

Financial Dollarization in Emerging Markets: Efficient Risk Sharing or Prescription for Disaster?

Lawrence Christiano, Husnu Dalgic and Armen Nurbekyan

Northwestern University, University of Mannheim and Central Bank of Armenia

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Motivation

Emerging markets are characterized by "Financial Dollarization"

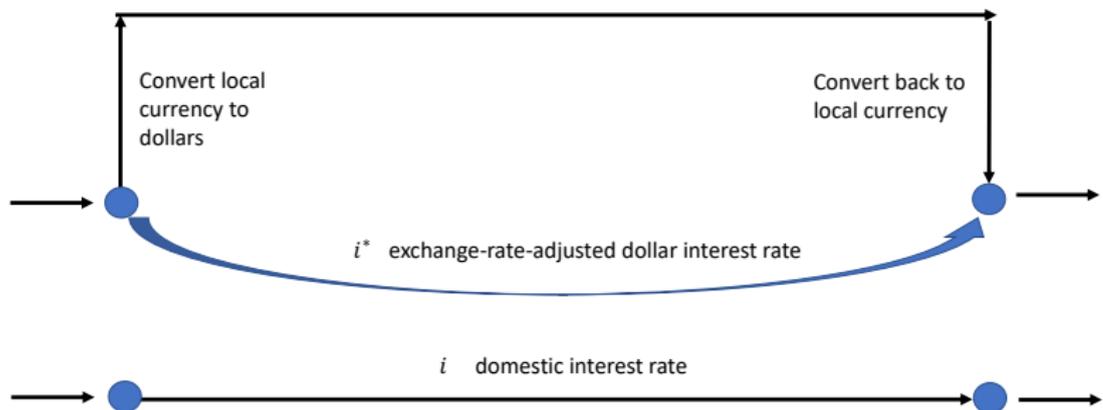
- Credit Dollarization → Firms borrow in foreign currency (FC)
- Deposit Dollarization → Households save in FC

Dollarization: Interpreted as source of financial fragility

Outline

- Deposit Dollarization as an insurance arrangement (Dalgic (2018))
 - ▶ Dollar savings provide good income insurance
 - ▶ Dollarization is driven by demand for insurance
- Cross country evidence: 140 countries 1970-2018
- We find no evidence that dollarization is associated with
 - ▶ Frequency of banking crises
 - ▶ Severity of banking crises
- Examine Peru as a Case Study
 - ▶ Is there evidence that firms with dollar liabilities experience balance sheet constraints after depreciation?
 - ▶ No. Complements results of Bleakley and Cowan (2008) on 5 Latin American economies.
 - ▶ Dollar-borrowing firms are the ones best able to absorb exchange rate shock.
- A simple model motivated by the evidence.

Figure: Local Currency and Dollar Deposits



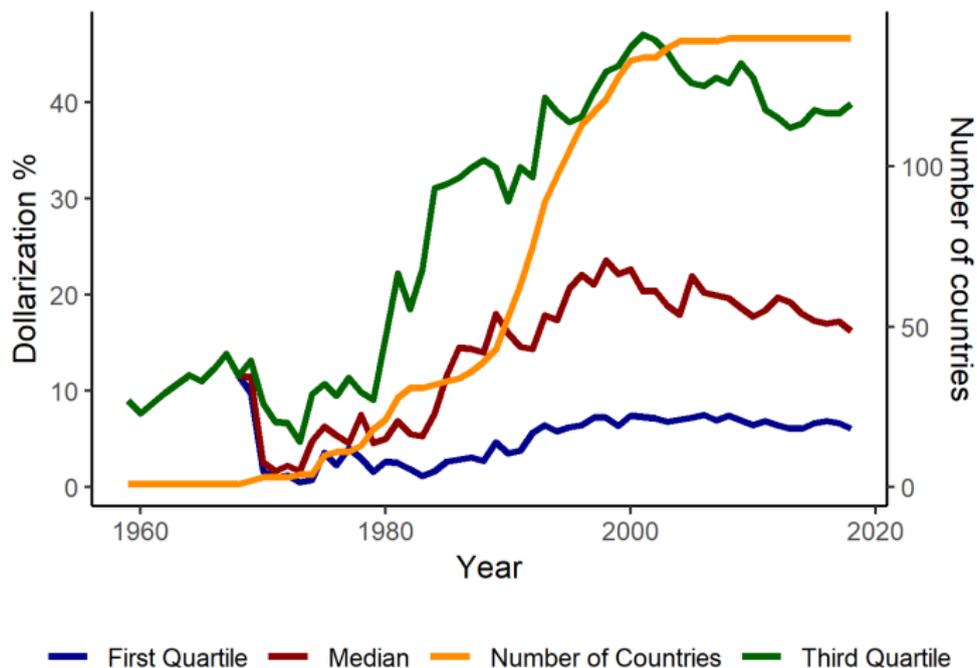
Deposit Dollarization

- Measure of deposit dollarization for a particular country:

$$\frac{\text{value of dollar deposits held by domestic residents}}{\text{total deposits held by domestic residents}}$$

- Dollarization data:
 - ▶ Levy-Yeyati, 2006, 'Financial Dollarization: Evaluating the Consequences', *Economic Policy*.
 - ▶ Data from individual central banks

Deposit Dollarization Still Important



Note: (i) sharp rise in deposit dollarization in 1980s and 1990s; (ii) after 2000, only slight downward trend.

Interpretation

- Our hypothesis: previous scatter reflects causality from cross-country variation in $cov(GDP, S/P)$ to deposit dollarization.
 - ▶ Dollar deposits provide more insurance, if currency depreciates a lot in recession.
 - ★ i^* jumps in a recession, exactly when households have low income.
 - ▶ What would make currency depreciate a lot in a recession?
 - ★ Standard: Disturbances to export demand (Hassan (2011), Gopinath and Stein (2018)), government irresponsibility, [▶ More](#) US crises (Gourinchas, Rey, Govillot (2017)).
- Reverse causality hypothesis:
 - ▶ Sunspots: fear of financial crisis motivates deposit dollarization, resulting currency mismatch in banks/firms causes anticipated crisis.
 - ▶ Will show evidence against this hypothesis.

Interest Rates

- Implication of hypothesis: in a country with high demand for income insurance
 - ▶ Shortage of local currency in loan market $\rightarrow i$ high (foreigners reluctant to supply local currency loans). [▶ More](#)
 - ▶ Relative abundance of dollar deposits $\rightarrow i^*$ low.
 - ▶ Premium on domestic interest rate, $i - i^*$, high.
- Households pay implicit tax to invest in dollars \rightarrow Price of insurance
 - ▶ Forego higher local interest rate i [▶ Computing \$i - i^*\$](#)

Implicit tax on Dollar Deposits

- Earnings on local deposits:

$$i^* \underbrace{d^*}_{\text{dollar deposits in local currency units}} + i \underbrace{d}_{\text{local currency deposits}}$$

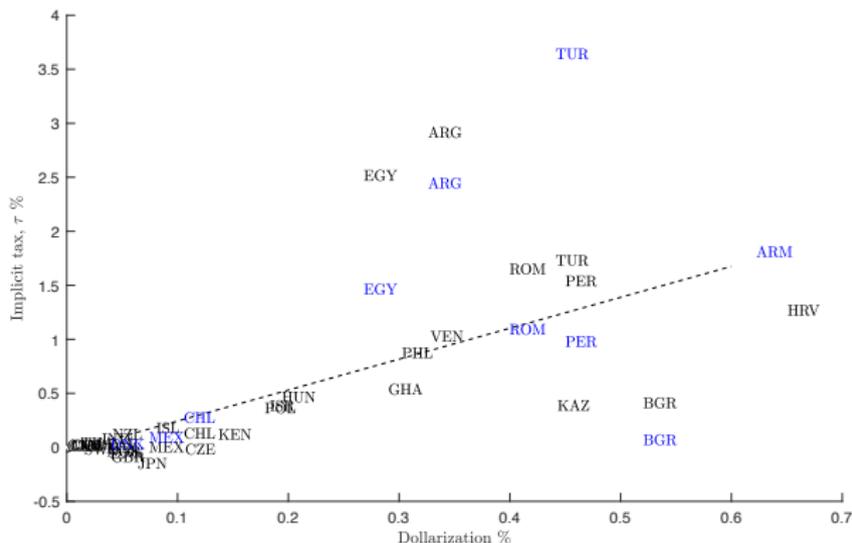
- Pay an implicit tax, τ , to obtain income insurance:

$$(d^* + d) i (1 - \tau) = d^* i^* + di,$$

solving:

$$\tau = \frac{(i - i^*) d^*}{i(d^* + d)}.$$

How Much is the Implicit Tax on Dollar Deposits?



People in countries with high dollarization are paying 0.5 - 1.5 percent on their deposits for income insurance. That's close to what hedge funds make in management fees.

Who is Providing the Insurance to Dollar Depositors?

- Does not appear to be the banks.
 - ▶ Since crises of 1980s and 1990s regulators have become averse to currency mismatch in banks.
- Data from IMF's Financial Soundness Indicators
 - ▶ Net open position in foreign exchange to capital
 - ▶ How much ER depreciation wipes out bank equity?
- Evidence from 115 countries, 2005-2018

Little Currency Mismatch in Banks, 2005-2018

Country	exchange depreciation, s , to wipe out bank assets ($s = S'/S$, $s > 1$ depreciation, $s < 1$ appreciation)
Norway	2.71
Israel	2.99
Switzerland	3.10
Botswana	3.14
Denmark	3.46
Kazakhstan	15.15
Central African Rep	17.81
Bolivia	18.13
Uganda	35.62
Armenia	39.20
Turkey	79.68
Slovak Republic	96.80
Rwanda	98.74
Burundi	211.04
Chad	358.86
Nicaragua	0.01
St. Kitts and Nevis	0.34
Congo	0.38
St. Lucia	0.43
Grenada	0.50
Dominica	0.75

If Not the Banks, then Who is Providing the Insurance?

- Simple Scenario: household deposits \$100 in bank and bank makes dollar-denominated loan to local firms
 - ▶ Households that own the firms provide the insurance (compensated by $i > i^*$).
- Variant of Simple Scenario: household deposits \$100 in bank and bank invests \$100 in T-bills; local firms issue dollar debt to foreigners
 - ▶ Local firms provide insurance.
- Less Relevant Scenario: household deposits \$100 in bank and bank invests \$100 in T-bills; local firms issue local currency debt to foreigners
 - ▶ Foreigners provide insurance, but this seems to be small in data.

If Not the Banks, then Who is Providing the Insurance?

- Data from 15 emerging market economies

	$\frac{\text{dollar deposits}}{\text{total deposits}}$	$\frac{\text{household (hh) dollar deposits}}{\text{firm dollar deposits}}$	$\frac{\text{firm dollars from banks}}{\text{firm dollars from everywhere}}$	$\frac{\text{hh dollar borrowing from banks}}{\text{total dollar deposits}}$	$\frac{\text{total dollar borrowing, firms}}{\text{total dollar deposits}}$
	Deposit			HH Share	NFC Share
	Dollarization				
Average	0.40	1.81	0.82	0.16	0.84
Median	0.36	1.55	0.97	0.13	0.87

- Most dollar deposits are held by households
- Looks like our 'simple scenario'
- Firms appear to bear the full (net) amount of the currency mismatch risk.
- Results are preliminary, still thinking about how to factor gov't, central bank and foreigners into the picture.

Deposit Dollarization as Insurance Arrangement

- Some people (ordinary households), by putting dollar deposits in banks, in effect receive business cycle insurance from others (non-financial firms).
- Dollarization of financial markets looks like many other markets (e.g., commodity futures) in which risk is reallocated among people.
 - ▶ In this respect, seems like deposit dollarization is Pareto improving.

Is Deposit Dollarization Destabilizing?

- For example, when a depreciation occurs in a recession (i.e., i^* is high), then
 - ▶ firms owe banks a lot of money just when they don't have very much.
 - ▶ if firms can't pay money back to banks, then banks in trouble.
- Bottom line: dollarization could (in principle) destabilize the financial system.
- Let's look at the facts....

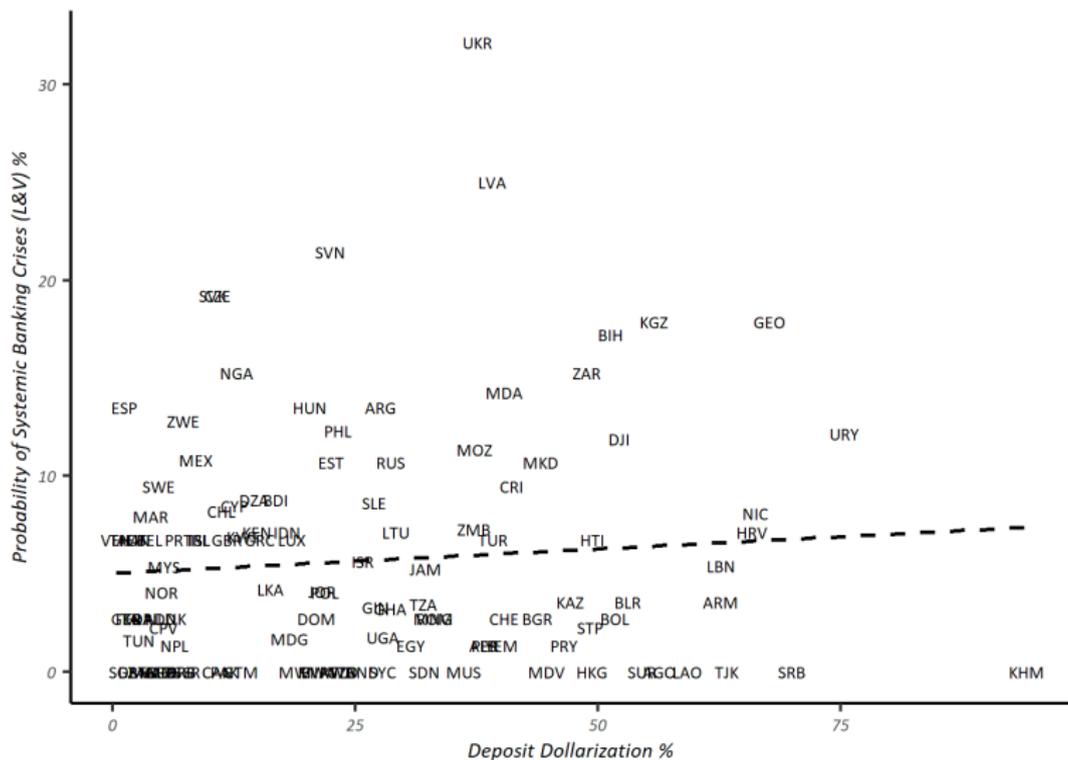
Data

- Data on systemic banking crises taken from Laeven & Valencia, 2018, 'Systemic Banking Crises Revisited'
 - ▶ Crisis:
 - ★ Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations).
 - ★ Significant banking policy intervention measures in response to significant losses in the banking system.
- Data on Sudden Stops from Reinhart and Rogoff (2009), Eichengreen and Gupta (2018).
- Data on cost of crisis: GDP growth from IMF.

Two Questions

- What is relation between deposit dollarization and *frequency* of crisis?
- What is relation between deposit dollarization and *intensity* of crisis when it happens?

Probability of a Banking Crisis versus Deposit Dollarization



Note: 1994-2018

Is Likelihood of Crisis Higher if Currency Depreciates in an Economy with Dollarized Deposits?

- Currency depreciation:
 - ▶ *Expenditure switching channel* - stimulates economy and improves balance sheets.
 - ▶ *Financial Channel* - hurts firms with unhedged dollar liabilities, who may put a drag on the economy by cutting back on investment.
- Levy-Yeyati (Econ Policy, 2006) argues that financial channel dominates expenditure switching channel, when deposit dollarization is above 10 percent.
 - ▶ Eduardo kindly provide us with his own data, but we find that his results are fragile.
[▶ details](#)
- Using our data, we do not find that an exchange rate depreciation is significantly more likely to lead to crisis if the economy has dollarized deposits.
 - ▶ Main predictor of crisis is interest on foreign debt/GDP. Global financial cycle VIX (Rey, 2015)
 - ▶ Too much external borrowing leads to crisis, not deposit dollarization. [▶ finding](#)

Table 4: Probability of Banking Crisis

	(1)	(2)	(3)	(4)	(5)	(6)
	Crisis	Crisis	Crisis	Crisis	Crisis	Crisis
Crisis						
Dollar (20)	-0.435 (-0.75)	-0.167 (-0.25)	-0.164 (-0.24)	0.234 (0.52)	0.0885 (0.13)	-0.0382 (-0.05)
Δer	-0.923* (-1.84)	-3.741 (-0.98)	-3.731 (-0.98)	0.279 (0.50)	-0.0503 (-0.02)	-1.189 (-0.25)
Dollar(20)* Δer	1.652** (2.29)	2.877 (0.56)	2.865 (0.56)	0.392 (0.55)	-0.931 (-0.25)	-1.008 (-0.16)
High FL/FA		1.500** (2.20)	1.479* (1.68)		1.471* (1.75)	1.032 (1.20)
VIX	0.166** (2.47)	0.166*** (2.93)	0.166*** (2.93)	0.0751* (1.78)	0.131*** (2.81)	0.126*** (2.64)
Reserves/GDP		-3.265** (-2.05)	-3.170 (-1.10)		-3.161 (-1.00)	-2.225 (-0.85)
Real GDP Growth		0.0205 (0.26)	0.0203		0.0157 (0.19)	0.0487 (0.61)
High FL/FA * Low Reserves			0.0377 (0.06)		-0.411 (-0.59)	-0.369 (-0.44)
External Debt						0.296*** (4.22)
Constant	-7.535*** (-5.06)	-8.421*** (-5.11)	-8.436*** (-5.16)	-5.994*** (-5.31)	-7.632*** (-5.96)	-7.936*** (-6.22)
N	2262	1524	1524	1919	1445	1186
Years	1995-2017	1995-2017	1995-2017	1995-2017	1995-2017	1995-2017
Countries	All	All	All	EMEs	EMEs	EMEs
Pseudo R2	0.0487	0.0761	0.0762	0.00382	0.0231	0.0356

t statistics in parentheses

* p<0.1, ** p<0.05, *** p<0.01

Table 5: Output Loss in the Event of a Crisis

	(1)	(2)	(3)	(4)	(5)	(6)
	Output Loss	Output Loss	Output Loss	Output Loss	Output Loss	Output Loss
Dollar (20)	-16.07 (-1.25)	-27.24 (-1.70)	-4.827 (-0.20)	-22.72 (-1.01)	-21.12 (-1.05)	37.46 (0.38)
Δer	-51.62 (-0.77)	14.54 (0.25)	95.26 (0.77)	-131.7 (-1.23)	86.66 (0.93)	324.7 (0.43)
Dollar(20)* Δer	42.69 (0.66)	74.05 (0.92)	-15.77 (-0.12)	119.8 (1.14)	-18.14 (-0.13)	-505.4 (-0.95)
VIX	-1.300 (-0.94)	-2.972* (-2.08)	-2.753 (-1.67)	-1.748 (-0.96)	-2.835 (-1.61)	-2.999 (-0.59)
High FL/FA		27.96** (2.40)	51.46 (1.65)		30.25** (2.81)	102.1 (0.68)
Reserves/GDP		67.54 (0.45)	75.29 (0.43)		107.0 (0.68)	16.54 (0.06)
Real GDP Growth		-2.005 (-1.61)	-2.279 (-1.36)		-2.738** (-2.87)	-1.278 (-0.46)
High FL/FA * Dollar (20)			-29.93 (-0.74)			-93.54 (-0.60)
External Debt						-0.0470 (-0.01)
Constant	72.99* (1.77)	102.3** (2.92)	79.01 (1.55)	91.36 (1.71)	90.13** (2.40)	54.25 (0.28)
N	41	18	18	25	15	13
Years	1995-2017	1995-2017	1995-2017	1995-2017	1995-2017	1995-2017
Countries	All	All	All	EMEs	EMEs	EMEs
Adj R2	0.00162	0.360	0.327	-0.0247	0.287	-0.172

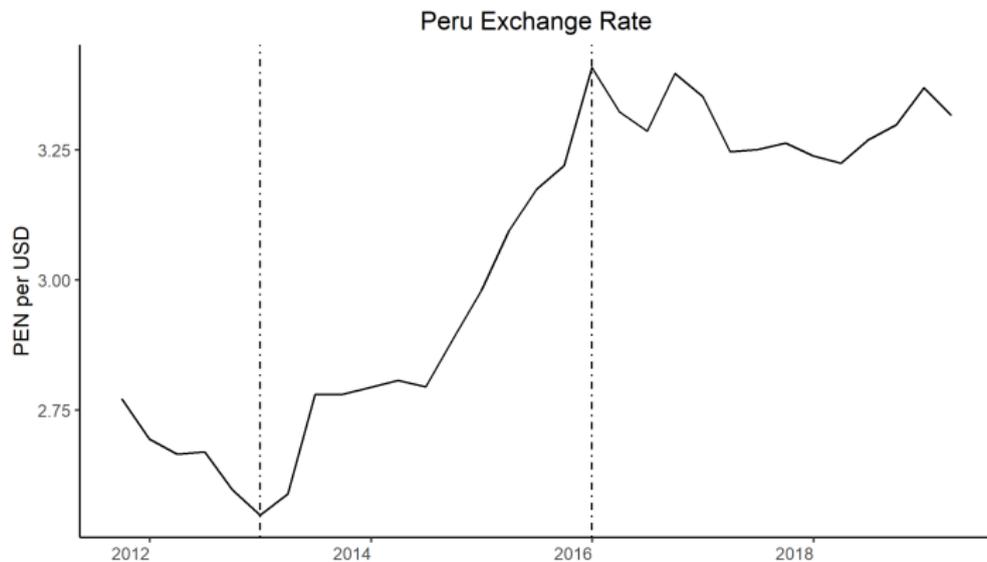
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Dollarization: Another Possible Pitfall

- Even if dollarization does not lead to *crisis*,
 - ▶ Financial channel may inefficiently reduce investment after an exchange rate depreciation.
- Not a lot of evidence that financial channel very big.
 - ▶ Bleakly and Cowan (RESTAT2008), report for 450 firms in 5 Latin American Countries in 1990s, that “firms holding more dollar debt do not invest less than their peso-indebted counterparts following a depreciation.”
 - ▶ We are looking more closely at non-financial firms in individual countries, such as Armenia, Turkey, Peru and others.

Peru: Fairly Big Depreciation Recently



Peru

- Studied two datasets
 - ▶ Quarterly data, 28 largest firms, 2014Q2-2016Q4. [▶ results](#)
 - ★ No evidence that these firms came under stress during recent depreciation.
 - ▶ Annual data, 118 firms, 1999-2014.
- In both data sets, performed stress test and found that firms can tolerate enormous depreciations.
- Question: do they cut back on investment (and, perhaps employment) after a depreciation?

Peru: Balance Sheet Effects

- Evidence from firms in Peru
 - ▶ 118 firms 1999-2014
 - ▶ Investment proxied by $\% \Delta \text{Fixed Assets}$
- Results suggest sales growth and GDP growth are main drivers of investment.
- Currency mismatch does not seem to matter, even for non-exporters.

Investment in a Panel of Peruvian Firms, 1999-2014

Table 6. Balance Sheet Effects

	(1)	(2)	(3)	(4)
	Investment	Investment	Investment	Investment
ΔER	-0.325* (0.188)	0.425 (0.443)	0.503 (0.494)	0.481 (0.535)
Mismatch * ΔER	-0.380 (1.087)	-0.275 (1.124)	-0.0205 (1.580)	-0.0477 (1.585)
Mismatch * Non Exporter * ΔER	0.166 (1.174)	0.208 (1.150)	-0.124 (1.751)	-0.0214 (1.737)
Mismatch		2.264 (2.300)	2.119 (2.587)	3.507 (2.843)
Sales/Assets		5.424** (2.453)	5.378** (2.546)	5.315** (2.614)
GDP		1.948** (0.894)	1.945** (0.904)	1.946** (0.964)
VIX		0.305 (0.265)	0.391 (0.260)	0.379 (0.287)
log(Assets)			-0.0925 (0.829)	-1.728 (1.474)
Leverage			0.155 (0.541)	0.158 (0.506)
Exporter			-0.404 (2.884)	-0.0958 (2.797)
Exporter * ΔER			-0.344 (0.832)	-0.295 (0.818)
Large				8.660* (5.216)
Large * Mismatch				-2.173 (4.936)
Large * Mismatch * ΔER				-0.113 (0.863)
N	1274	1273	1273	1273
R2	0.00428	0.0247	0.0251	0.0297

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

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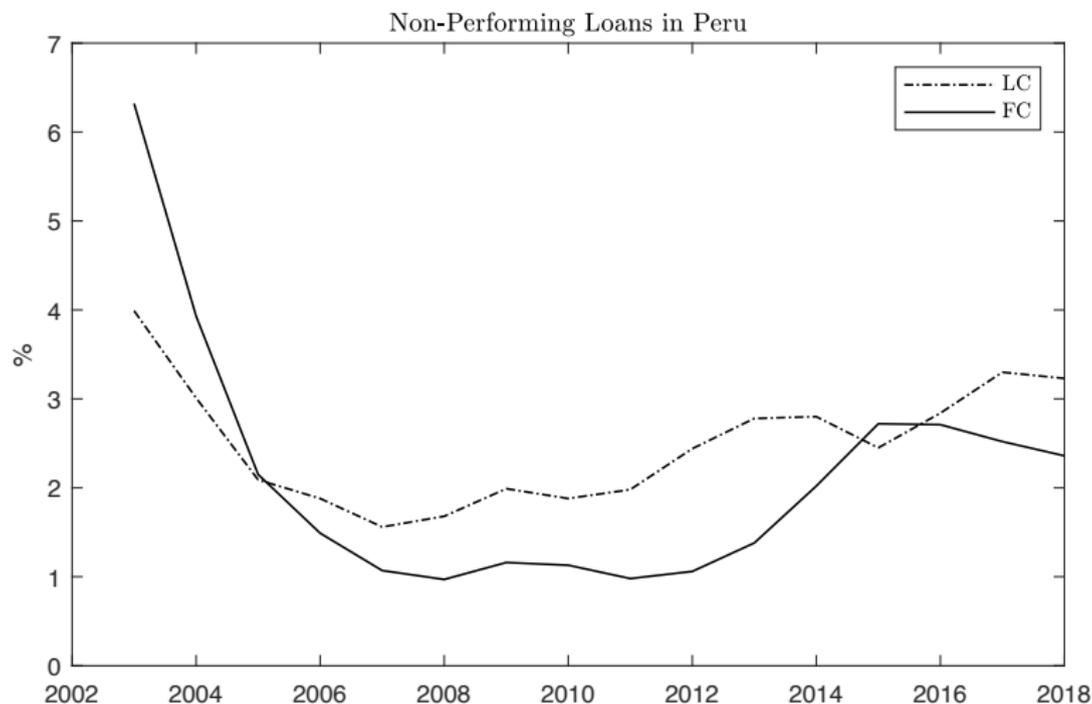
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Peru: Non-performing Local Currency (LC) and Foreign Currency (FC) Loans



Key empirical findings

- ① Exchange rate depreciates a lot in a recession → high deposit dollarization
- ② High deposit dollarization → high interest rate spread
- ③ Deposit dollarization not systematically related to:
 - ① likelihood of financial crisis
 - ② intensity of a crisis if it occurs.

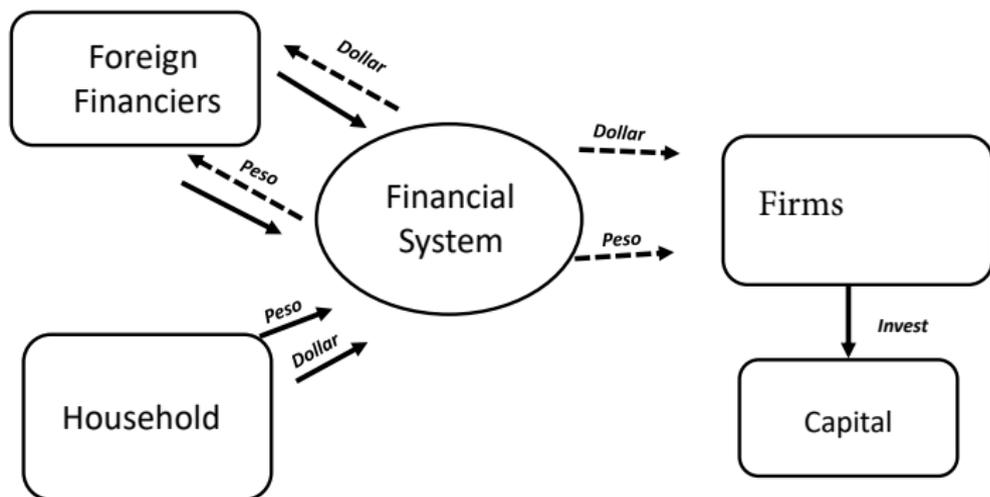
Requirements for Model

- Savers and Borrowers in Domestic Economy.
 - ▶ Necessary to think about insurance between residents of domestic economy.
- Foreigners:
 - ▶ To define exchange rate.
 - ▶ All agents must have clear reasons to trade dollars and pesos.
- Time:
 - ▶ Participants in financial markets need to make their decisions before uncertainty is realized.
 - ▶ Two periods.
- Shocks:
 - ▶ Needed if there is to be uncertainty.

Model

- Agents:
 - ▶ Households: Provide labor
 - ▶ Firms: Produce capital in first period, run it in the second period using labor
 - ▶ Foreign financiers: Borrow/lend in a domestic and foreign asset
 - ▶ All agents have similar problems, differentiated by sources of income, which produce different hedging needs.
- 2 periods
 - ▶ Period 1: Saving, capital production (no financial frictions), exports and imports
 - ▶ Period 2: Shocks realized, production, exports and imports, consumption
- 2 goods
 - ▶ Home good: Produced locally, exported
 - ▶ Foreign good: Imported
- 2 assets
 - ▶ 'Dollar': Promises r^* unit of Foreign good in period 2, per unit of period 1 domestic good.
 - ▶ 'Peso': r units of Home good in period 2, per unit of domestic good

Investment in a Panel of Peruvian Firms, 1999-2014



Worker Households

Period 1

- Households are endowed with Y units of Home good
- Save in dollar and peso assets

$$d + d^* = Y$$

Period 2

- Provides labor
- Consumption takes place

$$c_2^{house} = dr + d^* r^* e_2 + w_2 l_2$$

Worker Households

- Household problem,

$$\max_{d, d^*} E c_2^{house} - \frac{\lambda}{2} \text{var} (c_2^{house})$$

- Intertemporal budget constraint

$$c_2^{house} = (e_2 r^* - r) d^* + w_2 + Yr.$$

- Household portfolio choice

$$d^* = \frac{\overbrace{E(e_2 r^* - r)}^{\text{Speculative motive}}}{\lambda \text{var}(r^* e_2)} - \frac{\overbrace{\text{cov}(r^* e_2, w_2)}^{\text{Hedging motive}}}{\text{var}(r^* e_2)}$$

Firm-Households

Period 1

- Firms lack internal funds
- Borrow to invest
- Need foreign goods to produce K and p^K is shadow price:

$$p^K K = b + b^*.$$

Period 2

- Production

$$Y_2^h = (A_2 K)^\alpha l_2^{1-\alpha}$$

- Consumption

$$c_2^{firm} = r_2^K K - (br + b^* e_2 r^*)$$

Firm-Households

- Firm problem,

$$\max_{b^*, b, K} E(c_2^{firm}) - \frac{\lambda}{2} \text{var}(c_2^{firm})$$

- Period $t = 2$ budget constraint

$$c_2^{firm} = (r_2^K - p^K r) K - b^* (e_2 r^* - r).$$

- Firm choice,

$$b^* = -\frac{E(e_2 r^* - r)}{\text{var}(e_2 r^*) \lambda} + \frac{\text{cov}(e_2 r^*, r_2^K)}{\text{var}(e_2 r^*)} K$$
$$K = \frac{E(r_2^K - p^K r)}{\text{var}(r_2^K) \lambda} + b^* \frac{\text{cov}(e_2 r^*, r_2^K)}{\text{var}(r_2^K)}$$

Foreign Financiers

- Borrow in dollar asset market \rightarrow Make loans in domestic credit market
 - ▶ Dollar loans: $x^{\$}$, Peso loans: x^D
 - ▶ Loans are in units of foreign goods (e.g., 'dollars')
 - ▶ Total position: $x^{\$} + x^D = b^f$
- Exogenous income Y_2^f : correlated with export demand shifter Y_2^*
- Period 2 income (by arbitrage, $r^{\$} = e_1 r^*$):

$$x^{\$} e_1 r^* + \frac{x^D e_1 r}{e_2} - b^f r^{\$} + Y_2^f$$

- Foreign financier problem,

$$\max_{x^D} E \left(x^D e_1 \left(\frac{r}{e_2} - r^* \right) + Y_2^f \right) - \frac{\lambda^f}{2} \text{var} \left(x^D e_1 \left(\frac{r}{e_2} - r^* \right) + Y_2^f \right).$$

Foreign Financiers

- The solution to foreign financier problem,

$$x^D = \frac{\overbrace{E\left(\frac{r}{e_2} - r^*\right)}^{\text{Speculative Motive}}}{e_1 \text{var}\left(\frac{r}{e_2}\right) \lambda^f} - \frac{\overbrace{\text{Cov}\left(\frac{r}{e_2}, Y_2^f\right)}^{\text{Hedging Motive}}}{e_1 \text{var}\left(\frac{r}{e_2}\right)}$$

- If the exchange rate depreciates (e_2 high) when Y_2^f is low, covariance is positive
 - ▶ Financiers require risk premium to invest in peso assets (they are like the households).
- If the covariance is large, financiers do not want to invest in peso assets at all.
 - ▶ Related to large literature that suggests EME risk hard to diversify.

Equilibrium in Goods Market - Period 1

- Firms build capital K using domestic, k_h , and foreign, k_f , inputs

$$K = k_h^\omega k_f^{1-\omega}$$

- Foreigners demand c_1^*

$$c_1^* = \omega e_1^\eta Y^*, \eta > 0$$

- Goods market equilibrium

$$\begin{array}{ccccc} \text{Exports} & & \text{Domestic input} & & \text{Endowment} \\ \underbrace{c_1^*} & + & \underbrace{k_h} & = & \underbrace{Y} \end{array}$$

Equilibrium in Financial Markets - Period 1

- Financial markets clearing,
 - ▶ Peso asset market

$$\begin{array}{ccccc} \text{Domestic savings} & & \text{Foreign lending} & & \text{Total Borrowing} \\ \underbrace{d} & + & \underbrace{x^D e_1} & = & \underbrace{b} \end{array}$$

- Dollar asset market

$$d^* + x^{\$} e_1 = b^*$$

- Balance of payments,

$$\underbrace{c_1^* - e_1 k_f}_{\text{Trade Balance}} = \underbrace{d + d^* - (b + b^*)}_{\text{Net Asset Acquisition}}$$

Equilibrium - Period 2

- Final consumption good

$$c_2 = A \left[\omega_c^{\frac{1}{\delta}} (c_2^h)^{\frac{\delta-1}{\delta}} + (1 - \omega_c)^{\frac{1}{\delta}} (c_2^f)^{\frac{\delta-1}{\delta}} \right]^{\frac{\delta}{\delta-1}}, \quad A = \omega_c^{\omega_c} (1 - \omega_c)^{1-\omega_c}$$

- Production

$$Y_2^h = (A_2 K)^\alpha$$

- Goods market equilibrium

$$Y_2^h = \overbrace{c_2^h}^{\text{Domestic Consumption}} + \overbrace{c_2^*}^{\text{Exports}}, \quad c_2^* = \left(\frac{p_2^h}{e_2} \right)^{-\eta} Y_2^*$$

- Balance of Payments: $p_2^h c_2^* - e_2 c_2^f = (b - d) r + (b^* - d^*) r^* e_2$

Shocks - Uncertainty

- Export demand

$$Y_2^* = \xi + \nu$$

- Foreign financiers' income shock

$$Y_2^f = s\nu$$

- Export demand and foreign income shocks are correlated

$$\text{Cov}(Y_2^f, Y_2^*) = s \times \sigma_\nu^2$$

- Productivity shock A_2

Results

- We have analytic results for special cases.
- Mainly focus on numerical results.
- We are able to construct a panel of countries in which bigger depreciations in recession lead to:
 - ▶ more deposit dollarization by worker-households
 - ▶ higher premium on domestic (Peso) interest rate.

Interest Rate Spread

- Household and firm choices

$$b^* = -\frac{E(e_2 r^* - r)}{\text{var}(e_2 r^*) \lambda} + \frac{\text{cov}(e_2 r^*, r_2^k)}{\text{var}(e_2 r^*)} K$$
$$d^* = \frac{E(e_2 r^* - r)}{\lambda \text{var}(r^* e_2)} - \frac{\text{cov}(r^* e_2, w_2)}{\text{var}(r^* e_2)}$$

Use $GDP_2 = p_2^h Y_2^h = w_2 + r_2^k K$

- For the case $b^* - d^*$ small, we have the interest rate spread,

$$E(r - e_2 r^*) = -\frac{1}{2} \lambda \text{cov}(r^* e_2, GDP_2)$$

Calibration Targets

Table 9: Endogenous Variables and Corresponding Values for Peru

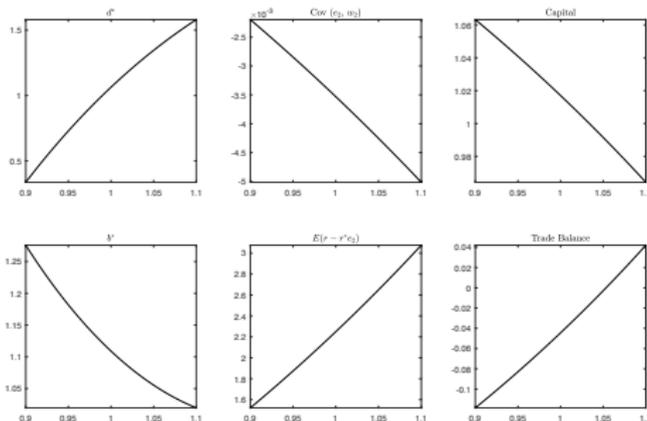
Variable	Description	Value	Peru
$\frac{p^K K}{Y} = \frac{b+b^*}{d+d^*} (1)$	Capital-output ratio	1.02	
$100 \times (r - 1)$	Domestic Rate	-0.3%	-0.3%
$E(e_2 r^*)$	Expected Dollar Rate	0.974	
$100 \times E(r - e_2 r^*)$	Spread (domestic agents)	2.25%	2.20% ⁽⁶⁾
$100 \times E(\frac{r}{e_2} - r^*)$	Spread (financier)	2.36%	
$d^* / (d^* + d)$	Deposit Dollarization	0.59	0.44 ⁽²⁾
$\frac{b-d}{b}$	Foreign Source of Peso Credit	-0.00	0.01 ⁽³⁾
$\frac{d^*-b^*}{d^*}$	Foreign Absorption of Dollar Deposits	-0.04	-0.37 ⁽³⁾
$b^* / (b + b^*)$	Credit Dollarization	0.60	0.40 ⁽³⁾
$\frac{c_1^* - \varepsilon_1 k_f}{Y}$	Trade Surplus (share of GDP)	-0.02	-0.02 ⁽⁴⁾
$100 \times \frac{E(r - r^* e_2)}{r} \frac{d^*}{d^* + d}$	Implicit tax on dollar deposits	1.3%	1.5% ⁽⁵⁾
ρ	Correlation, e_2, GDP	-0.21	-0.20 ⁽⁷⁾

Parameter	Description	Value
α	Capital Share, (11)	0.42
λ	Risk aversion, domestic residents (4), (14)	7.34
λ^F	Risk aversion, foreign financiers (22)	7.34
η	Elasticity of demand for exports, (28), (33)	6.61
δ	Elasticity of substitution (domestic final goods in period 2), (24)	1.00
$r^{\$}$	USD real interest rate, (17)	1
Y^*	Period 1 trade demand, (28)	0.53
s	Covariance parameter, financiers, (20)	7.39
ω	Investment home-bias, (7)	0.71
ω_c	Consumption home-bias, (24)	0.74
Y	Period 1 GDP, (1)	1.80
μ_A	Mean productivity, (11)	8.80
μ_ξ	Mean, ξ shock to foreign demand, (19)	5.79
μ_ν	Mean, ν shock to foreign demand, (19)	1.73
σ_A	Std dev productivity, (11)	$0.13\mu_A$
σ_ξ	Std dev ξ shock to foreign demand, (19)	$0.63\mu_\xi$
σ_ν	Std dev ν shock to foreign demand, (19)	$0.14\mu_\nu$

Note: model parameters selected to optimize a penalty function based on discrepancy between the entries in the ‘Peru’ and ‘Value’ columns in Table 2. Numbers in parentheses correspond to equations where the associated parameter is first used.

Increase in Volatility of Export Demand

- Increase standard deviation of export demand shock
 - ▶ $Cov(r^* e_2, GDP)$ becomes more negative, households save in dollars.
 - ▶ Firms more averse to dollar loans, shift into (higher interest) local currency loans.
 - ★ Firms scale back, K falls.
 - ▶ Premium on domestic interest rate rises.
 - ▶ Higher net asset accumulation, $d + d^* - (b + b^*)$, trade surplus rises (BOP).

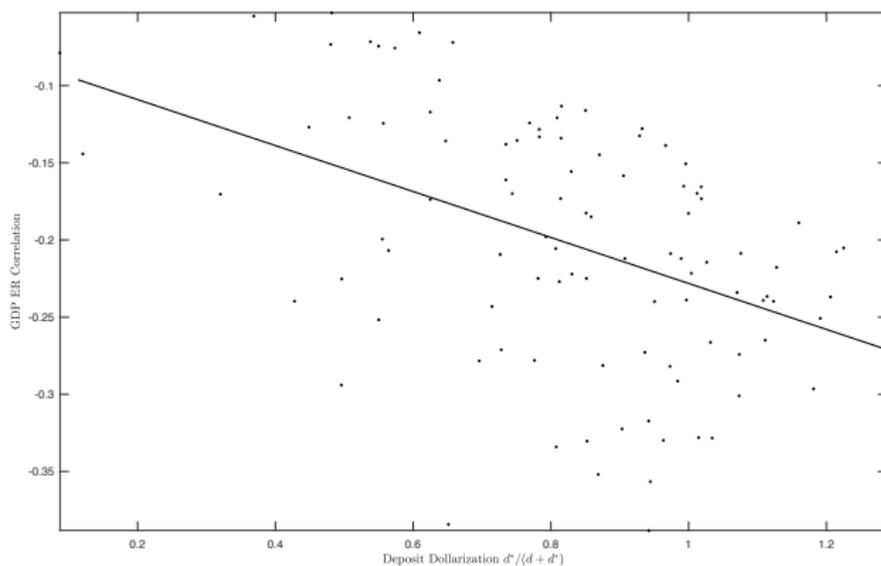


Other Experiments

- Increase volatility of technology shock:
 - ▶ Results change substantially, exchange rate appreciates in recession, so households don't want dollar assets.
- Increase risk aversion of foreign financiers:
 - ▶ increase λ^f
 - ▶ increase, s , $Cov(Y_2^f, Y_2^*) = s \times \sigma_v^2$
 - ▶ this makes $d^* = b^*$, so insurance arrangement exclusively between domestic firms and domestic households.

Dollarization vs GDP-ER Correlation

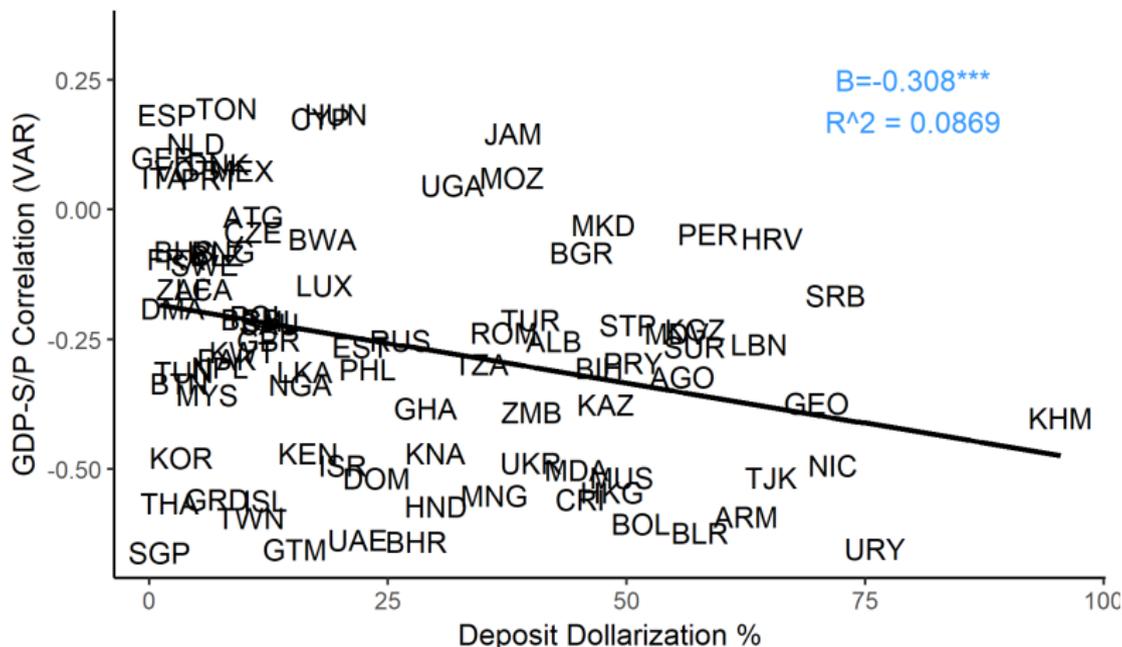
- Simulate different countries by simulating different values for model parameters
 - ▶ Standard deviation of trade, foreign income, productivity shocks



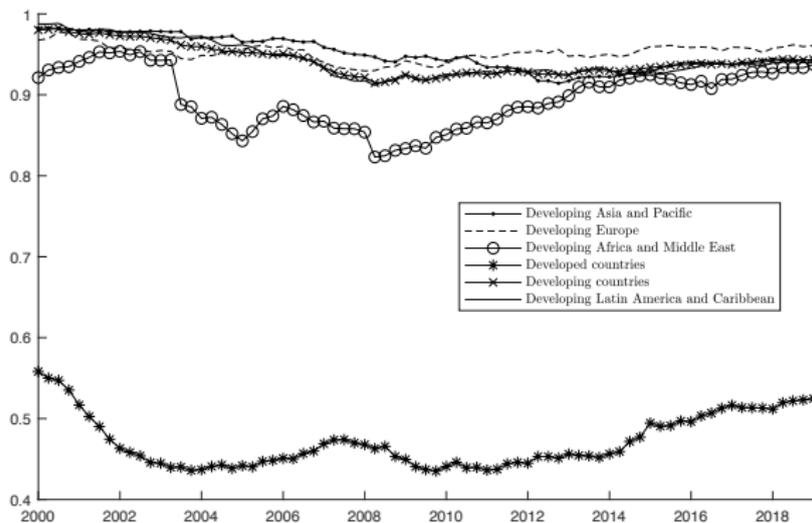
Conclusion

- Deposit dollarization may play a valuable risk-sharing role in EME's.
 - ▶ Allows some people (with different hedging requirements) to provide business cycle insurance to other people.
- Concerns that deposit dollarization destabilizes,
 - ▶ overall, seems to get little support from the data.
 - ▶ can be minimized by:
 - ★ keeping currency mismatch out of banks (they are highly leveraged).
 - ★ ensuring that banks assign proper risk weights in their capital requirements for dollar loans.
- All the usual reasons to regulate financial markets continue to apply.
 - ▶ Various externalities.

Deposit Dollarization versus How Much S_t/P_t Jumps in Recession: 2000-2018 (Bivariate one-lag VAR)

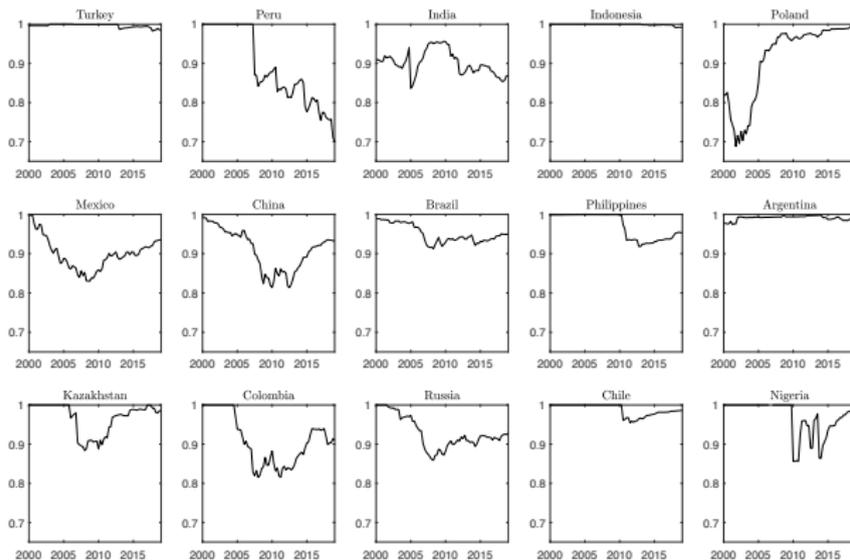


Foreigners Lend Little Domestic Currency into EME's



Note: foreign currency debt issued into international securities markets divided by total debt issuance (e.g., including debt denominated in domestic currency). Issuers include *all* entities of the given nationality. Debt is of all ratings, maturities, etc. Importance of measuring debt issuance by nationality rather than residence stressed in Hyun Shin, 'The Second Phase of Global Liquidity...', November, 2013). Data source: BIS.

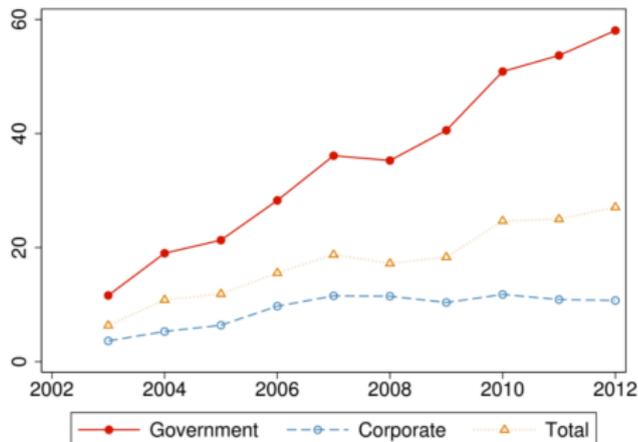
Share of Foreign Currency Borrowing By Selected Countries



Note: there is substantial variation in this share across countries. In two (Turkey and Indonesia) there is essentially no change.

Sov's and Non-Financial Firms (Du and Schreger 2017)

Figure 3: Share of External Debt in LC (Mean of 14 sample countries)



Notes: This figure plots the cross-country mean of the share of external debt by sector in LC. The cross-country mean gives each country in the sample an equal weight. Within each country, the share of total debt in LC is the weighted average of the share of sovereign and corporate debt in LC, weighted by the amount of each type of debt outstanding. The countries included in the sample are Brazil, Colombia, Hungary, Indonesia, Israel, Malaysia, Mexico, Peru, Poland, Russia, South Korea, South Africa, Thailand and Turkey.

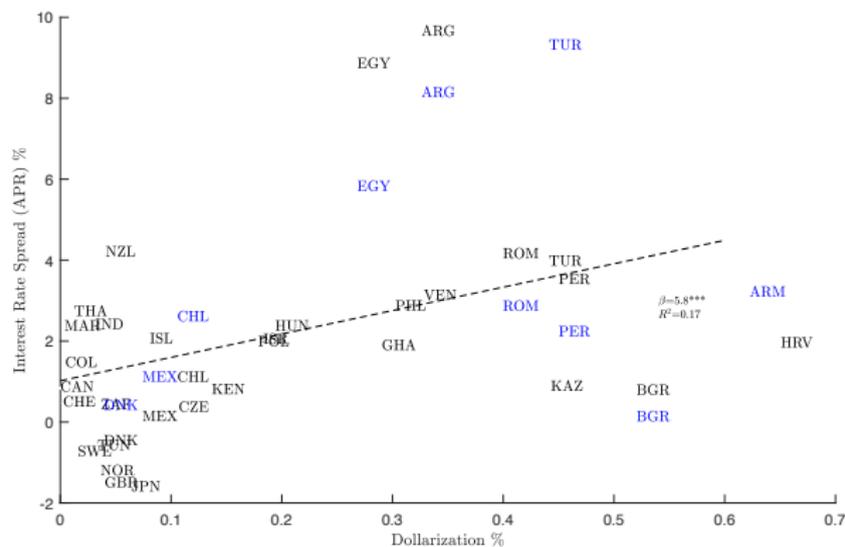
Domestic currency share of sov'n debt growing. But, sovereigns don't borrow much in emerging countries.

Note that the although the total is rising, it reaches a rather low max of 20%. [Go Back](#)

Computing $i - i^*$

- We use data for roughly 30 countries, on which we have observations from currency futures markets.
- For the foreign (risk-free) interest rate, we use the EURO for European Emerging markets and the US dollar for the others.
 - ▶ Foreign interest rate: $i^* = \frac{R^* S'}{S}$, S, S' denote current and next month's realized spot exchange rate; R^* foreign nominal rate (e.g., three month US gov't securities).
- For domestic risk-free interest rate we use Covered Interest Parity and Futures markets: $i = \frac{R^* F}{S}$
- So, the spread (APR) is: $i - i^* = 1200 \times \frac{R^*}{S} [F - S']$ we will only take averages for this object, so that S' is the expected exchange rate if forecast error in S' orthogonal to current variables.
- The only uncertainty in our measure of the spread is exchange rate uncertainty.

Computing $i - i^*$

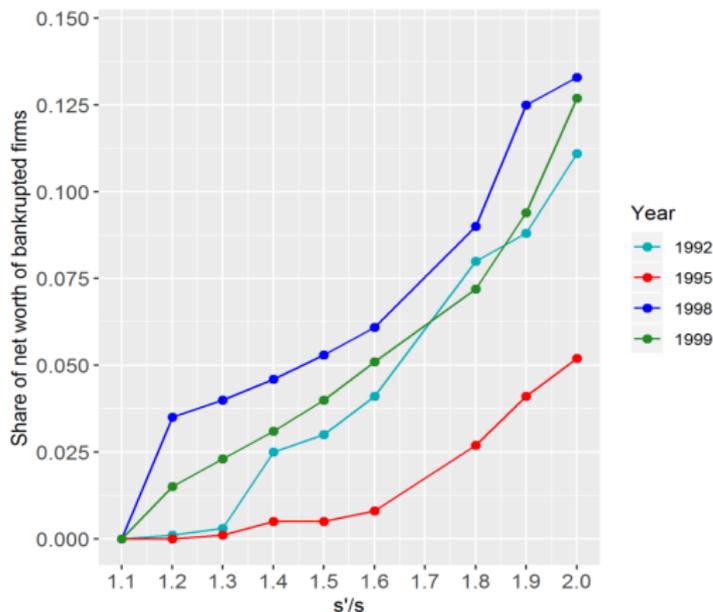


$i - i^*$ Blue: i interest rates on domestic deposits (central bank websites), Black: i^* our constructed deposit rate.

Peru: Firms in 2000s Much More Robust to Stress

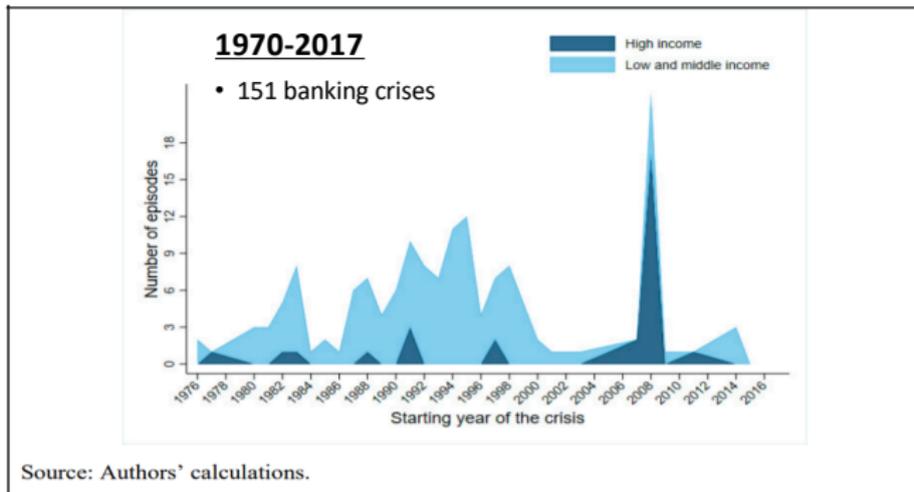
Figure 3. Share of net worth of bankrupted firms

Años: 1992, 1995, 1998 y 1999



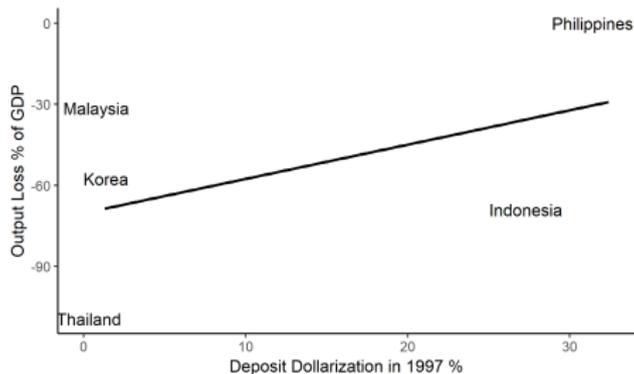
Source: Estados financieros de empresas. Vademécum bursátil de la BVL

Systemic Banking Crises by Laeven & Valencia 2018



Source: L. Laeven & F. Valencia "Systemic Banking Crises Revisited" IMFWP 2018

Selected Asian-Crisis Countries (Malaysia and Thailand do not allow Deposit Dollarization Now)



▶ Go Back

Inflation (in 1990s) Versus Dollarization (post 2000)





Note: in 1998 crisis, Won depreciated by a factor of 2. Later, depreciation partially offset.

Crisis When Currency Mismatch is Held by Firms

- Korean Won depreciated by a factor of 2.1 from 800 to 1,700 during Asian Financial Crisis.
- Suppose:
 - ▶ Leverage is 2 (this is the US and, arguably, Turkey (see Dalgic, et al)).
 - ▶ Credit dollarization is 50%.

Table: Assets and Liabilities of a Firm (all numbers in Won)

Before Crisis		After Crisis	
Assets	Liabilities	Assets	Liabilities
200	50 local currency debt	200	50 local currency debt
	50 dollar debt		100 dollar debt
	100 equity		50 equity

- The firm can weather this storm.

Crisis When Currency Mismatch is Held by Banks

- Banks have much higher leverage, maybe 10.
- Suppose bank has 50% dollar credit.

Table: Assets and Liabilities of a Bank (all numbers in Won)

Before Crisis		After Crisis	
Assets	Liabilities	Assets	Liabilities
200	90 local currency debt	200	90 local currency debt
	90 dollar debt		180 dollar debt
	20 equity		-70 equity

- This bank is now insolvent!

Levy-Yeyati Evidence

- Levy-Yeyati: with deposit dollarization, financial dominates expenditure switching channel.
- We find: Levy-Yeyati's results fragile.
 - ▶ not statistically significant using improved new econometric methods Mitchell Petersen (Review of Finance, 2009) used. [▶ SE](#)
 - ▶ Very sensitive to exactly how 'deposit dollarization' is measured. [▶ DD](#)
 - ▶ Point estimates reversed when post-2003 data are used. [▶ post](#)
 - ▶ Interest on Foreign Debt/GDP included drives out dollarization, exchange depreciation, etc. .
 - ★ Message if you borrow a lot, you could get into trouble. [▶ return](#)

Different Standard Errors

<i>left hand variable: Crisis Dummy</i>	(1)	(2)	(3)
	<i>OLS SE</i>	<i>Country Cluster</i>	<i>Country-Year Cluster</i>
Δer_{-1}	-0.829 (1.263)	-0.829 (0.706)	-0.829 (0.799)
FL/FA_{-1}	0.00348 (0.00303)	0.00348** (0.00139)	0.00348** (0.00137)
$dollar_{-1}$	0.674** (0.333)	0.674* (0.359)	0.674 (0.429)
$FL/FA \times \Delta er_{-1}$	0.0715 (0.0619)	0.0715** (0.0312)	0.0715** (0.0313)
$dollar \times \Delta er_{-1}$	1.310 (1.250)	1.310* (0.695)	1.310 (0.834)

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Different Standard Errors

Notes on previous table.

These are logit regressions. Δer_{-1} log change in exchange rate (depreciation if positive), lagged one period. FL/FA_{-1} ratio, foreign liabilities to foreign assets (whether to residents or non-residents) in domestic banking system.

$dollar_{-1}$ 1 if dollarization was greater than 10% in previous period; 0 otherwise

Sample period: 1975-2002

Column 2 exactly reproduces L-Y results (thanks to LY for sending us his code and data). Country Cluster standard errors assume dependence of error term over time within countries and independence across countries.

Column 1 computes standard errors assuming errors independent over time and across countries.

Column 3 implements Peterson's method which allows, in addition to dependence over time, dependence across countries for a given point in time. Crisis have a tendency to be correlated across countries.

If a crisis (i.e., '1') persists for more than one year, observations on subsequent years are dropped. The dropped data are treated as 'missing observations by STATA'. We follow L-Y in this procedure.

Note sensitivity of results to method of computing standard errors. Arguably, Peterson's approach is more appealing in this setting because of the cross-country 'contagion' associated with crises.

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Deposit Dollarization

Table: Different Measures of Deposit Dollarization in Levy-Yeyati's Table 5 Results

	10 Percent	15 Percent	20 Percent
<i>Crisis Dummy</i>			
Δer	-0.829 (0.706)	0.0781 (0.371)	0.0364 (0.356)
FL/FA	0.00348** (0.00139)	0.00268*** (0.000568)	0.00259*** (0.000550)
$dollar$	0.674* (0.359)	0.569* (0.333)	0.335 (0.321)
$FL/FA*\Delta er$	0.0715** (0.0312)	0.0533*** (0.0136)	0.0517*** (0.0132)
$dollar*\Delta er$	1.310* (0.695)	0.433 (0.460)	0.503 (0.451)
<i>Observations</i>	1104	1104	1104

Deposit Dollarization

Notes on previous table:

First column reproduces Levy-Yeyati's second column in 'Different Standard Errors' table. The other two columns in this table define the 'dollarization dummy' as 1 when deposit dollarization exceeds 15 and 20 percent, respectively. Levy-Yeyati's results depend on using a dummy that is unity when deposit dollarization exceeds 10 percent.

Note that significance of produce of dummy and exchange rate depreciation sensitive to definition of dollarization.

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Levy-Yeyati Analysis on Post-2003 Data

Table: Our Data: Levy-Yeyati Table 5, Column 2

	(1)	(2)	(3)	(4)
	Whole Sample	Without Armenia, 1994	2003 and Before	After 2003
LV Crisis Dummy				
<i>dollar</i> ₋₁	0.0954 (0.334)	0.141 (0.332)	0.547* (0.314)	-0.408 (0.530)
Δer ₋₁	-0.795** (0.366)	-0.795** (0.366)	-1.075 (1.920)	-0.777*** (0.293)
<i>dollar</i> \times Δer ₋₁	1.436*** (0.420)	0.923 (0.660)	1.632 (2.046)	-6.659** (2.659)
Constant	-4.001*** (0.589)	-4.001*** (0.589)	-4.007*** (0.367)	-3.989*** (1.009)
Observations	2861	2860	1161	1700

Standard errors in parentheses

Levy-Yeyati Analysis on Post-2003 Data

Notes on previous table. Here, we use our data set, which we extended to 2018. Interestingly, when we extend L-Y's analysis to the end of our sample (column 1), we get his result. In particular, the coefficient on $dollar * \Delta er_{-1}$ is statistically significant and it is larger than the coefficient on Δer_{-1} . This means that an exchange rate depreciation in a country with above 10% deposit dollarization raises the probability of crisis by $1.436 - .795 > 0$. An exchange rate depreciation in a country without deposit dollarization reduces the probability of a crisis by 0.795, presumably because in the absence of dollarization only the expenditure switching channel works, so that an exchange rate depreciation improves the health of all economic entities, not just banks. We see from column 2, however, that the results are driven by one single data point, Armenia in 1994. In that period there was a gigantic change in the exchange rate associated with Armenian independence from the Soviet Union (that was actually formally declared on September 21, 1991). So, if we drop the one outlier data point, the whole sample completely reverses L-Y's results. We suspect that's because many of the crises in the pre-2003 period occurred in emerging markets where deposit dollarization tends to be relatively high while the post -2003 crises occurred in developed economies where deposit dollarization is low (see columns 3 and 4). This is why analysis using only the later period seems to indicate that deposit dollarization immunizes you from crisis. Our inference is that deposit dollarization actually has little to do with crisis.

Levy-Yeyati Analysis on Post-2003 Data

Table: Our Data: Levy-Yeyati Table 5, Column 2

	(1)	(2)	(3)
	Whole Sample	External Debt Available	External Debt Available
LV Crisis Dummy			
dollar	0.0954 (0.334)	0.694 (0.429)	0.675 (0.439)
Δer_{-1}	-0.795** (0.366)	-0.0958 (1.139)	0.524 (0.773)
$dollar \times \Delta er_{-1}$	1.436*** (0.420)	0.851 (1.268)	0.758 (0.896)
Interest Paid on External Debt ₋₁			0.252*** (0.0745)
Interest Paid on External Debt $\times \Delta er_{-1}$			-0.578 (0.357)

Levy-Yeyati Analysis on Post-2003 Data

Notes on previous table. The results in Table 4 do not include Levy-Yeyati's variable, FL/FA , because we have not yet been able to find that variable for the post 2003 period. The table attempts to shed (preliminary) light on whether the omission of FL/FA in our Table 4 biases our results against Levy-Yeyati's hypothesis: when deposit dollarization is high, the financial channel dominates the expenditure switching channel of an exchange rate change. The results in the previous table go against the hypothesis. The first column in the table of the previous page reproduces the first column of Table 4 (so, we include the 1994 observation on Armenia). We found a variable that is not the same as FL/FA but which may in practice carry the same information. It is "Interest payments on external debt (% of GNI)", obtained from the World Bank. A difficulty is that we could find this variable for only 60% of our sample (the variable is available for major developing countries, but not advanced economies or very small ones). Column 2 redoes the calculations in column 1 using only the countries for which we have data on 'Interest payments on external debt'. Note that the L-Y results (the coefficient on $dollar \times \Delta er_{-1}$) are less significant on this sample. Column 3 reports the same econometric analysis, but also includes the 'interest payments on external debt' variable. We see little difference between columns 2 and 3 in terms of the major parameter of interest, $dollar \times \Delta er_{-1}$. This is the basis for our preliminary conclusion that excluding FL/FA has not biased our results against L-Y's hypothesis.

Our Table: Deposit Dollarization Does not Affect Probability of Crisis, External Debt Does

Table 1:

	<i>Dependent variable:</i>
1(5<Dollar<=20)	0.189 (0.354)
1(5<Dollar<=20) ΔER	1.088 (1.437)
1(20<Dollar<=50)	0.021 (0.325)
1(20<Dollar<=50) ΔER	1.523 (0.953)
1(Dollar>50)	-0.102 (0.386)
1(Dollar>50) ΔER	0.022 (1.266)
ΔER	-1.804** (0.815)
Real GDP Growth	-0.010 (0.018)
Reserves/GDP	-1.700 (1.264)
Imports/GDP	-0.0003 (0.001)
Interest on External Debt/GDP	0.100** (0.046)
Constant	-1.849*** (0.409)

Note: *p<0.1; **p<0.05; ***p<0.01

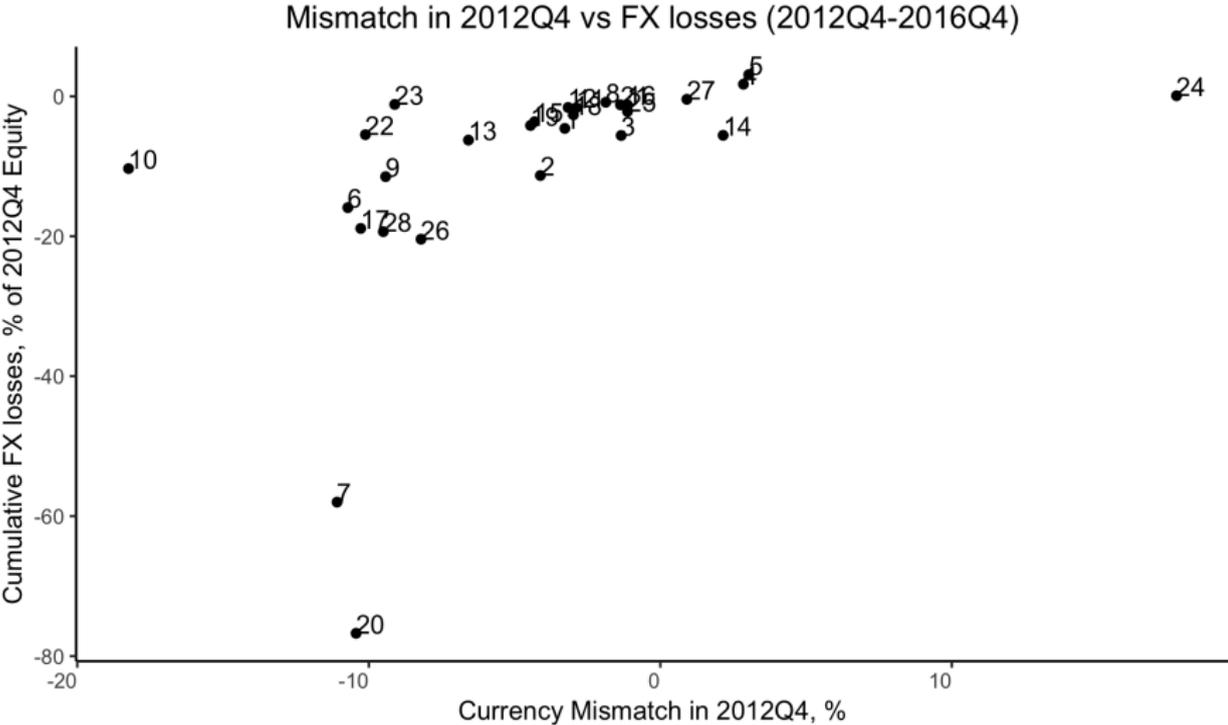
Peru: 28 Largest Firms in Recent Depreciation

- For each firm, have data on \$Assets and \$Liabilities, and S/ Assets and S/ Liabilities.
- Compute 'currency mismatch' for each firm, at start of 2014:

$$\text{Currency Mismatch} = \frac{\$Assets - \$Liabilities}{Total Assets}$$

- Compute, for 2014Q2-2016Q4 and as percent of firm equity
 - ▶ FX losses
 - ▶ Net Earnings
 - ▶ Growth in total assets (proxy for investment)

Peru: 28 Largest Firms in Recent Depreciation



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Figure: FX Losses, 2014Q2-2016Q4, vs Currency Mismatch in 2012Q4

Peru: 28 Largest Firms in Recent Depreciation

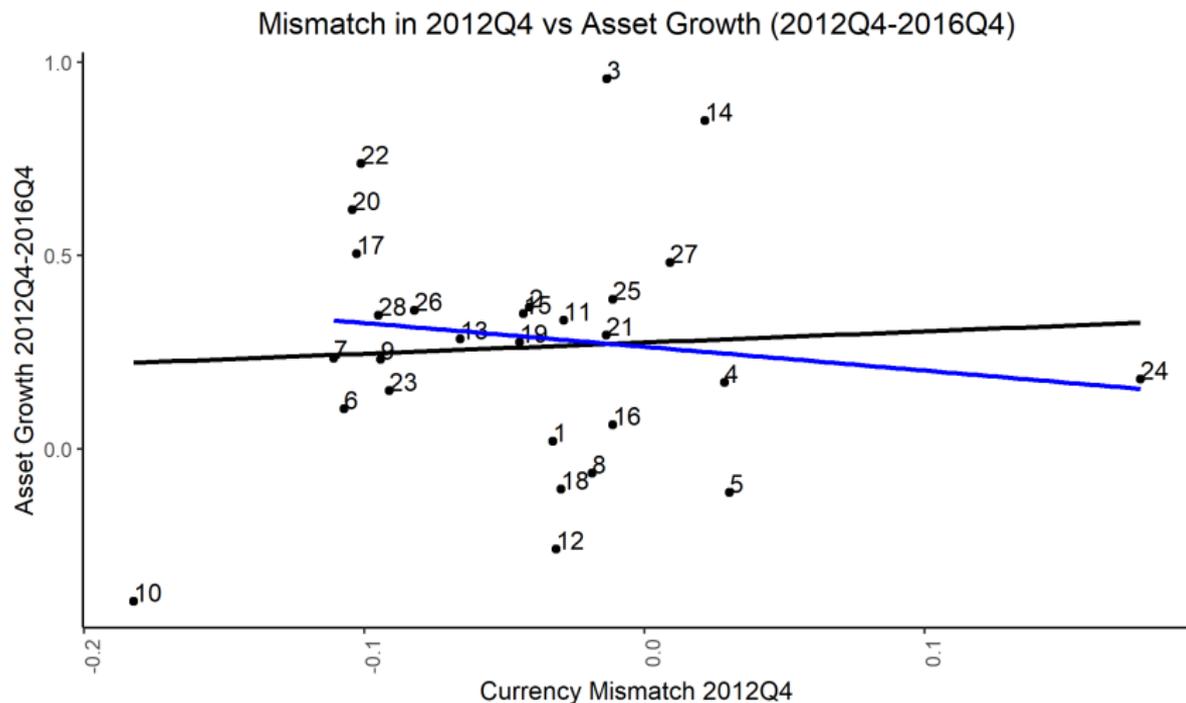


Figure: Investment, 2014Q2-2016Q4, vs Currency Mismatch in 2012Q4

Stress Testing

- What would be the effect of a 100% depreciation on firms?
- Data for unbalanced sample of Peruvian 118 firms covering the years 1999-2014
 - ▶ N. R. Ramírez-Rondán (*Empirical Economics*, May 2018))
- Data on dollar denominated assets and liabilities
 - ▶ $A^{\$}, A^S, L^{\$}, L^S$
 - ▶ $E_{t,i}^{S'} = A^S + A^{\$}S' - L^S - L^{\$}S'$

$$I_{t,i}^{S'} = \begin{cases} 1 & \text{if } E_{t,i}^{S'} < 0 \\ 0 & \text{otherwise} \end{cases}$$

$$\frac{\sum_i I_{t,i}^{S'} \times E_{t,i}}{\sum_i E_{t,i}}$$

- 100 percent depreciation \rightarrow the net worth of the bankrupted firms is less than 1.5 percent of total net worth
- 200 percent depreciation \rightarrow less than 10 percent of total net worth.

Peru: Stress Test for Exchange Rate Depreciation

