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

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Motivation

Emerging markets are characterized by "Financial Dollarization"

- Credit Dollarization $\rightarrow$ Firms borrow in foreign currency (FC)
- Deposit Dollarization $\rightarrow$ Households save in FC

Two Themes in Financial Dollarization Literature

- Dollarization a source of international risk sharing

    - Gourinchas, Rey and Govillot, "Exorbitant Privilege and Exorbitant Duty"

- Dollarization a source of financial fragility

    - Bocola and Lorenzoni (2020)
    - Most central bankers very skeptical:
        * A few rule out deposit dollarization.
        * Most allow it, but only because otherwise dollars would go under mattresses .

- Politics

    - Currency depreciation $\longrightarrow$, businesses that borrowed in dollars have to transfer scarce national resources to 'rich foreigners'.

Findings

- Financial Dollarization is an *intra*-national insurance arrangement (Dalgic (2018))
  - ▶ Device for one group of people to insure others within countries.
  - ▶ Provide evidence that intra- national insurance flows bigger than inter-national flows.
- We find no evidence that dollarization is associated with
  - ▶ Frequency of banking crises
  - ▶ Severity of banking crises
  - ▶ Cross country evidence from large number of countries for 1995-2018.
- Examine Peru (also, Armenia) as a Case Study
  - ▶ No strong evidence that firms with dollar liabilities experience balance sheet constraints after depreciation?
  - ▶ Dollar-borrowing firms are the ones best able to absorb exchange rate shock.
- A simple model motivated by the evidence.

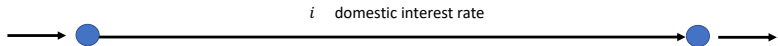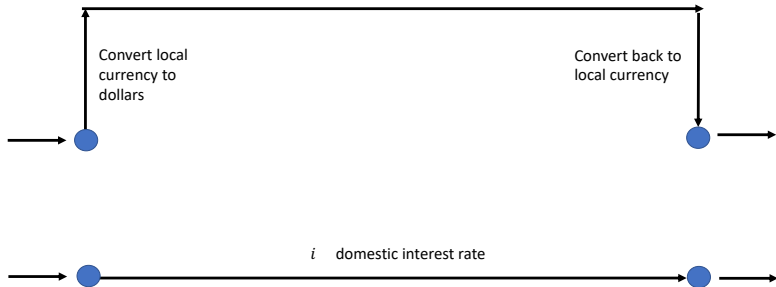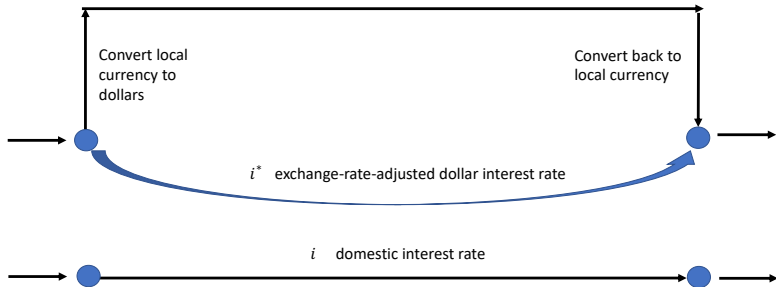Figure: Local Currency and Dollar Deposits

i domestic interest rate

Figure: Local Currency and Dollar Deposits

Convert local currency to dollars

Convert back to local currency

i domestic interest rate

Figure: Local Currency and Dollar Deposits

Convert local currency to dollars

Convert back to local currency

i^* exchange-rate-adjusted dollar interest rate

i domestic interest rate

Deposit Dollarization

- Measure of deposit dollarization for a particular country:

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

- Deposit dollarization:
  - ▶ Some evidence that this is the major part by far, of non-equity bank liabilities to domestic residents.
  - ▶ Excludes bank bond and commercial paper issues, but that seems small in EMEs.
  - ▶ In Peru, total deposit liabilities held by residents were 94 percent of total non-equity liabilities to residents in December 2019.
    - ★ Main source of savings for most households

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

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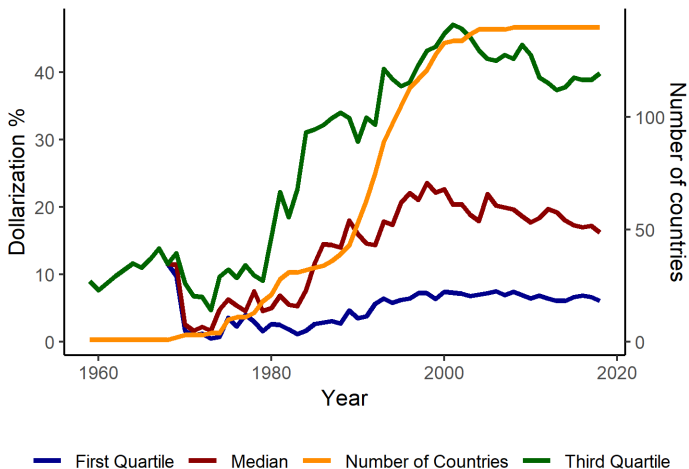
Note: (i) sharp rise in deposit dollarization in 1980s and 1990s; (ii) after 2000, only slight downward trend.

Deposit Dollarization versus How Much S_t/P_t Jumps in Recession: 2000-2018
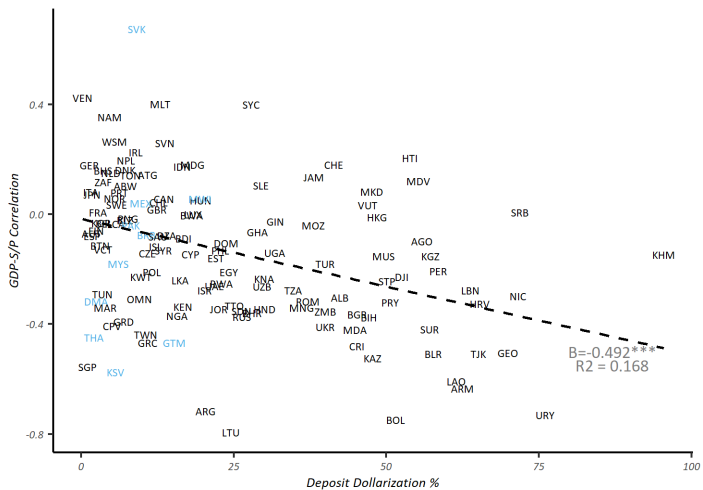
Determinants of Dollarization

			Dependent variable:		
			Dollarization		
	(1)	(2)	(3)	(4)	(5)
Corr($\Delta GDP, \Delta S/P$)	−34.161***	−30.287***	−34.183***	−33.680***	−20.439**
	(6.843)	(7.976)	(8.336)	(8.129)	(9.849)
Av Inflation		0.027***	0.025***	0.025***	0.022***
		(0.005)	(0.005)	(0.005)	(0.005)
Gini			0.170	0.271	0.057
			(0.195)	(0.196)	(0.270)
Fuel Export			−0.057	−0.069	−0.073
			(0.091)	(0.088)	(0.063)
Reserves/GDP			0.026	0.021	−0.003
			(0.016)	(0.016)	(0.014)
Institutions				−0.389**	−0.239
				(0.189)	(0.197)
External Debt					0.253***
					(0.085)
Constant	21.429***	20.462***	10.937	9.519	12.942
	(1.882)	(2.194)	(7.515)	(7.360)	(14.152)
Observations	121	112	94	87	58
R^2	0.168	0.232	0.325	0.392	0.362
Adjusted R^2	0.161	0.218	0.287	0.347	0.272
Residual Std. Error	19.592 (df = 119)	19.197 (df = 109)	17.924 (df = 88)	17.144 (df = 80)	16.768 (df = 50)

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

Dependent variable is the average dollarization between 2000-2018. Right hand variables are average inflation in the 90s ('Av Inflation'); average Gini index in the sample, 2000-2018, ('Gini'); fuel exports (as a share of total exports) in the sample, 2000-2018, ('Fuel Export'); Central Bank reserves (as a share of GDP) in the sample, 2000-2018, ('Reserves/GDP').

Political institutions ('Institutions') are proxied by "Constraints on the Executive Authority", 2000-2018, provided by Polity V database provided by Center for Systemic Peace ("https://www.systemicpeace.org/inscrdata.html"); External Debt (as a share of GDP), in the sample 2000-2018, ('External Debt').

Heteroskedasticity consistent standard errors appear in parentheses.

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, 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 $\longrightarrow$ Price of insurance

Dollarization and interest rate Spreads
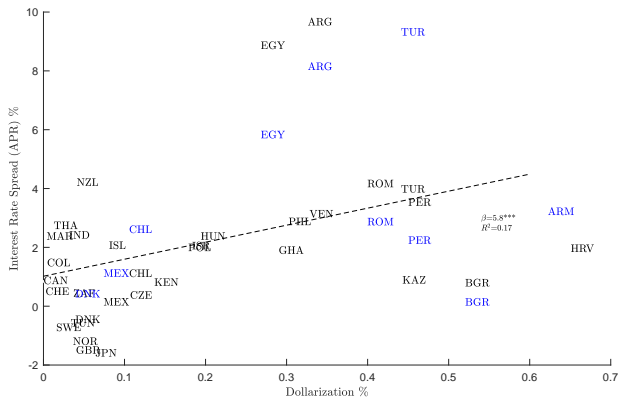
Notes: For the observations marked in blue, local deposit rates (local and foreign currency) were obtained from Central Bank websites. In the case of observations marked in black, the local deposit rate was inferred using covered interest parity, local and future's market exchange rates (monthly rates taken from Datastream) as well as dollar risk free rates. In some cases, both measures of the domestic interest rate are available . The line in the figure is the least squares that uses actual local dollar rates when available (blue) and uses derivative-based rates otherwise (black). The least squares line based on the black observations only is not included because it is virtually indistinguishable from the line reported. Data covers the period 2004-2017.

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

If Not the Banks, then Who is Providing the Insurance?
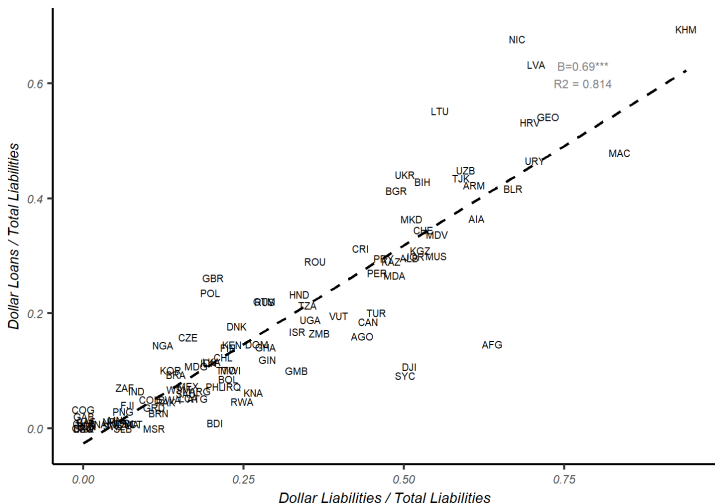
Notes: Data obtained from International Monetary Fund database, Financial Soundness Indicators. Each country is indicated by its World Bank code and the data represent, for each country, averages over the period, 2000-2018. The numerator variables on the y and x-axes are 'Foreign currency denominated loans' and 'Foreign currency denominated liabilities', respectively. Both variables are expressed as a fraction of 'Total liabilities'. The dashed line is the least squares line fit to the data, where B denotes the slope and $R2$ denotes the R^2. The three stars on B indicates significance at the 1 percent level.

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

	$\frac{\text{dollar deposits}}{\text{total deposits}}$
	Deposit
	Dollarization
Average	0.40
Median	0.36

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

- Data from 15 emerging market economies

	$\frac{\text{dollar deposits}}{\text{total deposits}}$	$\frac{\text{household (hh) dollar deposits}}{\text{firm dollar deposits}}$
	Deposit	
	Dollarization	
Average	0.40	1.81
Median	0.36	1.55

- Most dollar deposits are held by households

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

- Data from 15 emerging market economies

	$\frac{\text{dollar deposits}}{\text{total deposits}}$	$\frac{\text{household (hh) dollar deposits}}{\text{firm dollar deposits}}$	$\frac{\text{firm dollars from banks}}{\text{firm dollars from everywhere}}$
Deposit Dollarization			
Average	0.40	1.81	0.82
Median	0.36	1.55	0.97

- Most dollar deposits are held by households
- Looks like our 'simple scenario'
-
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If Not the Banks, then Who is Providing the Insurance?

- Data from 15 emerging market economies

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

- Most dollar deposits are held by households
- Looks like our 'simple scenario'
-
-

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

- Data from 15 emerging market economies

	dollar deposits / total deposits	household (hh) dollar deposits / firm dollar deposits	firm dollars from banks / firm dollars from everywhere	hh dollar borrowing from banks / total dollar deposits	total dollar borrowing, firms / 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.
-

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

- Data from 15 emerging market economies

	dollar deposits / total deposits	household (hh) dollar deposits / firm dollar deposits	firm dollars from banks / firm dollars from everywhere	hh dollar borrowing from banks / total dollar deposits	total dollar borrowing, firms / 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.

Cross- versus Within-Country Holdings of Financial Assets

- Simple market clearing identity:

$$d_t^* + d_t^{*,f} = b_t^* + b_t^{*,f}$$

$d_t^* \sim$ \$ supply by domestic EME residents to financial system (e.g., deposits)

$d_t^{*,f} \sim$ \$ supply by foreigners to domestic residents (e.g., dollar bonds)

$b_t^* \sim$ \$ demand by domestic EME residents (e.g., dollar bonds)
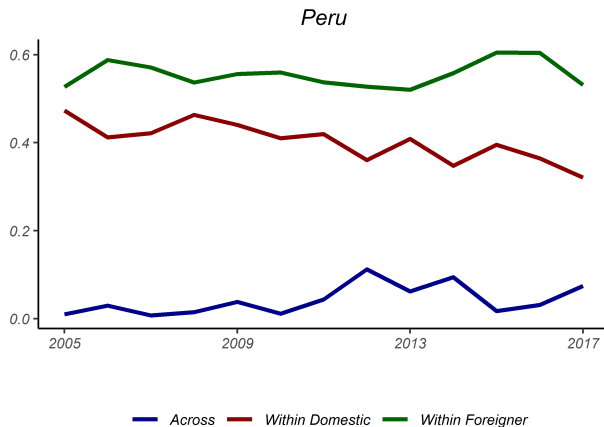
$b_t^{*,f} \sim$ \$ demand by foreigners from domestic residents (e.g., Tbills)

- Simple identity:

$$\underbrace{\min[d_t^*, b_t^*]}_{\text{intra-national flow}} + \underbrace{\min[d^{*,f}, b^{*,f}]}_{\text{within-foreigner flow}} + \underbrace{|b_t^* - d_t^*|}_{\text{inter-national flow}} = \underbrace{b_t^* + b_t^{*,f}}_{\text{gross flows}}$$

Example: Peru

Figure: Fraction of Financial Trade, Peru

International Versus Intra-national Insurance Flows

- Intra-national insurance

$$\min \frac{\left[\overbrace{d_t^*}^{\text{Dollar Deposits}} , \quad \overbrace{b_t^*}^{\text{Dollar Loans}} \right]}{GDP_t}$$
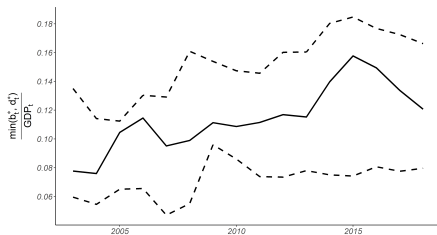
- International Insurance,

$$\frac{|d_t^* - b_t^*|}{GDP_t}$$
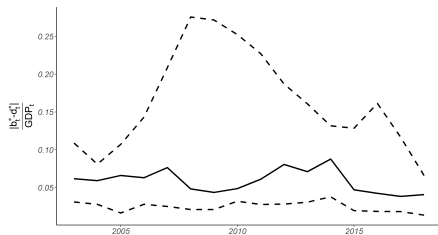
- Intra vs International insurance

$$\frac{\min [d_t^*, b_t^*]}{|d_t^* - b_t^*|}$$

International Versus Intra-national Insurance Flows

Figure: Insider vs Across
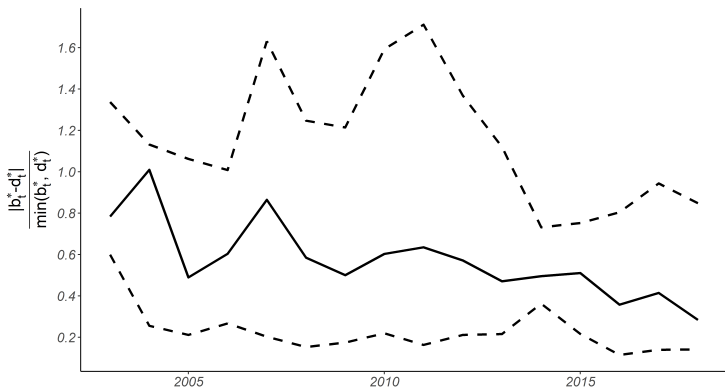

(a) Insider $\frac{\min\left(d_t^*,b_t^*\right)}{GDP_t}$

(b) Across, $\frac{|d_t^*-b_t^*|}{GDP_t}$

International Versus Intra-national Insurance Flows

Figure: Insider vs Across $\frac{|d_t^* - b_t^*|}{\min\left(d_t^*, b_t^*\right)}$

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 Eichengreen and Gupta (2018).

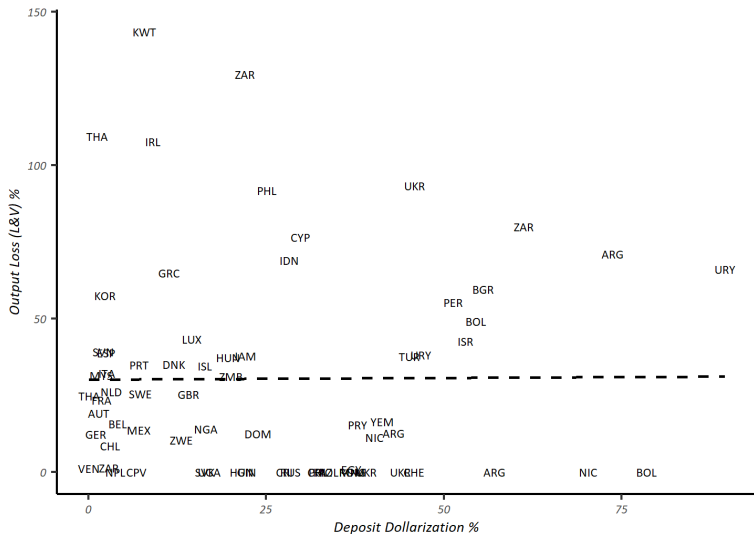- Data on cost of crisis: GDP growth from IMF.

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
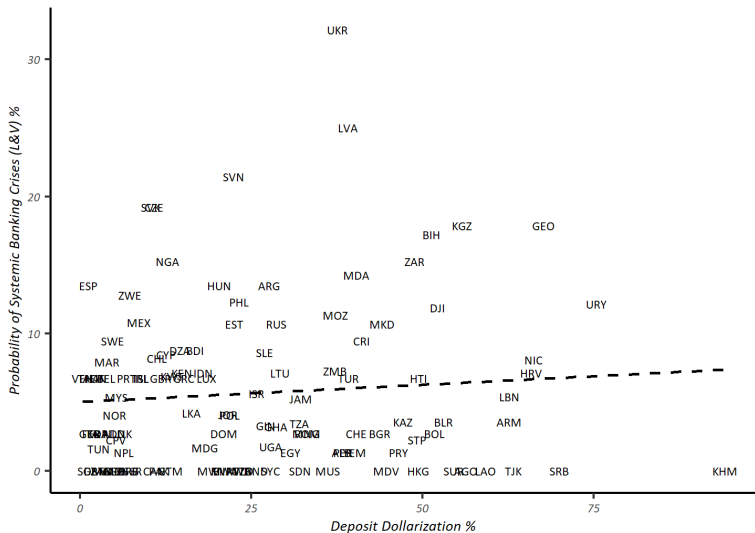
Note: 1994-2018

Loss of Output In a Banking Crisis versus Deposit Dollarization

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

Probability of Banking Crisis

	(1)	(2)	(3)	(4)	(5)	(6)
Dollar (20)	-0.435	-0.167	-0.303	0.234	-0.235	-0.734
	(-0.75)	(-0.25)	(-0.38)	(0.52)	(-0.28)	(-0.75)
Δer	-0.923*	-3.741	-3.703	0.279	0.166	-0.283
	(-1.84)	(-0.98)	(-0.97)	(0.50)	(0.08)	(-0.08)
Dollar(20)*Δer	1.652**	2.877	2.681	0.392	-1.545	-2.811
	(2.29)	(0.56)	(0.54)	(0.55)	(-0.48)	(-0.55)
High FL/FA		1.500**	1.546		1.677*	1.544
		(2.20)	(1.61)		(1.67)	(1.27)
VIX	0.166**	0.166***	0.166***	0.0751*	0.132***	0.126***
	(2.47)	(2.93)	(2.91)	(1.78)	(2.83)	(2.77)
Reserves/GDP		-3.265**	-2.927		-2.424	-1.033
		(-2.05)	(-1.02)		(-0.73)	(-0.45)
Real GDP Growth		0.0205	0.0184		0.0118	0.0404
		(0.26)	(0.23)		(0.14)	(0.53)
High FL/FA * Low Reserves			-0.0742		-0.763	-1.252
			(-0.11)		(-0.84)	(-0.97)
Dollar(20) * Low Reserves			0.274		0.733	1.538
			(0.34)		(0.65)	(1.30)
External Debt						0.332***
						(5.84)
Constant	-7.535***	-8.421***	-8.472***	-5.994***	-7.786***	-8.281***
	(-5.06)	(-5.11)	(-5.04)	(-5.31)	(-5.36)	(-5.80)
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	0.0765	0.00382	0.0276	0.0537

t statistics in parentheses

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

For list of countries see footnote **??**.

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

- 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 %ΔFixed Assets

- Results suggest sales growth and GDP growth are main drivers of investment.

- Currency mismatch does not seem to matter, even for non-exporters.

Peru: Balance Sheet Effects

	(1)	(2)	(3)	(4)
Mismatch	4.540	2.705	1.481	2.671
	(3.428)	(3.221)	(2.387)	(2.733)
Mismatch * ΔER	-0.0386	-0.0736	-0.0837	-0.114
	(0.202)	(0.192)	(1.580)	(1.582)
ΔER		0.224	0.545	0.525
		(0.438)	(0.525)	(0.568)
log(Assets)	-11.00	2.164	-0.274	-1.939
	(7.098)	(4.460)	(0.870)	(1.379)
Leverage	0.457	0.240	0.148	0.154
	(0.458)	(0.453)	(0.532)	(0.496)
Sales/Assets	19.72**	30.12***	5.941**	5.884**
	(9.723)	(9.695)	(2.902)	(2.955)
GDP		1.464*	2.103**	2.109*
		(0.807)	(1.019)	(1.082)
Mismatch * Non Exporter * ΔER			-0.0425	0.0608
			(1.743)	(1.722)
VIX			0.417	0.404
			(0.293)	(0.310)
Exporter			-0.866	-0.502
			(3.136)	(3.062)
Exporter * ΔER			-0.302	-0.253
			(0.834)	(0.819)
Large				8.456
				(5.196)
Large * Mismatch				-1.355
				(4.936)
Large * Mismatch * ΔER				-0.102
				(0.851)
N	1316	1316	1275	1275

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

Non-Performing Loans in Peru
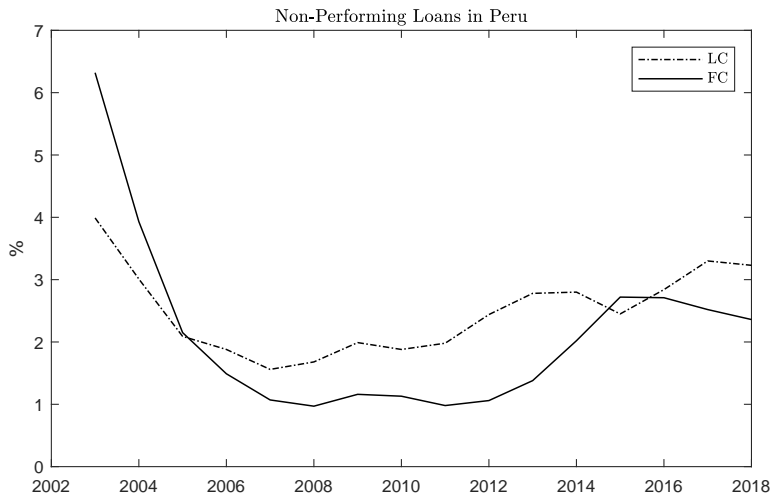
Key empirical findings

1. Exchange rate depreciates a lot in a recession $\rightarrow$ high deposit dollarization

2. High deposit dollarization $\longrightarrow$ 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, 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
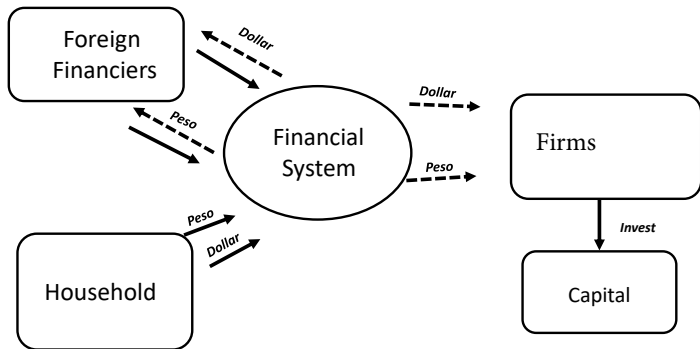
Worker Households

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,

$$\max_{d,d^*} Ec_2^{house} - \frac{\lambda}{2} var\left(c_2^{house}\right)$$

- Intertemporal budget constraint

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

- Household portfolio choice

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

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,

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

- Period $t = 2$ budget constraint

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

- Firm choice (K decision has similar form):

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

Foreign Financiers

- Borrow in dollar asset market $\longrightarrow$ 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,

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

Foreign Financiers

- The solution to foreign financier problem,

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

- 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

$$\overbrace{c_1^*}^{\text{Exports}} + \overbrace{k_h}^{\text{Domestic input}} = \overbrace{Y}^{\text{Endowment}}$$

Equilibrium in Financial Markets - Period 1

- Financial markets clearing,
  - ▶ Peso asset market

$$\overbrace{d}^{\text{Domestic savings}} + \overbrace{x^D e_1}^{\text{Foreign lending}} = \overbrace{b}^{\text{Total Borrowing}}$$

- Dollar asset market

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

- Balance of payments,

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

Equilibrium - Period 2

- Final consumption good

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

- Production

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

- Goods market equilibrium

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

- 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

$$Cov\left(Y_2^f, Y_2^*\right) = s \times \sigma_\nu^2$$

- 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

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

$$d^* = \frac{E\left(e_2 r^* - r\right)}{\lambda var\left(r^* e_2\right)} - \frac{cov\left(r^* e_2, w_2\right)}{var\left(r^* e_2\right)}$$

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,

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

Calibration Targets

Variable	Description	Model	Peru
(a)	(b)	(c)	(d)
$\frac{b+b^*}{d+d^*}$	Total domestic borrowing / Total domestic lending	1.02	
$100 \times (r-1)$	Domestic Rate	-0.3%	-0.3%
$E\left(e_2 r^*\right)$	Expected Dollar Rate	0.975	
$100 \times E(r - e_2 r^*)$	Spread (domestic agents)	2.24%	2.20%[6]
$100 \times E(\frac{r}{e_2} - r^*)$	Spread (financier)	2.50%	
$d^* / (d^* + d)$	Deposit Dollarization	0.60	0.44[2]
$\frac{b-d}{b}$	Foreign Source of Peso Credit	0.04	0.01[3]
$\frac{d^* - b^*}{d^*}$	Foreign Absorption of Dollar Deposits	-0.00	-0.07[3]
$b^* / (b + b^*)$	Credit Dollarization	0.59	0.40[3]
$\frac{c_1^* - e_1 k_f}{Y}$	Scaled Trade Surplus	-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	-0.23	-0.20[7]
$std(log(e_2))$	Standard Deviation, e_2	0.04	0.03[8]

Calibrated Parameters

Parameter	Description	Value
α	Capital Share, 15	0.38
λ	Risk aversion, domestic residents, 9, 19	1.55
λ^f	Foreign Financier Risk aversion, 29	1.55
η	Elasticity of demand for exports, 34, 39	3.28
Y^*	Period 1 trade demand, 34	1.35
s	Covariance parameter, financier income, 26	3.82
Y	Period 1 GDP, 7	3.17
μ_ν	Mean, ν shock to foreign demand, 24	2.97
μ_A	Mean productivity, 15	7.85
μ_ξ	Mean, ξ shock to foreign demand, 24	7.16
σ_A	Std dev, log productivity, 15	$0.22\mu_A$
σ_ξ	Std dev, log ξ shock to foreign demand, 24	$0.68\mu_\xi$
σ_ν	Std dev log u shock to foreign demand, 24	$0.22\mu_\nu$

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).
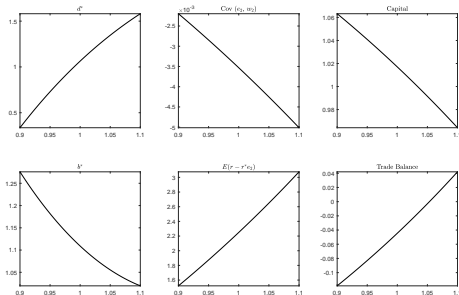
Other Experiments

- 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, $Cov\left(Y_2^f, Y_2^*\right) = s \times \sigma_\nu^2$
  - 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
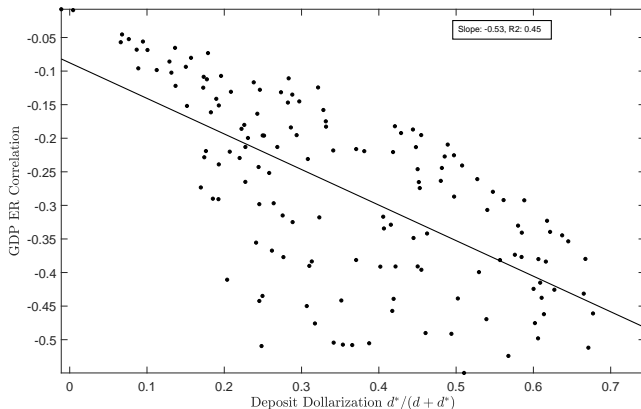
Preventing Deposit Dollarization

- Exercise: Preventing domestic dollar deposits
- Households have to save everything in peso assets
  - Spread narrows (still positive)
  - Exchange rate becomes more volatile
  - Foreigners slightly benefit

$\Delta Spread$	ΔV_{e_2}	ΔU_{HH}	ΔU_{Firm}	ΔU_{For}
-0.15%	0.7%	-0.13%	-0.3%	0.003%

Concluding Observations

- Empirical results drawn mainly from 2000s, and so are conditional on the regulatory environment of this time.

  - Examples: good idea to minimize currency & dollar maturity mismatch in banks.

- We question the skepticism about credit and deposit dollarization:

  - Dollarization may have important, unrecognized benefits (intra-national insurance mechanism).

 - Financial risks associated with may not be as large as many think.

Crisis: Message of Preceding Example

- The example is extreme.
  - In practice, firms borrow long-term and a crisis depreciation is partially reversed.
  - In the case of Korea: depreciation 110% from January 1997 to January 1998.
    - Depreciation from January 1997 to January 1999 'only' 50%.
  - Dalgic, et al's 2017 study of Turkey suggests it is large firms and firms with exports that borrow the bulk of dollar credit.
    - These firms are relatively resilient to exchange rate changes.
- Message:
  - Insist that banks have no currency mismatch.
  - Allow some mismatch in firms, which have lower leverage and can handle exchange rate shocks better.
  - In this case, dollarization may not be so dangerous.

Did We Get the Causality Backwards?

- We have argued that exchange rate depreciations in recessions drive the demand for deposit dollarization.
  - ▶ That in turn (due to regulations) drives credit dollarization.

- But, is it possible that causality goes the other way around?
  - ▶ Could it be that deposit dollarization is the *cause* of recessions accompanied by currency depreciation?
  - ▶ That possibility seems inconsistent with the evidence that deposit dollarization is uncorrelated with:
    - ★ frequency of sudden stops and financial crisis.
    - ★ the severity of recessions that follow a sudden stop and/or financial crisis.

- So, we are (cautiously) comfortable with the causality assumptions implicit in our analysis.

Selected Asian-Crisis Countries (Malaysia and Thailand do not allow Deposit Dollarization Now)
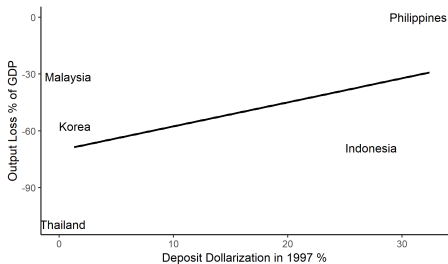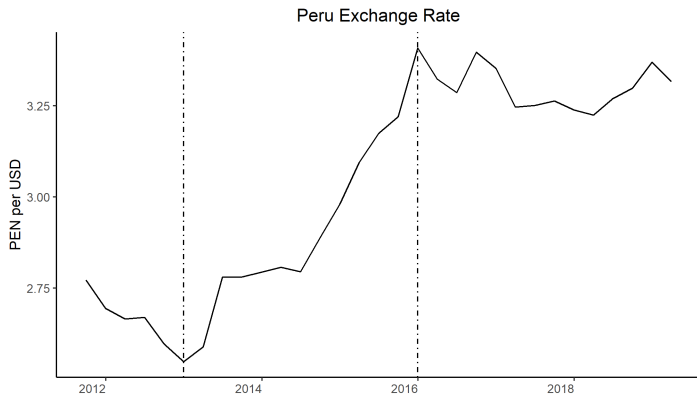
Inflation (in 1990s) Versus Dollarization (post 2000)

Note: strong positive correlation between inflation in 1990s and dollarization in 2000s.

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Peru: Fairly Big Depreciation Recently


Peru Exchange Rate

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:

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

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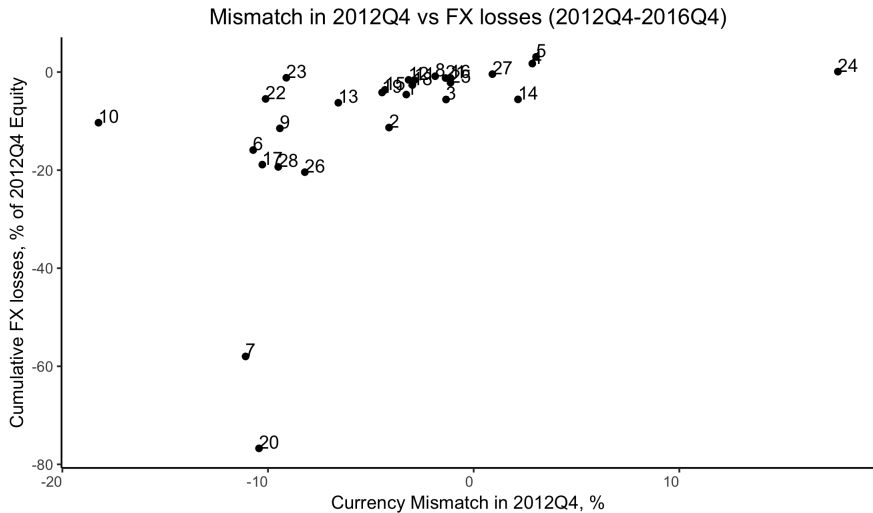
Figure: FX Losses, 2014Q2-2016Q4, vs Currency Mismatch in 2012Q4

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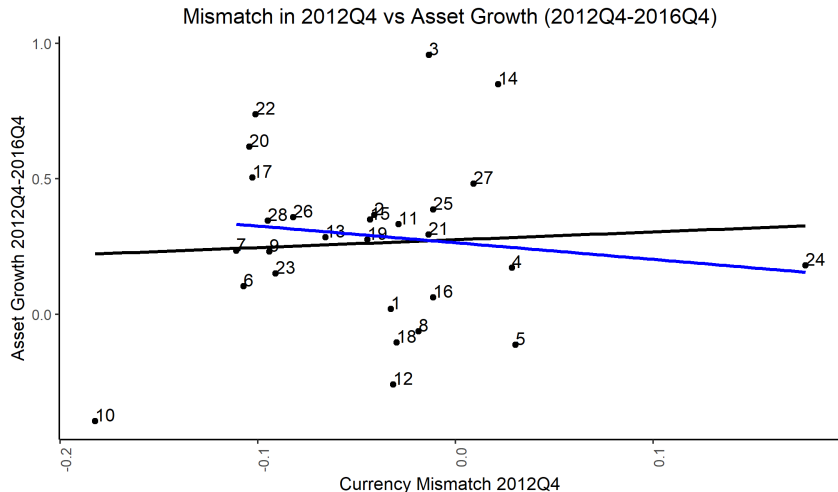# Peru: 28 Largest Firms in Recent Depreciation

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 Peruvianv 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 $\longrightarrow$ the net worth of the bankrupted firms is less than 1.5 percent of total net worth
- 200 percent depreciation $\longrightarrow$ less than 10 percent of total net worth.

Peru: Stress Test for Exchange Rate Depreciation

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