unit, firm i will be indifferent between covered FC and domestic debt \rightarrow The representative investor, given the liquidity of the covered FC debt market, allocates the shares of covered FC debt such that in the margin firms are indifferent between domestic currency and covered FC debt

Market participants rarely have a complete hedge: They do not only take covered FC debt

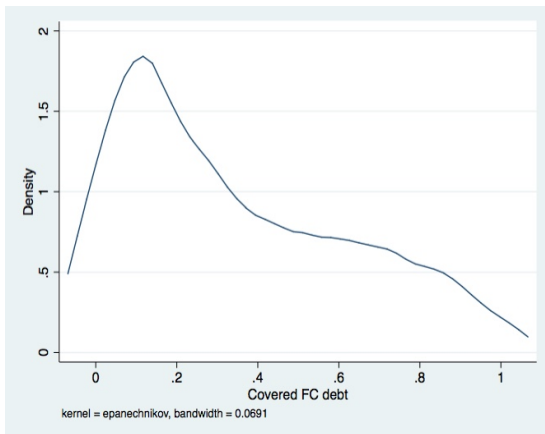


Figure: Covered FC debt = long position forward/FC debt

- The average (median) covered FC debt is 35% (27%)

Operational hedging is very limited: Firms seem to hedge gross exposure

Variables (in logs)	(1)	(2)	(3)	(4)	(5)
	Imports	Total FC debt	Financial FC debt	Trade credit	Exposure
Exports	0.229*** (0.006)	0.323*** (0.007)	0.349*** (0.008)	0.051*** (0.011)	0.33*** (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

Variables (in logs)	(1)	(2)	(3)	(4)
	Total FC debt	Financial FC debt	Trade credit	Exposure
Net Exports	0.559*** (0.012)	0.589*** (0.013)	0.1*** (0.021)	0.583*** (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

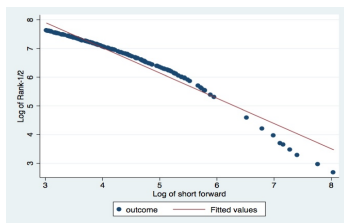
Robust Standard error in parenthesis *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Operational hedging is very limited: Including firm FE weakens even further the operational hedging correlation

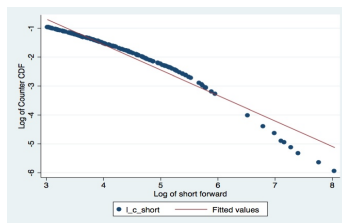
Variables (in logs)	(1)	(2)	(3)	(4)	(5)
	Imports	Total FC debt	Financial FC debt	Trade credit	Exposure
Exports	0.078*** (0.005)	0.03** (0.013)	0.05*** (0.015)	-0.013 (0.019)	0.022* (0.012)
Observations	25,508	12,371	9,687	4,795	11,497
Firm FE	Yes	Yes	Yes	Yes	Yes
R-squared:	0.06	0.14	0.16	0.004	0.15

Variables (in logs)	(1)	(2)	(3)	(4)
	Total FC debt	Financial FC debt	Trade credit	Exposure
Net Exports	0.108*** (0.022)	0.104*** (0.024)	0.06* (0.036)	0.062*** (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

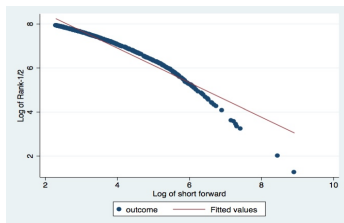
Search effort increasing in size of procured FC Back



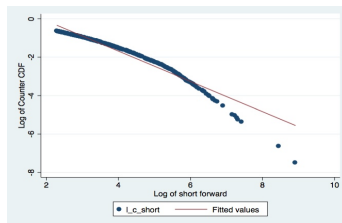
a) Short positions 2005: OLS fit of $\alpha = -.88$; t-student = -58.74; R-squared = 0.953. Fitted for observations above the median. Using Rank.



b) Short positions 2005: OLS fit of $\alpha = -.88$; t-student = -58.19; R-squared = 0.952. Fitted for observations above the median. CCDF.



c) Short positions 2013: OLS fit of $\alpha = -.78$; t-student = -85.19; R-squared = 0.948. Fitted for observations above the median. Using Rank.



d) Short positions 2013: OLS fit of $\alpha = -.79$; t-student = -83.68; R-squared = 0.946. Fitted for observations above the median. Using CCDF.

Is the Colombian forward market illiquid?

- Between 2005 and 2013, the lion share of FC forward were intermediated by banks with foreign investors (Cardozo-Alvarado et al. (2014)):
 - 54 percent of trades were done between banks and offshore agents; 25 percent amongst banks; **only 15 percent between banks and pension funds**

Is the Colombian forward market illiquid?

- Banks in the OTC forward market in Colombia, offset the ER 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: Matching is difficult for large amounts!
 - If they fail to do so, they sell their most liquid FC assets (Cardozo-Alvarado et al. (2014))
 - Banks are subject to constraints on their holdings on foreign assets: the difference between FC assets and liabilities cannot exceed 50% of their capital, and cannot be negative (Mora-Arbelaez et al. (2015))
 - From a theoretical point of view these are features of costly search and bargaining coupled with funding constraints: **Impediments for liquidity (Vayanos and Wang (2013))**

And a binding funding constraint imposed by regulation

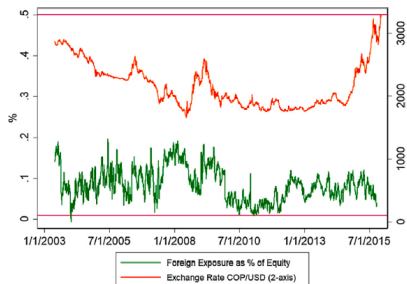


Figure: FC exposure of the financial system as % of equity

- Banks were never close to the upper limit of FC exposure and in very few occasions where below the lower limit
- Perez-Reyna and Villamizar-Villegas (2019) notice that banks have as a relevant lower limit a 1% FC exposure. Banks want to avoid the penalty involved when violating the lower limit
- This restricts the supply of FC forward contracts when banks fail to match the forward contracts within the market

Furthermore, by regulation, banks cannot have a total FC exposure (including derivatives and long term assets) of more than 20% of their equity, or less than -5%

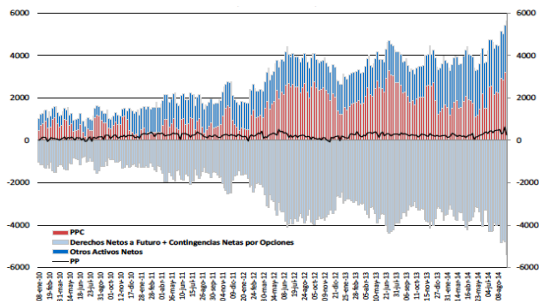


Figure: Total FC exposure of the financial system

- Given these regulations, banks seem to be targeting a constant long run total FC exposure. This might limit further the supply of FC forwards

Robustness: Scatterplot instead of binscatter

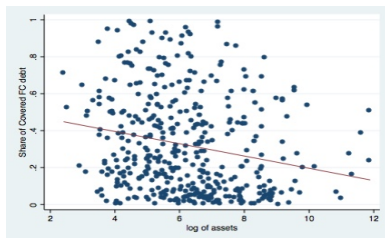


Figure: Share of Covered FC debt vs firm size
(controlling for firm FE);

$R^2 = 0.05$, $t - statistic = -4.5$

Back

Robustness: Both relationships hold without outliers

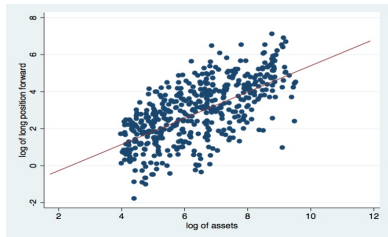


Figure: Long position in the forward market vs firm size

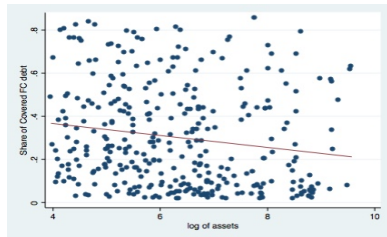


Figure: Share of Covered FC debt vs firm size (controlling for firm FE)

Back

To control for bank variation caused by shifts in risk perception I filter by VIX and Colombian EMBI

Variables	(1)	(2)	(3)	(4)	(5)
	Excess Reserves	Excess Reserves	Excess Reserves	Excess Reserves	Excess Reserves
$\log(emb_{it})$	0.031*** (0.007)			0.038 (0.034)	
$\log(Vix_{it})$	-0.059*** (0.006)			-0.044 (0.027)	
$\log(emb_{it-1})$		0.029*** (0.006)		-0.007 (0.034)	0.025 (0.034)
$\log(Vix_{it-1})$		-0.057*** (0.007)		-0.015 0.026	-0.031 0.027
$\log(emb_{it-2})$			0.03*** (0.006)		0.005 (0.034)
$\log(Vix_{it-2})$			-0.057*** (0.007)		-0.027 (0.027)
Constant	0.034** (0.015)	0.036** (0.015)	0.034** (0.015)	0.038** (0.015)	0.036** (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 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

To control for bank variation caused by shifts in risk perception I filter by VIX and Colombian EMBI

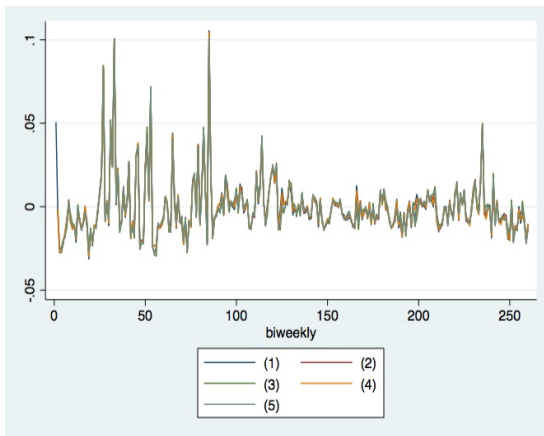


Figure: Excess Reserves filtered by Vix and Colombian EMBI

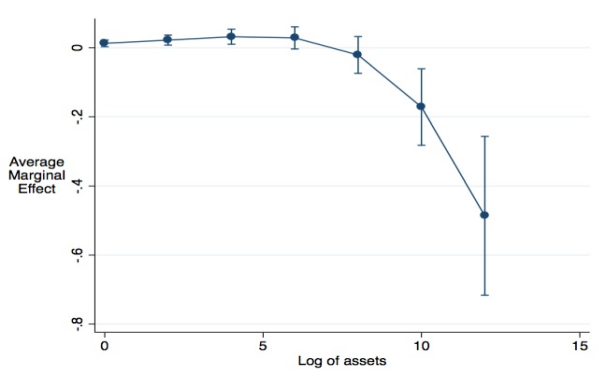
Formula for decomposition

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

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

Back

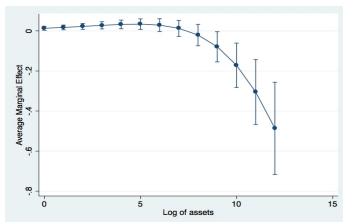
Robustness with less bins



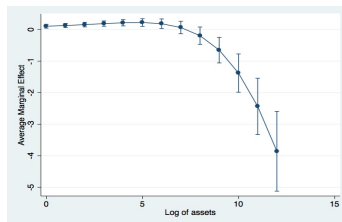
Average Marginal Effect of FC debt on FC forwards

Main

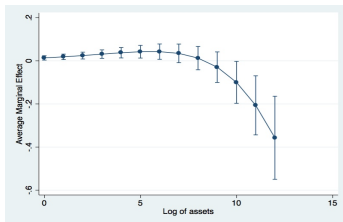
Average Marginal Effect of FC debt on FC forwards



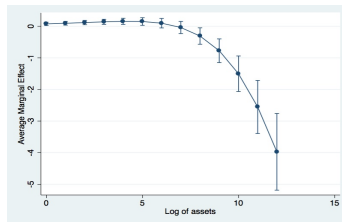
a) Financial FC debt, firm, macro and firm-macro controls (including FXI)



b) Trade Credit, firm, macro and firm-macro controls (including FXI)



c) Financial FC debt, firm controls, and year FE



d) Trade Credit, firm controls, and year FE

AME of forward premium on FC forwards long positions for different firm size

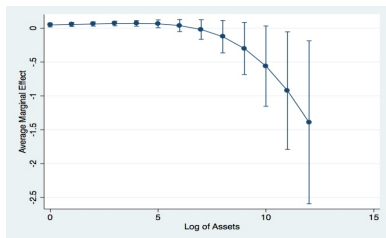


Figure: Financial FC debt, firm, macro and firm-macro controls (including FXI)

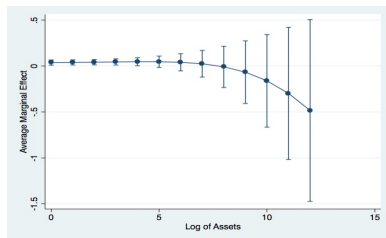


Figure: Trade Credit, firm, macro and firm-macro controls (including FXI)

Back

back

The forward premium is increasing in the quantity of the long positions

Variables	Log Fwd Premium	Log Fwd Premium	Log Fwd Premium	Log Fwd Premium
Log of long position	.045*** (.003)	.007** (.003)	.008** (.004)	.01409*** (.004)
Maturity		-.003*** (.000)	-.003*** (.000)	-.003*** (.000)
Year	YES	YES	YES	YES
Bank	NO	NO	YES	YES
Sector	NO	NO	NO	YES
R-squared	0.29	0.41	0.41	0.41

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

[Back](#)

[back](#)

The forward premium has a non-linear effect in hedging as a function of size

[Back](#)
[back](#)

Variables	(1) Long Position	(2) Long Position	(3) Long Position
Size	0.457*** (0.084)	0.424*** (0.089)	0.492*** (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* (3.133)	7.391** (3.15)	4.391 (3.13)
Size*Forward Premium	-0.782 (0.526)	-1.444** (0.573)	-0.565 (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 error in parenthesis *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Robustness: Without outliers in terms of size

[Back](#)
[back](#)

Variables	(1)	(2)	(3)
	Long Position	Long Position	Long Position
Size	0.764*** (0.154)	0.69*** (0.149)	0.773*** (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 (5.912)	15.185*** (5.528)	-1.902 (5.743)
Size*Forward Premium	0.371 (1.14)	-3.203*** (1.125)	0.837 (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 error in parenthesis *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

AME of 1 p.p increase in the overall CC restrictions index on long position forwards

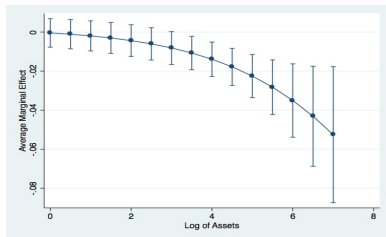


Figure: Financial FC debt

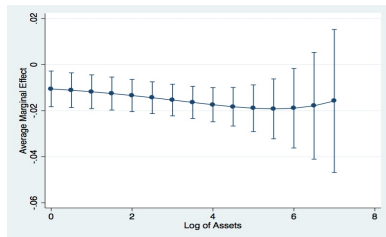


Figure: Trade Credit

[Back](#)

[Inflows/Outflows](#)

[Latent model](#)

[Capital Control Index](#)

AME of 1 p.p increase in the inflows/outflows restriction index on FC forwards long positions for different firm size

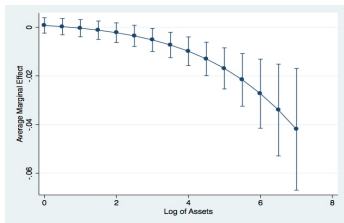


Figure: Financial FC debt - Inflows

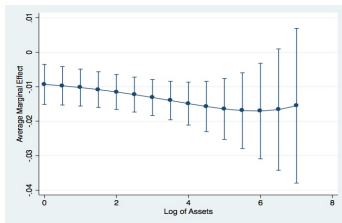


Figure: Trade Credit - Inflows

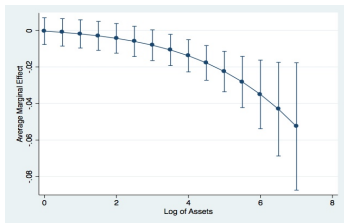


Figure: Financial FC debt - Outflows

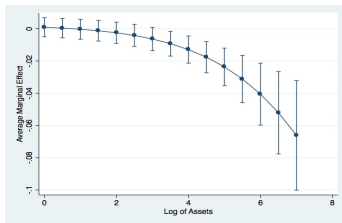
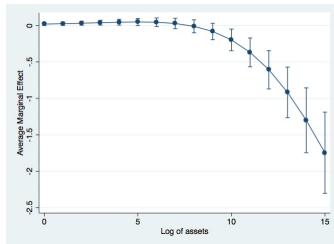
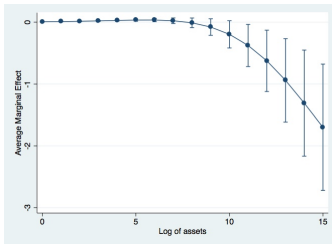


Figure: Trade Credit - Outflows

Tobit vs RE Tobit: Very similar results



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



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

Main

Latent model - financial FC debt

Variables	(1)	(2)
	LP Fwd	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 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

latent Model - trade credit

Variables	(1) LP Fwd	(2) LP Fwd
Size	0.11 (0.11)	0.09 (0.11)
Trade Credit	108.03** (48.7)	112.5** (49.1)
CC Index	-1.82** (0.86)	-1.9** (0.86)
Size*Trade Credit	-11.73* (6.7)	-12.07* (6.73)
Size*CC Index	0.23 (0.18)	0.26 (0.18)
Trade Credit*CC Index	-110.7 (71.2)	-117.6 (71.45)
Size*CC Index*Trade Credit	10.27 (9.94)	10.89 (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 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Back

back

Is the Colombian forward market illiquid? - Empirical Measure

- As an empirical measure of market imperfections that limit the supply of FC in the derivatives market we use the Fernández et al. (2016) Capital Control overall restrictions index
- It is based on the analysis of the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)
- 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, financial credits, derivatives, commercial credits, guarantees, real estate transactions, and FDI
- Using a narrative information, they 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

Capital flows in Colombia have been more restricted in comparison with more efficient economies

Back

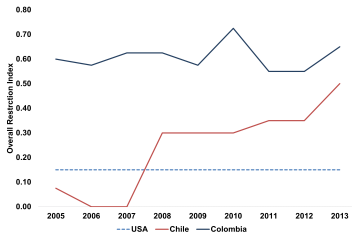


Figure: Overall

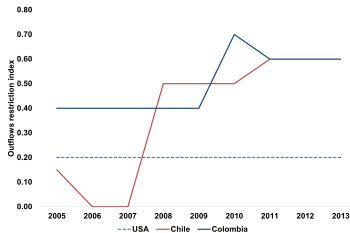


Figure: Outflows

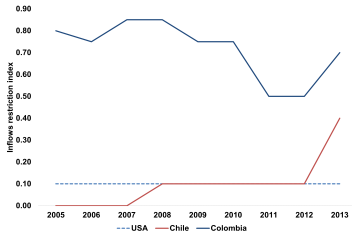


Figure: Inflows

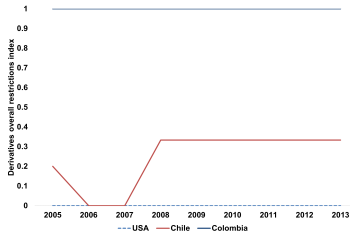


Figure: Derivatives

Suggestions IV: Control for Trade Credit and short positions in the derivatives market: Is financial FC debt still a driver for long positions? **Yes it is**

Variables	(1) LP Fwd	(2) LP Fwd
Size	0.21*** (0.007)	0.2*** (0.007)
Leverage	0.15** (0.07)	0.16*** (0.07)
FC Assets	0.025 (0.017)	0.022 (0.016)
Financial FC debt	0.16** (0.077)	0.15** (0.071)
Trade Credit	-5.5*** (1.47)	-5.71*** (1.5)
SP Fwd		2.59*** (0.29)
Exports	0.0056**** (0.003)	0.006** (0.003)
Foreign	0.47*** (0.003)	0.46*** (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 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The IV specification for financial FC debt: **Non-linearities** in hedging strategies across size hold when controlling for trade credit and short positions!

Back

Variables	(1) LP Fwd	(2) LP Fwd	(3) LP Fwd	(4) LP Fwd
Size	0.22*** (0.008)	0.21*** (0.008)	0.22*** (0.008)	0.22*** (0.009)
Leverage	0.18** (0.07)	0.19*** (0.071)	0.18** (0.07)	0.18** (0.07)
FC Assets	0.033 (0.03)	0.026 (0.028)	0.025 (0.027)	0.025 (0.028)
Instrumented Financial FC debt	-0.5 (0.5)	-0.44 (0.5)	3.21*** (0.88)	3.22*** (0.88)
Instrumented Financial FC debt*Size			-0.56*** (0.13)	-0.56*** (0.13)
Trade Credit	-6.49*** (1.62)	-6.77*** (1.65)	-6.84*** (1.67)	-2.65 (4.08)
Trade Credit*Size				-0.79 (0.84)
SP Fwd		2.87*** (0.36)	2.86*** (1.66)	2.87*** (0.354)
Exports	0.006** (0.003)	0.006** (0.003)	0.0058* (0.003)	0.0058** (0.0032)
Foreign	0.49*** (0.04)	0.48*** (0.039)	0.48*** (0.039)	0.48*** (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 error in parenthesis *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Even when I change the definition of the dependent variable, the non-linearities as a function of size hold

Variables	(1)	(2)	(3)
	LP Fwd/Financial	LP Fwd/Financial	LP Fwd/Financial
Size	0.53*** (0.094)	0.54*** (0.094)	0.47*** (0.093)
Size Squared	-0.016** (0.007)	-0.018** (0.007)	-0.013* (0.007)
Leverage	-0.68** (0.29)	-0.71*** (0.288)	-0.57** (0.283)
FC Assets	0.012 (0.04)	0.018 (0.045)	0.018 (0.044)
Trade Credit		-19.188*** (5.07)	-18.55*** (5.02)
SP Fwd			3.68*** (0.513)
Exports	0.012 (0.009)	0.012 (0.009)	0.013 (0.009)
Foreign	0.014 (0.08)	0.08 (0.084)	0.08 (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 error in parenthesis *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

First stage with year fixed effects

First Stage - Tobit

Variables	(1) Total FC debt	(2) Financial FC debt	(3) Trade Credit
Size	0.052*** (0.0006)	0.06*** (0.0007)	0.026*** (0.0008)
Leverage	0.0208*** (0.006)	0.219*** (0.007)	0.092*** (0.008)
FC Assets	0.012*** (0.004)	0.0121*** (0.004)	0.008 (0.005)
Exports	-0.012*** (0.001)	-0.137*** (0.011)	-0.001 (0.001)
Exports*Excess Reserves	6.586*** (0.38)	7.50*** (0.38)	1.36** (0.53)
Tradable	0.056*** (0.0021)	0.08*** (0.022)	0.005* (0.003)
Foreign	0.097*** (0.0025)	0.043*** (0.003)	0.146*** (0.003)
Other firm controls	YES	YES	YES
Year Fixed Effects	YES	YES	YES
Partial F-Statistic	18	22	10
Observations	163,927	163,927	163,927

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

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

First stage with year FE and filtered Excess Reserves (with EMBI and VIX)

First Stage - Tobit

Variables	(1) Total FC debt	(2) Financial FC debt	(3) Trade Credit
Size	0.052*** (0.0007)	0.06*** (0.0007)	0.026*** (0.0008)
Leverage	0.208*** (0.006)	0.219*** (0.007)	0.092*** (0.008)
FC Assets	0.012*** (0.004)	0.012*** (0.004)	0.008 (0.005)
Exports	0.022*** (0.002)	0.025*** (0.017)	0.006*** (0.002)
Exports*Excess Reserves	9.348*** (0.74)	10.667*** (0.75)	2.174** (1.007)
Tradable	0.055*** (0.0021)	0.079*** (0.022)	0.005* (0.002)
Foreign	0.098*** (0.0025)	0.044*** (0.003)	0.146*** (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: Author's calculations based on SS, DIAN-DANE, SFC and BdR.

First stage with year FE and constant share of exports (first observation per firm)

First Stage - Tobit

Variables	(1) Total FC debt	(2) Financial FC debt	(3) Trade Credit
Size	0.053*** (0.0007)	0.06*** (0.0007)	0.027*** (0.0008)
Leverage	0.147*** (0.001)	0.148*** (0.001)	0.064*** (0.006)
FC Assets	0.011 (0.004)	0.012*** (0.004)	0.007 (0.005)
Exports	0.16*** (0.009)	0.168*** (0.011)	0.05*** (0.012)
Exports*Excess Reserves	1.36** (0.52)	1.9*** (0.53)	0.069 (0.75)
Tradable	0.059*** (0.0021)	0.084*** (0.022)	0.005* (0.003)
Foreign	0.099*** (0.0025)	0.045*** (0.003)	0.146*** (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: Author's calculations based on SS, DIAN-DANE, SFC and BdR.

Second stage: Long Position

Table: Second Stage (Long Position) - 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 (0.698)			-0.167 (0.698)			-3.801* (2.083)		
Financial FC debt		0.72 (0.693)			0.72 (0.693)			-4.681** (2.335)	
Trade Credit			-12.976*** (2.943)			-12.976*** (2.943)			-41.172*** (10.912)
FXI Purchases				49.561*** (12.924)	49.413*** (12.91)	52.52*** (12.956)	46.777*** (13.015)	48.988*** (12.897)	41.126*** (13.569)
FXI Sales				232.98*** (71.253)	230.627*** (71.17)	252.047*** (71.227)	185.837** (73.858)	164.921** (72.264)	167.828** (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: Author's calculations based on SS, DIAN-DANE, SFC and BdR.

Second stage: Short Position

Table: Second Stage (Short Position) - 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*** (0.211)			-2.682*** (0.211)			-3.802*** (0.602)		
Financial FC debt		-2.727*** (0.209)			-2.727*** (0.209)			-3.046*** (0.624)	
Trade Credit			-6.551*** (0.757)			-6.551*** (0.757)			-10.612*** (2.749)
FXI Purchases				-11.166*** (2.887)	-11.492*** (2.886)	-10.831*** (2.885)	-11.365*** (2.911)	-11.409*** (2.894)	-12.267*** (2.987)
FXI Sales				-52.392*** (15.272)	-53.096*** (15.267)	-54.944*** (15.245)	-55.722*** (15.917)	-57.312*** (15.657)	-61.48*** (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: Author's calculations based on SS, DIAN-DANE, SFC and BdR.

Logit FE: The drivers of FC debt with firm level variables and Macro variables or Year FE

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*** (0.0480)	1.130*** (0.0535)	0.693*** (0.0778)	1.340*** (0.0878)	1.753*** (0.0951)	0.221 (0.145)
Leverage	0.766*** (0.184)	0.901*** (0.198)	0.384 (0.309)	0.682*** (0.203)	0.953*** (0.219)	0.321 (0.347)
FC Assets	-0.00336 (0.0422)	0.000144 (0.0425)	1.237** (0.616)	0.0659 (0.0914)	0.0636 (0.0892)	0.892 (0.751)
Net Forwards	-0.554*** (0.152)	-0.579*** (0.161)	-0.556 (0.347)	-0.525*** (0.166)	-0.653*** (0.179)	-0.431 (0.390)
Exports	0.108 (0.0755)	0.102 (0.0722)	0.137 (0.219)	1.998*** (0.406)	3.606*** (0.462)	-0.942 (0.655)
Foreign	-0.0840 (0.106)	-0.0886 (0.109)	-0.148 (0.182)	1.936*** (0.301)	0.205 (0.328)	0.814* (0.485)
E[RER Depreciation]				-0.362* (0.193)	0.304 (0.212)	-2.820*** (0.317)
E[Spread]				-0.0441 (0.0445)	-0.0753 (0.0462)	0.234*** (0.0834)
E[Spread] * Size				0.0190** (0.00956)	0.0195** (0.00975)	-0.00344 (0.0169)
E[Spread] * Foreign				-0.0653* (0.0342)	-0.0839** (0.0355)	0.0658 (0.0606)
E[Spread] * Exports				0.121** (0.0599)	0.212*** (0.0574)	0.000444 (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 error in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Logit FE: The drivers of FC Forwards with firm level variables and Macro variables or Year FE

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*** (0.0719)	0.774*** (0.121)	0.728*** (0.0798)	0.876*** (0.0997)	0.584*** (0.165)	0.926*** (0.108)
Leverage	-0.534* (0.280)	-1.221** (0.483)	-0.304 (0.314)	-0.508* (0.280)	-1.185** (0.478)	-0.258 (0.315)
FC Assets	-0.406 (0.318)	0.00994 (0.122)	-0.258 (0.305)	-0.406 (0.321)	-0.000950 (0.128)	-0.245 (0.306)
Financial FC Debt	1.019*** (0.311)	0.282 (0.405)	1.004*** (0.365)	0.990*** (0.311)	0.361 (0.404)	1.004*** (0.367)
Trade Credit	-2.593** (1.163)	-3.346 (3.472)	-2.606** (1.183)	-2.674** (1.160)	-2.393 (3.348)	-2.631** (1.170)
Exports	-0.00213 (0.0219)	0.0879 (0.0780)	-0.494 (0.336)	-0.0783 (0.190)	-0.333 (0.464)	-1.632** (0.650)
Foreign	-0.281** (0.135)	0.242 (0.233)	-0.440*** (0.139)	0.146 (0.344)	-0.559 (0.533)	-0.288 (0.378)
Forward Premium				-3.612 (3.251)	5.265 (5.797)	-7.182** (3.555)
Forward Premium * Size				0.697 (0.560)	2.392*** (0.875)	-0.0195 (0.607)
Forward Premium * Foreign				1.366 (2.291)	-10.85*** (3.408)	8.399*** (2.591)
Forward Premium * Exports				5.036* (2.865)	3.953 (3.546)	13.51*** (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 error in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Tobit: The drivers of FC debt with firm level variables and year FE - First Stage

Variables	(1) Total FC Debt	(2) Financial FC Debt	(3) Trade Credit
Size	0.0525*** (0.0007)	0.0603*** (0.0009)	0.0265*** (0.0008)
Leverage	0.208*** (0.0224)	0.219*** (0.252)	0.0916*** (0.0160)
FC Assets	0.0120** (0.0052)	0.0122** (0.0051)	0.00758** (0.0039)
Exports	0.00103** (0.0005)	0.001* (0.0005)	0.0005* (0.0003)
Foreign	0.0982*** (0.003)	0.0441*** (0.003)	0.146*** (0.005)
Constant	-0.523*** (0.0065)	-0.564*** (0.0078)	-0.603*** (0.0146)
Observations	144,337	144,337	144,337
Year Fixed Effects and other firm level controls:	Yes	Yes	Yes

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

Back

Tobit: The drivers of FC Purchases with firm level variables and year FE - Second Stage

Variables	(1) Long position	(2) Long position	(3) Long position	(4) Long position	(5) Long position	(6) Long position
Size	0.282*** (0.0130)	0.274*** (0.0126)	0.259*** (0.0101)	0.259*** (0.0168)	0.277*** (0.0144)	0.239*** (0.0116)
Leverage	0.359*** (0.0887)	0.328*** (0.0888)	0.272*** (0.0887)	0.295*** (0.0941)	0.332*** (0.0842)	0.229** (0.0912)
FC Assets	0.0459** (0.0220)	0.0440** (0.0213)	0.0425** (0.0206)	0.0497** (0.0250)	0.0434** (0.0211)	0.0450** (0.0220)
Exports	0.00640* (0.00361)	0.00640* (0.00360)	0.00637* (0.00360)	0.00641* (0.00360)	0.00640* (0.00360)	0.00638* (0.00358)
Foreign	0.598*** (0.0426)	0.516*** (0.0373)	0.733*** (0.0552)	0.551*** (0.0486)	0.519*** (0.0381)	0.591*** (0.0704)
Total FC Debt (IV)	-5.143*** (0.772)			-1.325 (2.028)		
Financial FC Debt (IV)		-4.744*** (0.773)			-5.165*** (1.272)	
Trade Credit (IV)			-18.66*** (2.635)			3.904 (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*** (0.134)	-4.410*** (0.132)	-4.417*** (0.133)	-4.392*** (0.135)	-4.416*** (0.134)	-4.374*** (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 error in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Tobit: The drivers of FC Sales with firm level variables and year FE - Second Stage

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Short position	Short position	Short position	Short position	Short position	Short position
Size	0.144*** (0.00378)	0.146*** (0.00382)	0.123*** (0.00289)	0.137*** (0.00439)	0.143*** (0.00437)	0.120*** (0.00314)
Leverage	0.122*** (0.0208)	0.120*** (0.0206)	0.0582*** (0.0208)	0.103*** (0.0223)	0.113*** (0.0216)	0.0520** (0.0212)
FC Assets	-0.00409 (0.0169)	-0.00549 (0.0194)	-0.00631 (0.0163)	-0.00571 (0.0199)	-0.00596 (0.0204)	-0.00767 (0.0206)
Exports	1.16e-05 (0.000275)	7.47e-06 (0.000276)	-4.74e-05 (0.000271)	1.78e-05 (0.000273)	1.04e-05 (0.000275)	-4.46e-05 (0.000270)
Foreign	0.0642*** (0.00898)	0.0240*** (0.00785)	0.0751*** (0.0119)	0.0507*** (0.00998)	0.0215*** (0.00805)	0.0561*** (0.0148)
Total FC Debt (IV)	-2.925*** (0.212)			-1.709*** (0.501)		
Financial FC Debt (IV)		-3.220*** (0.217)			-2.698*** (0.476)	
Trade Credit (IV)			-5.881*** (0.689)			-2.663 (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*** (0.0275)	-1.322*** (0.0276)	-1.259*** (0.0258)	-1.303*** (0.0274)	-1.315*** (0.0278)	-1.253*** (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 error in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Long positions are a decreasing function of size

Variables	(1) Long Position	(2) Long Position	(3) Long Position
Size	0.423*** (0.345)	0.448*** (0.036)	0.381*** (0.032)
Size squared	-0.023*** (0.0039)	-0.0264*** (0.0041)	-0.014*** (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 error in parenthesis *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

[Back](#)

Covered FC debt is a decreasing function of size (with the exemption of trade credit)

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

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

● Covered FC debt = long position forward/FC debt

Back

Excluding observations outside the 5th to 95th percentiles

- Less pronounced and not significant [Back](#)

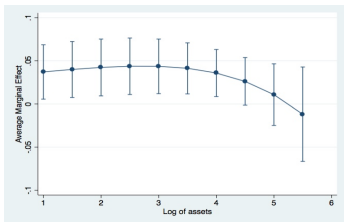


Figure: Financial FC debt, firm, macro and firm-macro controls (including FXI)

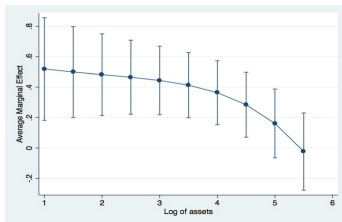


Figure: Trade Credit, firm, macro and firm-macro controls (including FXI)

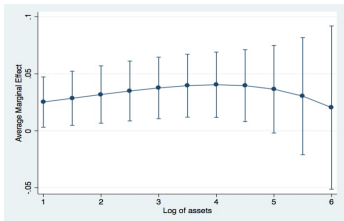


Figure: Financial FC debt, firm controls, and year FE

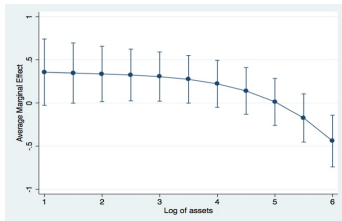


Figure: Trade Credit, firm controls, and year FE

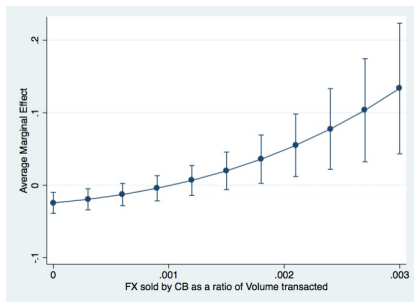
Covered FC debt is a decreasing function of size

Variables	(1) Long Position	(2) Long Position	(3) Long Position
Size	0.246*** (0.15)	0.229*** (0.012)	0.26*** (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

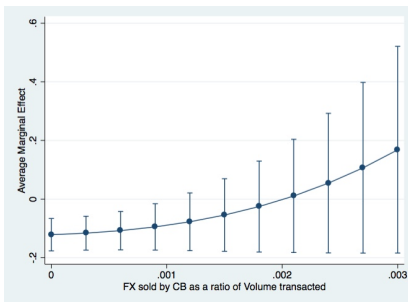
Back

Robustness with less bins

Figure: Average Marginal Effect of FC debt on FC forwards



(a) Financial FC debt



(b) Trade Credit

Tobit: The drivers of FC debt excluding Oil and Mining Sector

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

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

Tobit: The drivers of FC forwards excluding Oil and Mining Sector

Variables	(1)	(2)
	Long position	Short position
Size	0.552*** (0.0864)	12.45* (6.358)
Leverage	0.0753 (0.180)	1.735 (2.063)
FC Assets	0.0353 (0.0346)	-0.264 (0.699)
Financial FC Debt	1.092*** (0.344)	19.58* (11.34)
Trade Credit	-13.53*** (3.646)	14.46* (8.759)
Exports	-2.428** (1.103)	-10.90 (7.260)
Foreign	0.661** (0.323)	-1.969 (40.55)
Forward Premium	9.031** (3.633)	-64.49 (38.89)
Forward Premium*Size	0.166 (0.627)	-5.555 (9.442)
Forward Premium*Foreign	-3.144 (3.029)	140.1 (86.10)
Forward Premium*Exports	8.247*** (3.105)	48.86 (51.92)
Constant	-16.84*** (2.021)	-125.0* (66.62)
Observations	161,063	161,063
Other controls at the Firm, macro and firm-macro interactions:	Yes	Yes

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

FXI as a driver of firm level FC debt

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

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

Time Varying Coefficients for total FC debt: 2005-2013

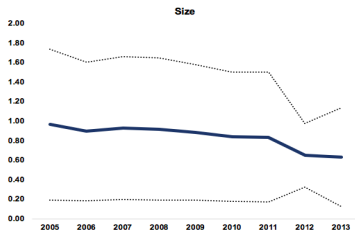


Figure: Size

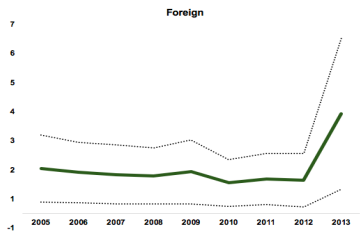


Figure: Foreign

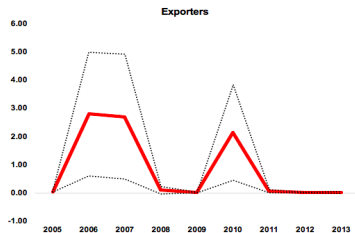


Figure: Exporters

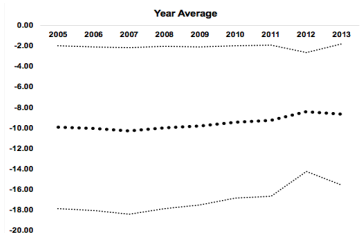


Figure: Year average

Time Varying Coefficients for FC forwards: 2005-2013

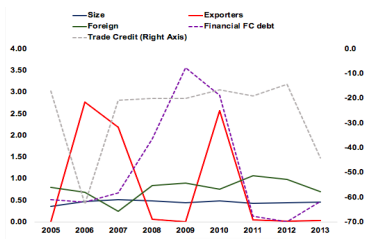


Figure: Long position

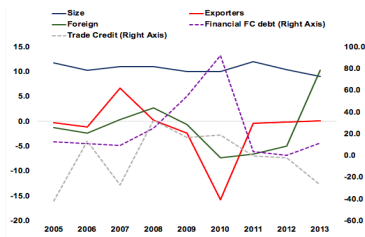


Figure: Short position