Financial Dollarization:

Efficient Intranational Risk Sharing or Prescription for Disaster?

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Financial Dollarization in Emerging Markets

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

Two Themes in Financial Dollarization Literature

- Dollarization a source of international risk sharing
    - Gourinchas, Rey and Govillot, "Exorbitant Privilege and Exorbitant Duty"

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- Dollarization a source of financial fragility
  - Levy-Yeyati (2006); Bocola and Lorenzoni (2020)

Findings

- Financial Dollarization is an *intra*-national insurance arrangement
  - Device for one group of people to insure others within countries.
  - Provide evidence that intra- national insurance flows bigger than international flows.

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  - Frequency of banking crises
  - Severity of banking crises
  - Large balance sheet effects

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  - Provide evidence that intra- national insurance flows bigger than international flows.
- We find no evidence that dollarization is associated with
  - Frequency of banking crises
  - Severity of banking crises
  - Large balance sheet effects
- A simple model motivated by the evidence.

Data

- 140 countries 2000-2018
  - Determinants of Dollarization + Determinants of banking crises
- 16 Small Open Economies 2000-2018
  - Who borrows/lends in FC: Households vs Firms
- Peru and Armenia: Firm level data
  - Balance sheet effects following depreciations

Motivation

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- Measuring the comovement,

$$\frac{\Delta GDP_t}{\sigma_{\Delta GDP}} = \alpha + \rho \frac{\Delta \frac{S_t}{P_t}}{\sigma_{\Delta S/P}} + \epsilon_i$$

- Annual data from IFS (2000-2018)
- $\hat{\rho}$: Correlation coefficent
  - Direction-free
  - How many standard deviation movement in GDP is associated with one stdev increase in the exchange rate

Determinants of Dollarization

	Dependent variable:					
	Dollarization					
	(1)	(2)	(3)	(4)	(5)	(6)
Corr($\Delta GDP, \Delta S/P$)	−34.161***	−30.287***	−34.183***	−33.680***	−34.177***	−20.439**
	(6.843)	(7.976)	(8.336)	(8.129)	(8.266)	(9.849)
Av Inflation		0.027***	0.025***	0.025***	0.025***	0.022***
		(0.005)	(0.005)	(0.005)	(0.006)	(0.005)
Gini			0.170	0.271	0.112	0.057
			(0.195)	(0.196)	(0.191)	(0.270)
Commodity Export			−0.057	−0.069	−0.056	−0.073
			(0.091)	(0.088)	(0.087)	(0.063)
Reserves/GDP			0.026	0.021	0.028*	−0.003
			(0.016)	(0.016)	(0.016)	(0.014)
Institutions				−0.389**	−0.368**	−0.239
				(0.189)	(0.180)	(0.197)
CB Independence					−9.251	
					(9.361)	
External Debt						0.253***
						(0.085)
Constant	21.429***	20.462***	10.937	9.519	20.023**	12.942
	(1.882)	(2.194)	(7.515)	(7.360)	(9.656)	(14.152)
Observations	121	112	94	87	73	58
R^2	0.168	0.232	0.325	0.392	0.460	0.362
Adjusted R^2	0.161	0.218	0.287	0.347	0.402	0.272
Residual Std. Error	19.592 (df = 119)	19.197 (df = 109)	17.924 (df = 88)	17.144 (df = 80)	15.535 (df = 65)	16.768 (df = 50)

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

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Interpretation

- Negative $cov\,(GDP, S/P) \longrightarrow$ High Dollarization (Dalgic, 2018)
- Negative $cov\,(GDP, S/P)$: currency depreciates in recession
  - Dollar returns jump, 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)).

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- 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.

Who is Providing the Insurance?

- Not the banks
  - IMF Financial Soundness Indicators, 115 countries, 2005-2018
  - Banks hold little mismatch

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- Not the banks
  - IMF Financial Soundness Indicators, 115 countries, 2005-2018
  - Banks hold little mismatch
- Data from 16 emerging market economies

	$\frac{\text{dollar deposits}}{\text{total deposits}}$	$\frac{\text{household (hh) dollar deposits}}{\text{Total dollar deposits}}$	$\frac{\text{firm dollars from banks}}{\text{firm dollars from everywhere}}$	$\frac{\text{hh dollar borrowing from banks}}{\text{total dollar deposits}}$	$\frac{\text{total dollar borrowing, firms}}{\text{total dollar deposits}}$
	Deposit Dollarization			HH Share	NFC Share
Average	0.38	0.59	0.84	0.21	0.90
Median	0.36	0.62	0.91	0.15	0.94

- Most dollar deposits are held by households
- Most dollar credit is sourced from local banks
- Firms appear to bear the full (net) amount of the currency mismatch risk.
- Governments dollar position slightly positive due to less borrowing in dollars (Du & Scheger, 2013) and high reserves

International Versus Intra-national Insurance Flows

- Intra-national insurance

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

- International Insurance,

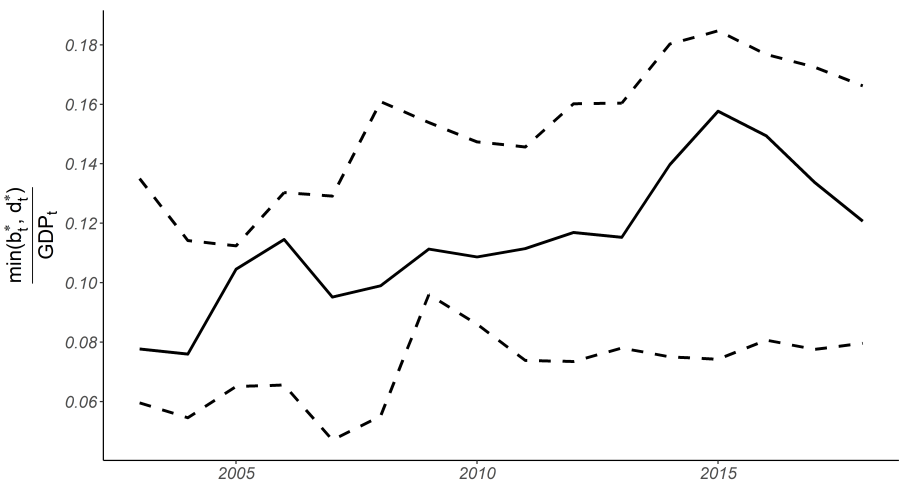
$$\frac{|d_t^* - b_t^*|}{GDP_t}$$

- Intra vs International insurance

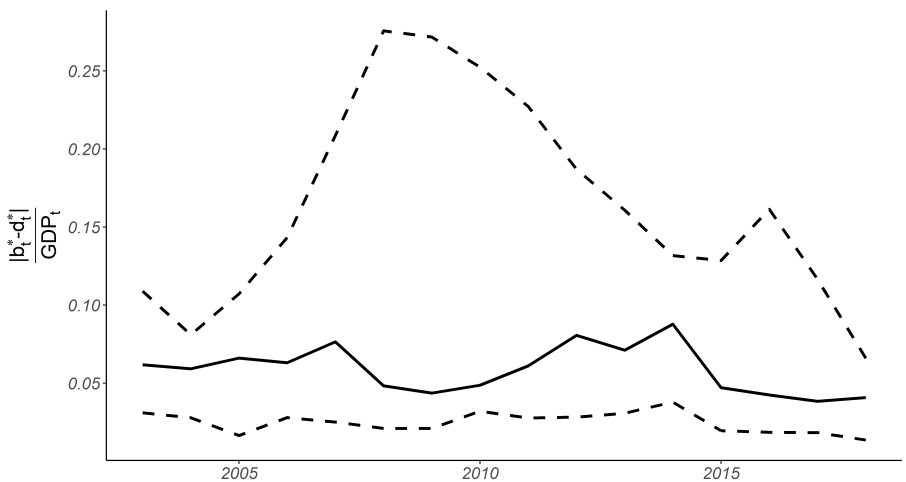
$$\frac{\min\left[d_t^*, b_t^*\right]}{|d_t^* - b_t^*|}$$

International Versus Intra-national Insurance Flows

Figure: Insider vs Across



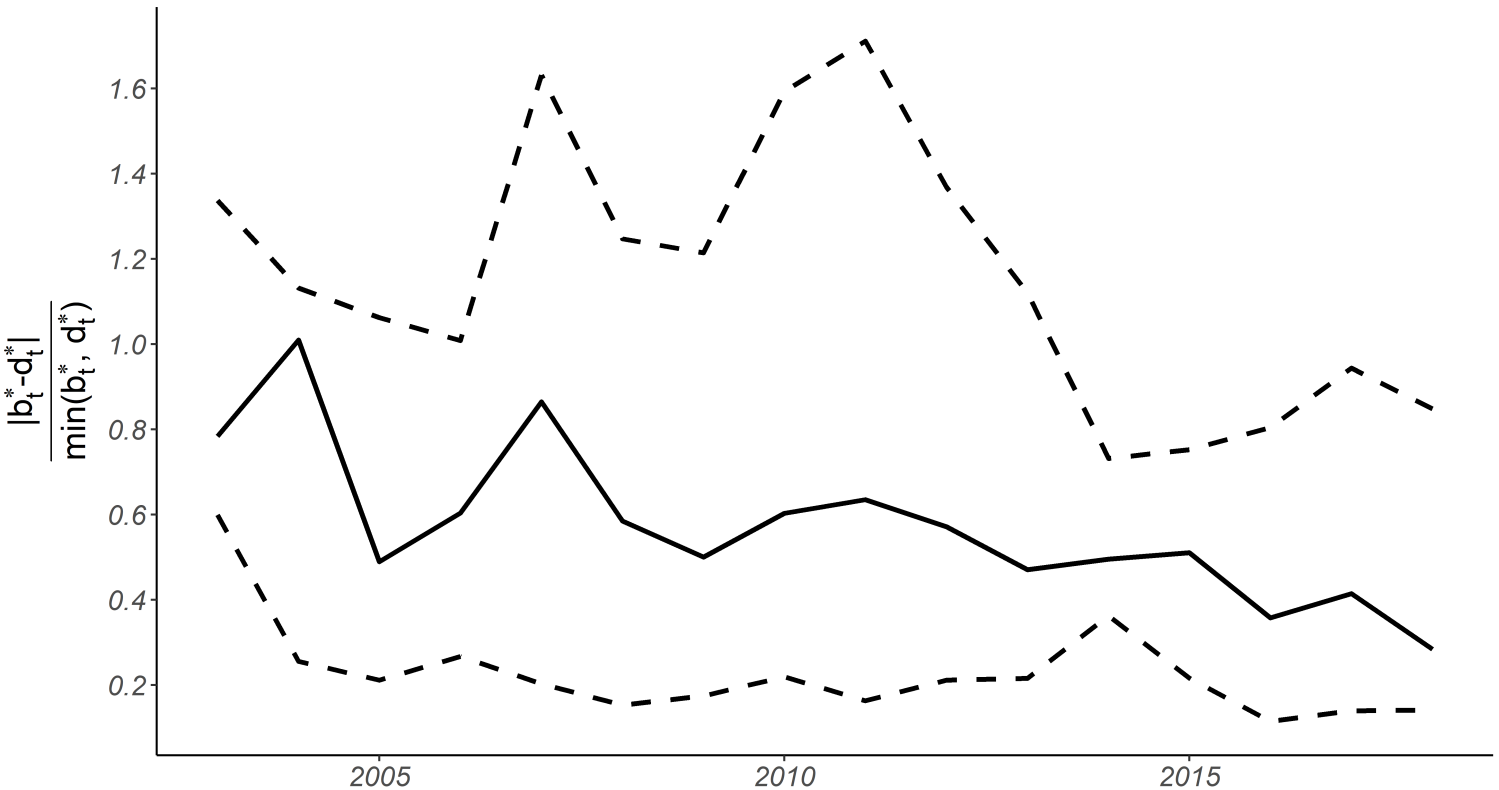
(a) Insider $\frac{\min\left(d_t^*, b_t^*\right)}{GDP_t}$



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

International Versus Intra-national Insurance Flows

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



Where are the Foreigners?

- Data on the currency composition of international flows from Benetrix et. al. (2020):

$$\overbrace{d_t^* + d_t^{*,f}}^{\text{dollar claims of domestic residents and foreigners' dollar claims on domestic residents}}$$

$$= \overbrace{b_t^* + b_t^{*,f}}^{\text{domestic resident dollar liabilities and foreigners' dollar liabilities to domestic residents}}$$

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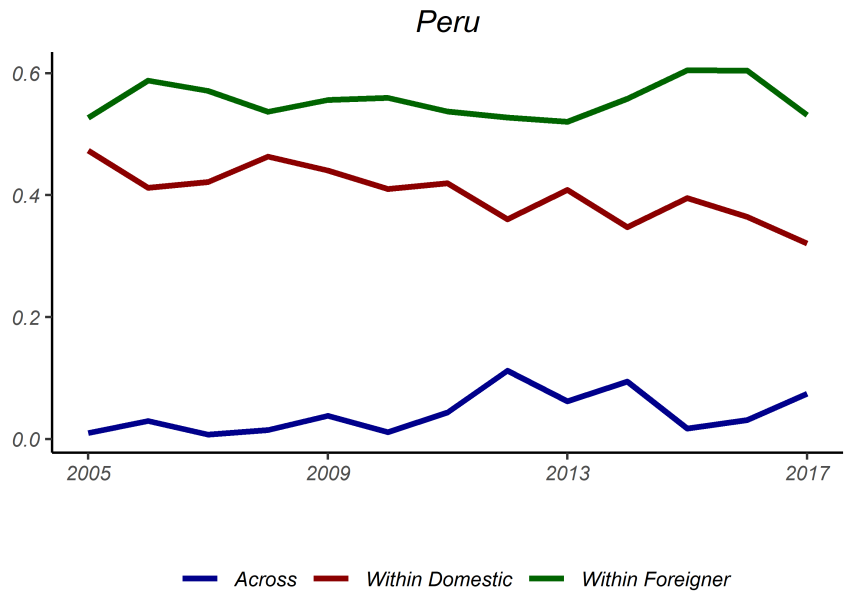
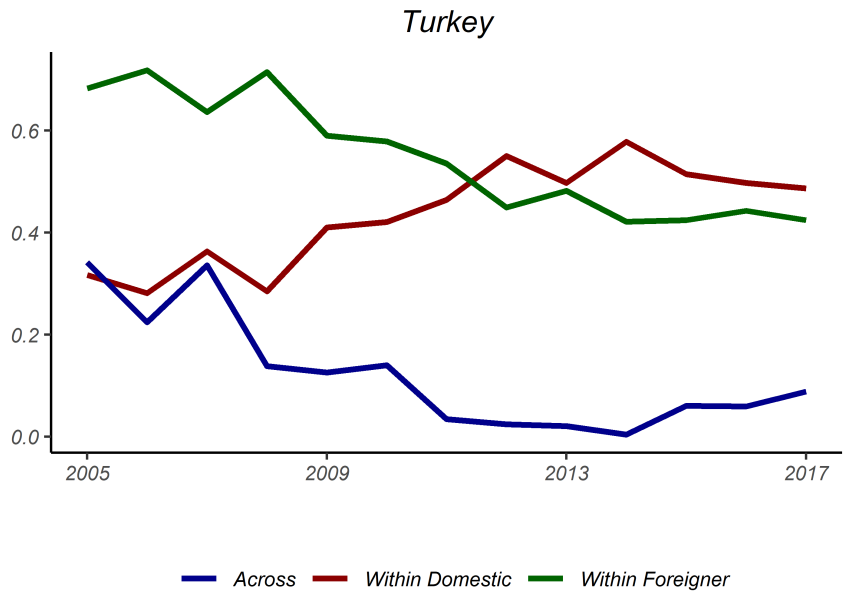
- Then, we have the following decomposition (following Chari-Christiano (2020)):

$$\overbrace{\frac{\min\left[d_t^*, b_t^*\right]}{b_t^* + b_t^{*,f}}}^{\text{within country insurance}} + \overbrace{\frac{\min\left[d_t^{*,f}, b_t^{*,f}\right]}{b_t^* + b_t^{*,f}}}^{\text{within foreigner insurance}} + \overbrace{\frac{\left|b_t^* - d_t^*\right|}{b_t^* + b_t^{*,f}}}^{\text{across country insurance}} = 1$$

Example: Peru and Turkey





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.
  - If that is the case, deposit dollarization is Pareto improving
- Is deposit dollarization destabilizing?
  - 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.

Dollarization and Banking Crises

- 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.

- Relation between deposit dollarization and *frequency* of crisis?

- Relation between deposit dollarization and *intensity* of crisis when it happens?

Does Dollarization Predict Banking Crises?

- Evidence based on logit regressions ▸ results
  - Levy-Yeyati (2006), Schularick and Taylor (2009). Gourinchas and Obstfeld (2012),
  - Binary variable $Dollar\,(20)_{i,t-1} = 1$ if dollarization exceeds 20 percent in the previous year
- Dollarization does not predict banking crisis ▸ results
  - Area under the ROC curve (AUC) measure
    - Suss & Treitel (2020), Fuster et al. (2020)
  - Main predictor of crisis is
    - Foreign debt, $\frac{\text{Foreign Liabilities of Banks}}{\text{Foreign Assets of Banks}}$, (Gourinchas and Obstfeld, 2012)
    - Global financial cycle, VIX (Rey, 2015, Forbes and Warnock, 2012)
  - Too much external borrowing leads to crisis, not deposit dollarization.

Balance Sheet Effects

- Even if dollarization does not lead to *crisis*,
  - Financial channel may inefficiently reduce investment after an exchange rate depreciation
- Evidence from firms in Peru: 28 Largest Firms in Recent Depreciation ▸ results
  - Firms with dollar debt suffer initially but recover quickly
- Evidence from firms in Peru:118 firms 1999-2014 ▸ results
  - Results suggest sales growth and GDP growth are main drivers of investment
  - Weak balance sheet effects
- Evidence from Armenia: Corporate Tax registry 2014-2016 ▸ results
  - Weak balance sheet effects
  - FC borrowers with large leverage suffer
- Stress test ▸ results
  - 100 percent depreciation $\longrightarrow$ the net worth of the bankrupted firms is less than 1.5 percent of total net worth

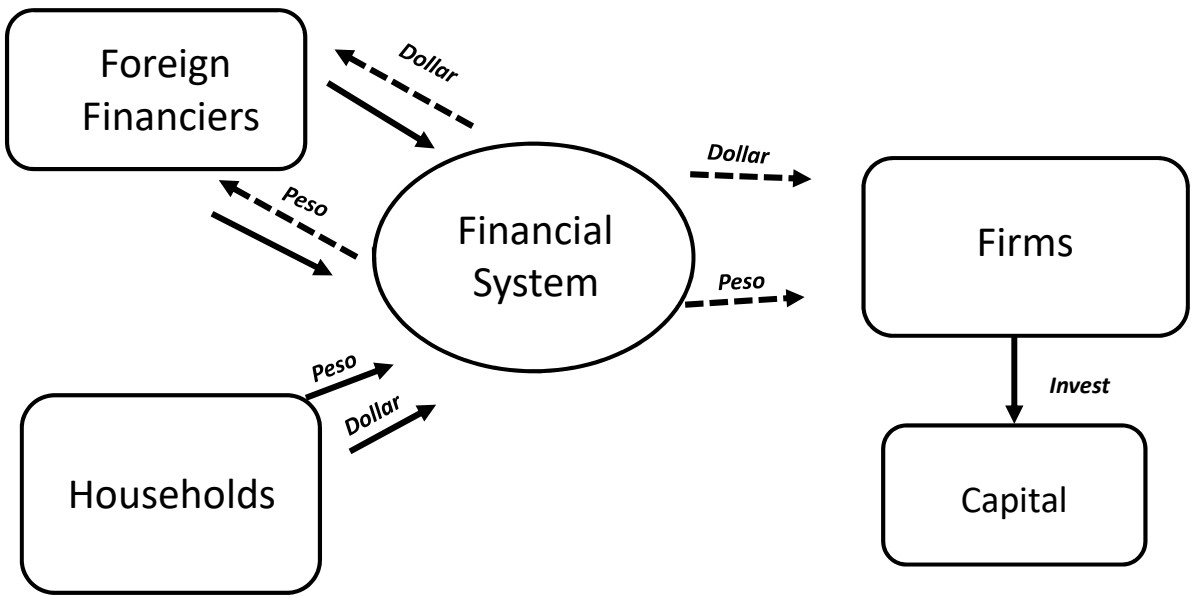
Key empirical findings

1. Exchange rate depreciates a lot in a recession $\rightarrow$ high deposit dollarization
2. High deposit dollarization $\longrightarrow$ high interest rate spread ▸ results
3. Most dollar debt is financed locally
4. Deposit dollarization not systematically related to:
   - 4.1 likelihood of financial crisis
   - 4.2 intensity of a crisis if it occurs.

Model

- 2 periods
  - Period 1: Saving, capital production, exports and imports
  - Period 2: Shocks realized, production, exports and imports, consumption
- Agents
  - Households: Provide labor
  - Firms: Own the capital, hire 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 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 consumption good in period 2, per unit of domestic good.

Financial Markets, period 1



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,

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

- Substitute similarly t=1 budget constraint

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

- Dollar debt choice

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

- Investment choice

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

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,

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

- 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.

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- 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 - 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

$$Y_2^h = (AK)^{\alpha}$$

- Goods market equilibrium

$$Y_2^h = \overbrace{c_2^h}^{\text{Domestic Consumption}} + \overbrace{c_2^*}^{\text{Exports}}$$

- 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 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

Interest Rate Spread

- Household and firm choices

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

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)
$\frac{b+b^*}{d+d^*}$	$\frac{\text{Total domestic borrowing}}{\text{Total domestic lending}}$	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]

Importance of Hedging by Foreigners

- Can we explain interest rate spreads in the data without foreginers' hedging motive ?

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

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

1. Set $s = 0$ in the benchmark economy
   - Spread halves
   - Large lending in LC to domestic borrowers
   - Large increase in dollarization $\longrightarrow$ Insurance provided by foreigners
2. Set $s = 0$ and target the spread with λ^f
   - Require large foreign risk aversion (45 vs 7 in the benchmark)

Importance of Hedging by Foreigners

Variable	Description	Model	Peru	$s = 0$ no adj.	$s = 0$ adj. λ^f only
(a)	(b)	(c)	(d)	(e)	(f)
$\frac{b+b^*}{d+d^*}$	$\frac{\text{Total domestic borrowing}}{\text{Total domestic lending}}$	1.02		1.04	1.02
$100 \times (r-1)$	Domestic Rate	-0.3%	-0.3%	-0.2%	-0.3%
$E(e_2 r^*)$	Expected Dollar Rate	0.975		0.975	0.975
$100 \times E(r - e_2 r^*)$	Spread (domestic agents)	2.24%	2.20%[6]	1.19	2.20%
$100 \times E(\frac{r}{e_2} - r^*)$	Spread (financier)	2.50%		1.38%	2.46%
$d^*/(d^*+d)$	Deposit Dollarization	0.60	0.44[2]	1.26	0.62
$\frac{b-d}{b}$	Foreign Source of Peso Credit	0.04	0.01[3]	1.22	0.16
$\frac{d^*-b^*}{d^*}$	Foreign Absorption of Dollar Deposits	-0.00	-0.07[3]	1.14	0.08
$b^*/(b+b^*)$	Credit Dollarization	0.59	0.40[3]	-0.17	0.56
$\frac{c_1^*-e_1 k_f}{Y}$	Scaled Trade Surplus	-0.02	-0.02[4]	-0.04	-0.02
$100 \times \frac{E(r-r^* e_2)}{r} \frac{d^*}{d^*+d}$	Implicit tax on dollar deposits	1.3%	1.5%[5]	1.5%	1.4%
ρ	Correlation, e_2, GDP	-0.23	-0.20[7]	-0.19	-0.23
$std(log(e_2))$	Standard Deviation, e_2	0.04	0.03[8]	0.04	0.04

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.

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: Fairly Big Depreciation Recently

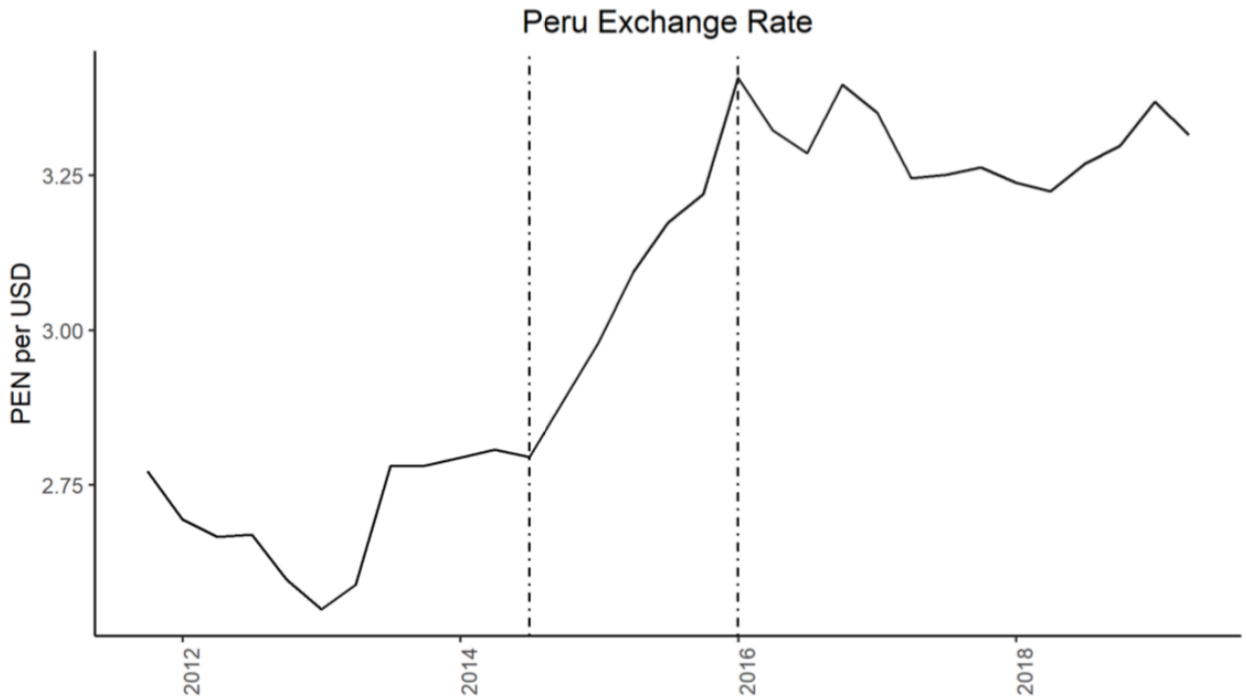


Figure 1: Nominal Exchange Rate in Peru

Peru: 28 Largest Firms in Recent Depreciation

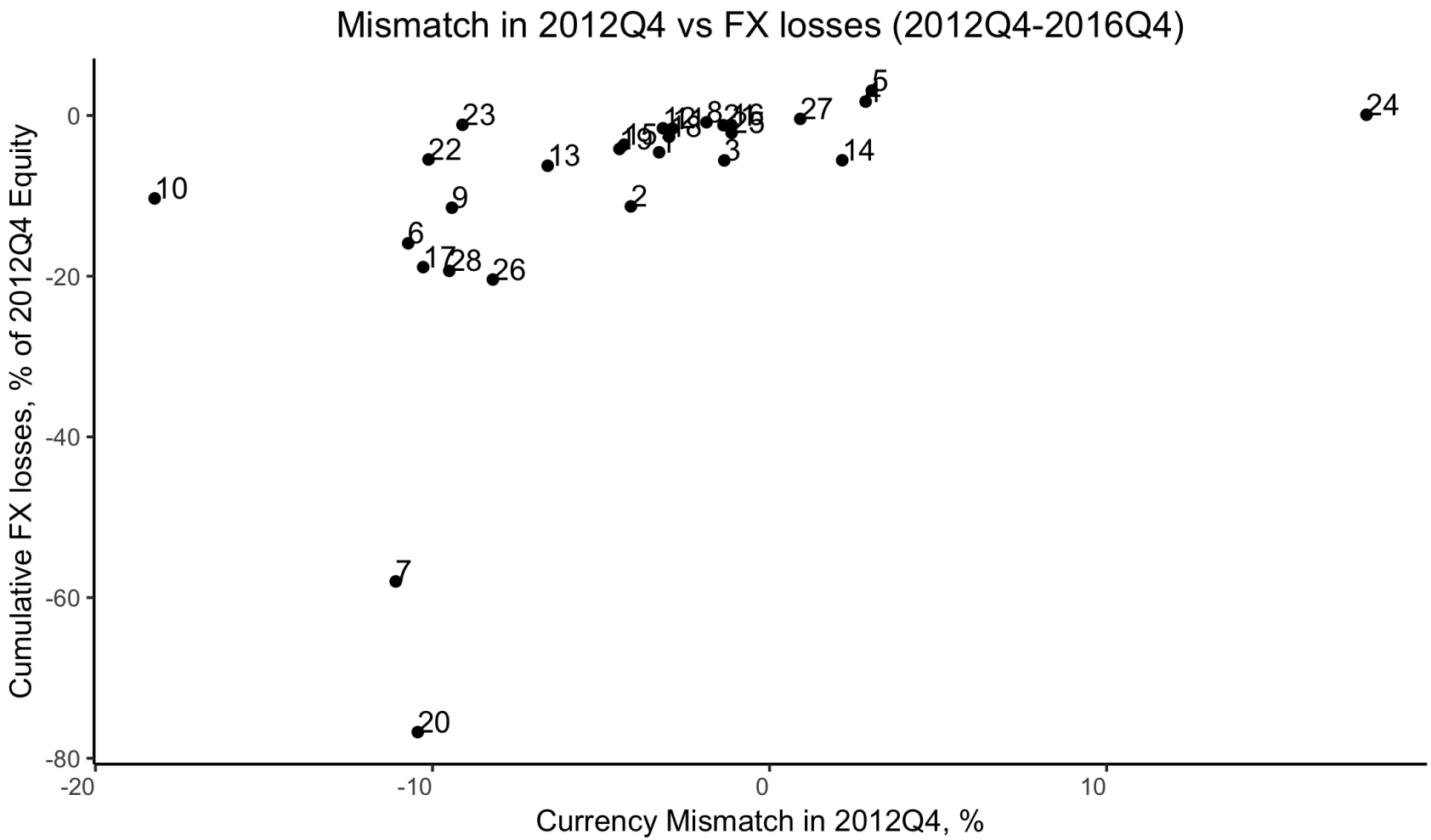


Figure: Credit Dollarization vs FX Losses 2014Q2-2016Q4

Peru: 28 Largest Firms in Recent Depreciation

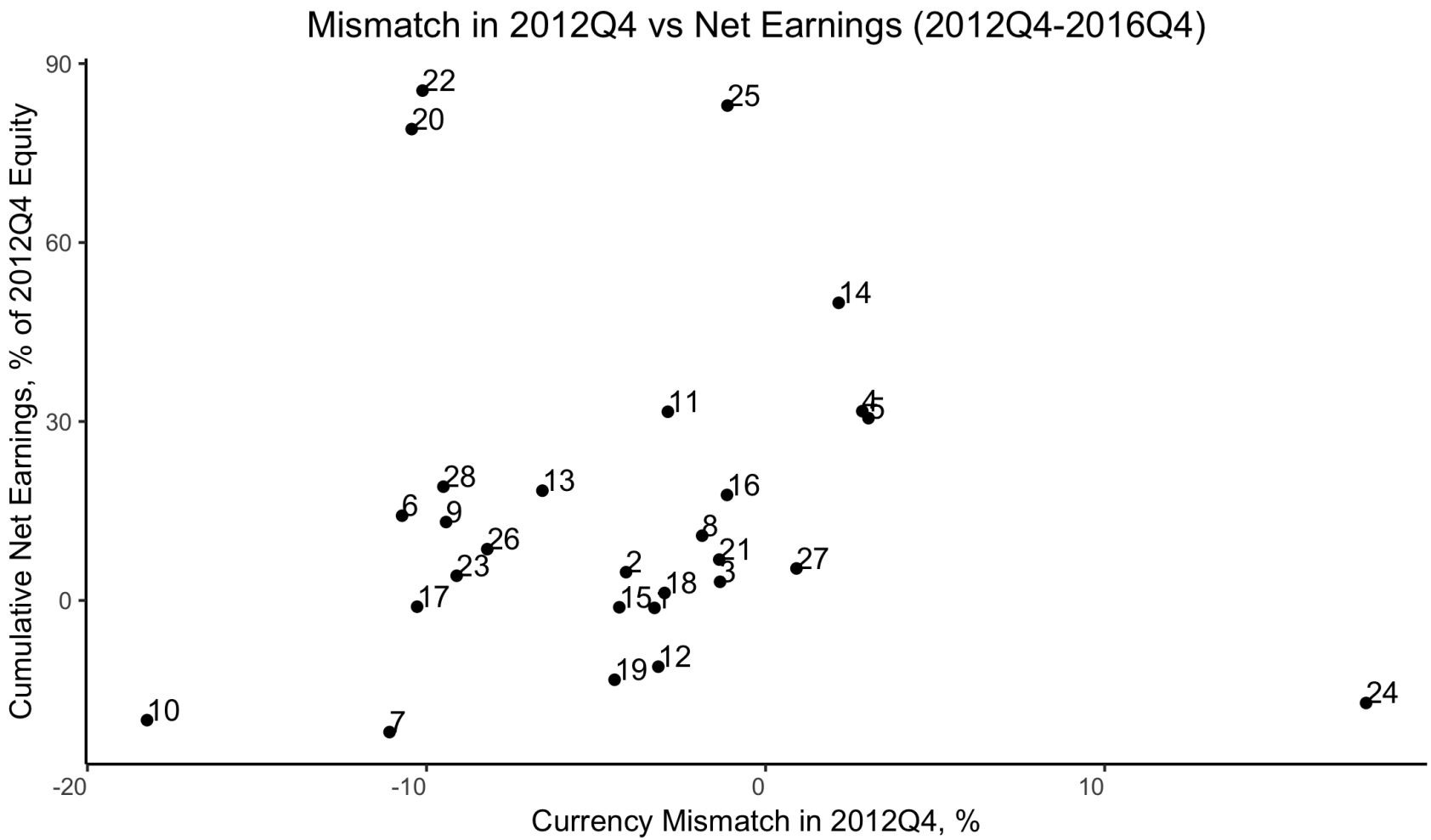


Figure: Credit Dollarization vs Net Earnings 2014Q2-2016Q4

Peru: 28 Largest Firms in Recent Depreciation

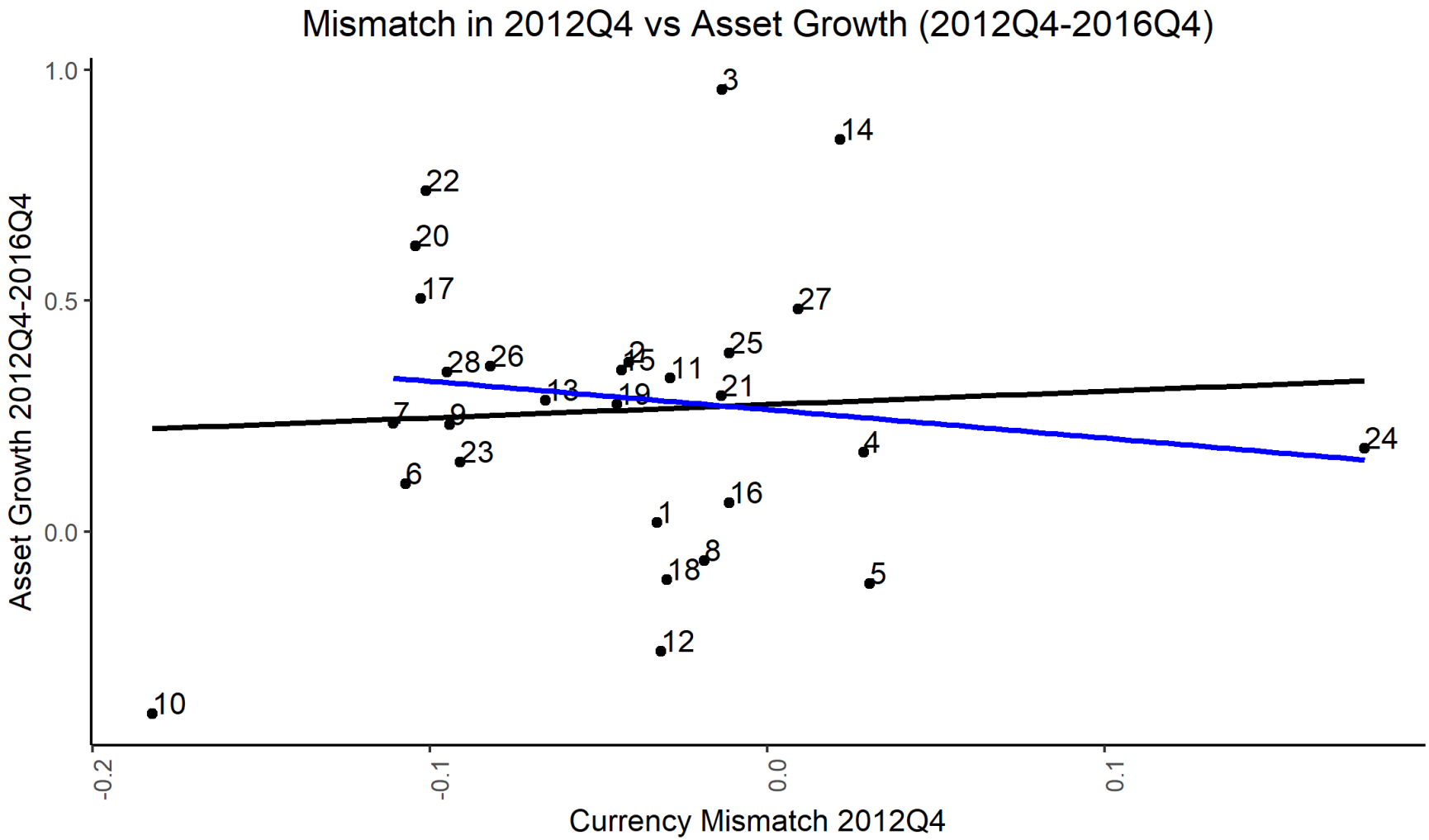


Figure: Credit Dollarization vs Asset Growth 2014Q2-2016Q4

Peru: Balance Sheet Effects

- Even if dollarization does not lead to *crisis*,
  - Financial channel may inefficiently reduce investment after an exchange rate depreciation
- 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 be related

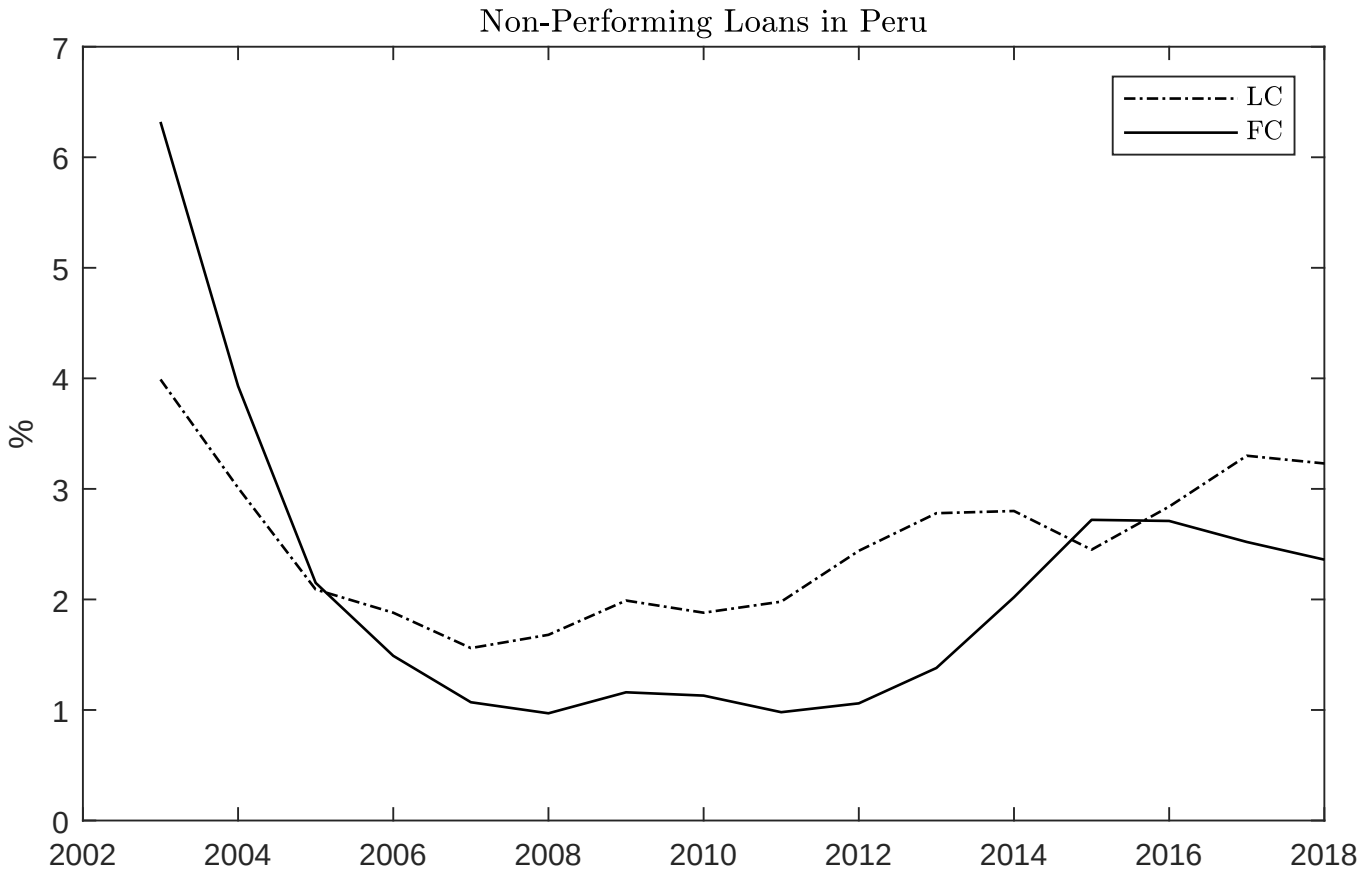
Peru: Balance Sheet Effects

	(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
R2	0.174	0.128	0.0256	0.0299
firm fe	yes	yes	no	no
year fe	yes	no	no	no

Standard errors in parentheses

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

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



Source: Central Bank of Peru

Stress Testing

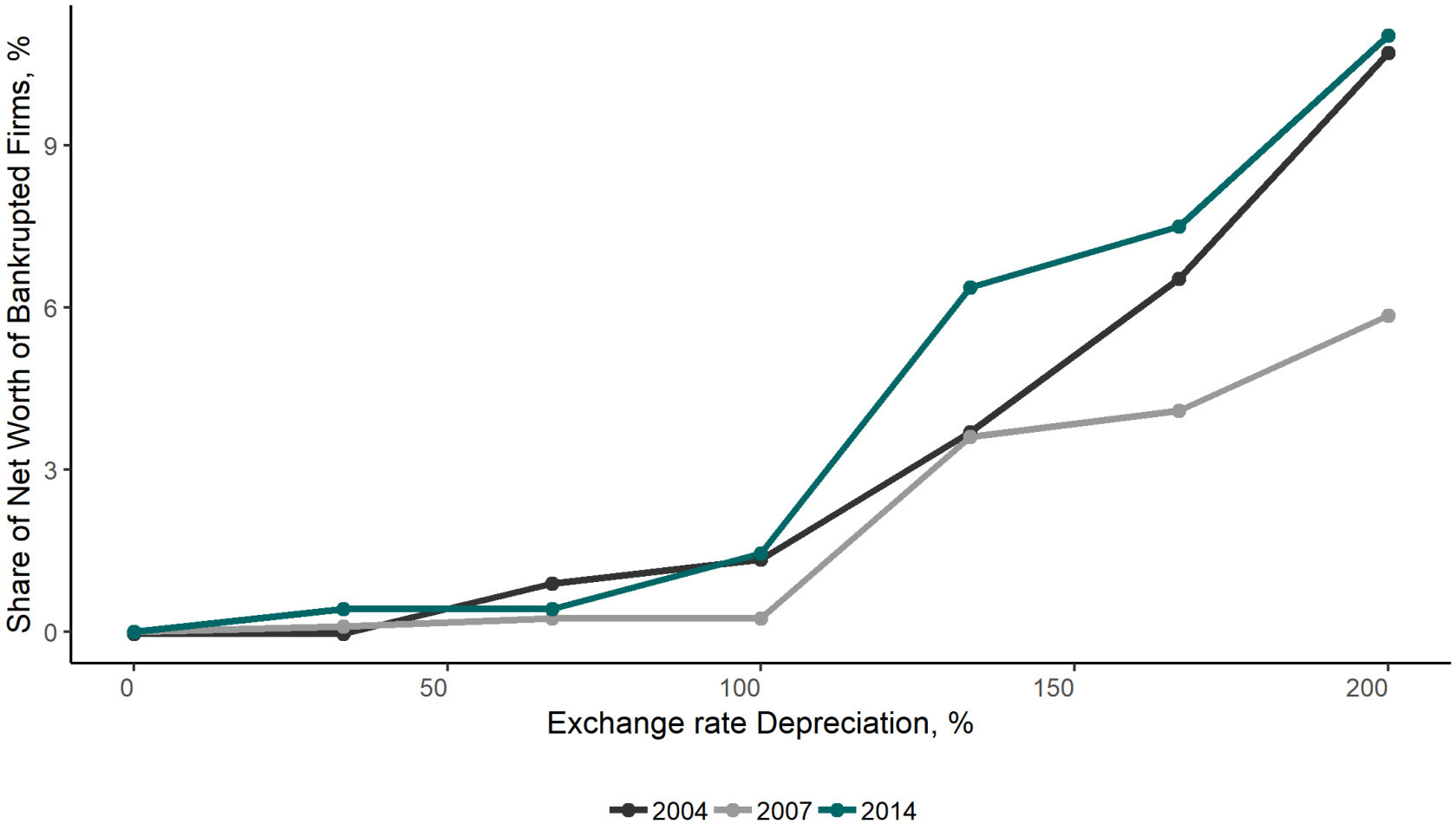
- What would be the effect of a 100% depreciation on firms?
- Data for unbalanced sample of Peruvianv 118 firms covering the years 1999-2014
  - N. R. Ramírez-Rondán (*Empirical Economics*, May 2018))
- Data on dollar denominated assets and liabilities
  - $A^{\$}, A^{S}$ $L^{\$}, L^{S}$
  - $E_{t,i}^{S'}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

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

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

- 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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Armenia

- Large and persistent depreciation in 2015
- Currency mismatch at the end of 2013 vs investment in 2015

Source: Central Bank of Armenia

Armenia

- High credit dollarization has negative effect only for the most levered firms
- High Leverage: top 25% $\frac{\text{Total Credit}}{\text{Total Assets}}$

Table: Balance Sheet Effects in Armenia

Investment		2015	2016	2015	2016
$\frac{\text{Dollar Credit}}{\text{Total Credit}}_{2013}$	(1)	0.0329	-0.0299	0.0749	-0.0227
		(0.76)	(-0.87)	(0.81)	(-0.86)
$\text{High Leverage}_{2013}$	(2)			12.54	4.601
				(1.17)	(0.50)
$\frac{\text{Dollar Credit}}{\text{Total Credit}}_{2013} \times \text{High Leverage}_{2013}$	(3)			-0.258**	-0.0420
				(-2.21)	(-0.39)
Age	(4)	0.0754	-0.0120	0.0854	0.0484
		(0.20)	(-0.04)	(0.23)	(0.16)
Employees	(5)	0.00726	0.00453	0.00675	0.00423
		(1.64)	(1.23)	(1.48)	(1.45)
N		679	609	671	594

Notes: ; *t* statistics in parentheses

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

Notes: left-hand variable is 100 $\times$ Δ*Capital*; sources: Armenian credit registry and corporate tax reports.

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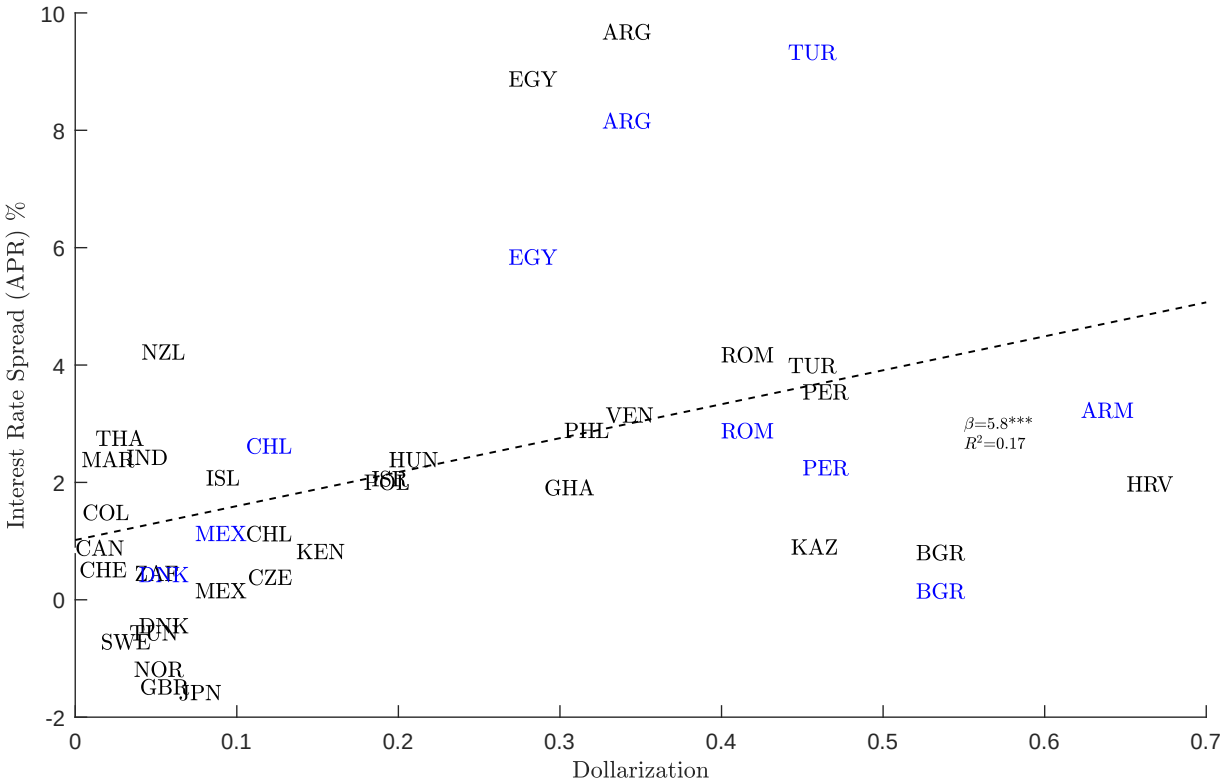
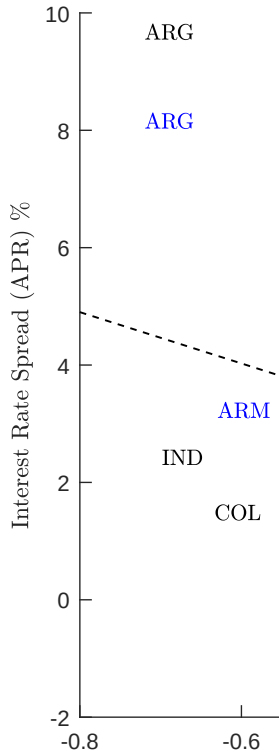
Dollarization vs Interest Rate Spreads





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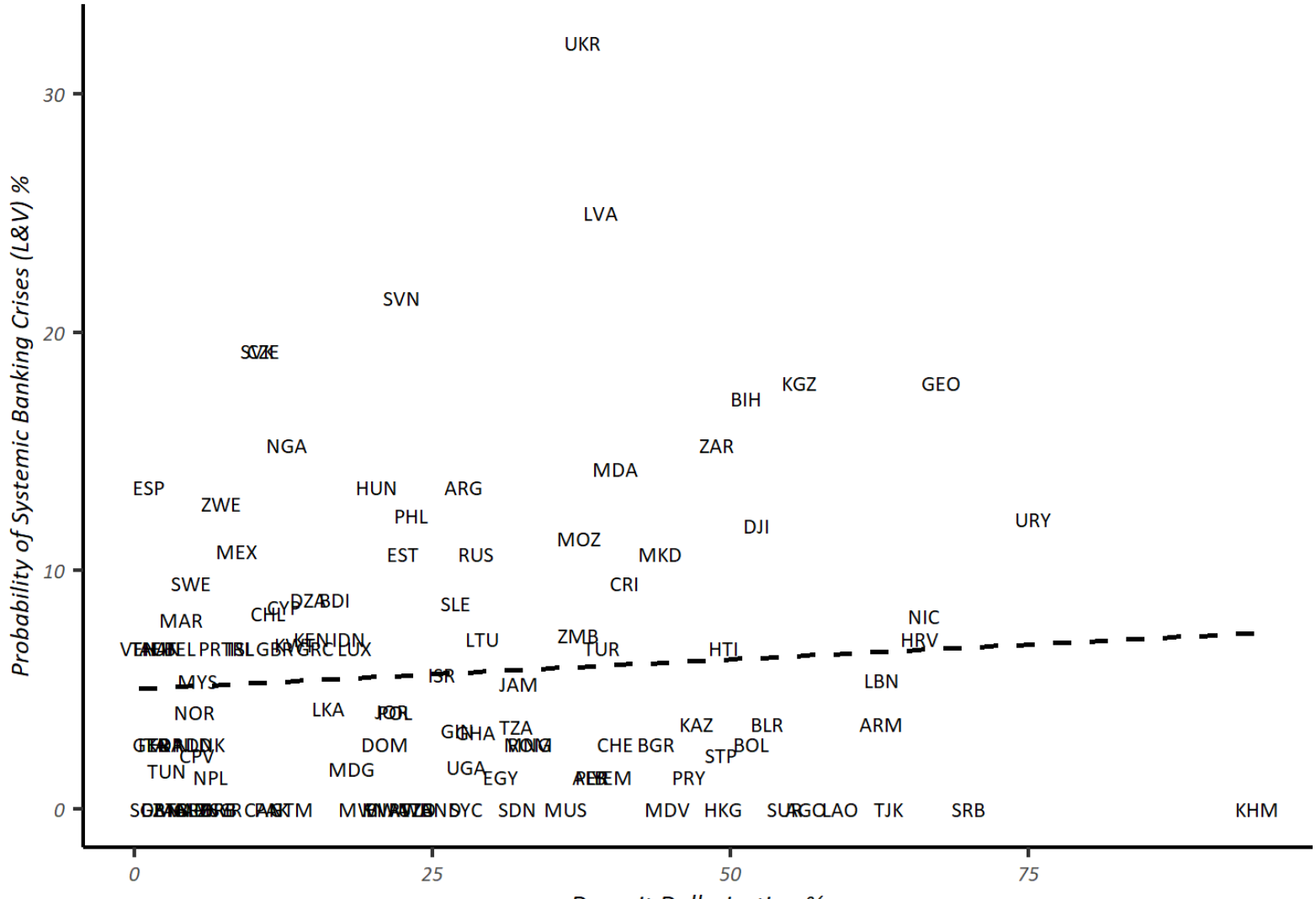
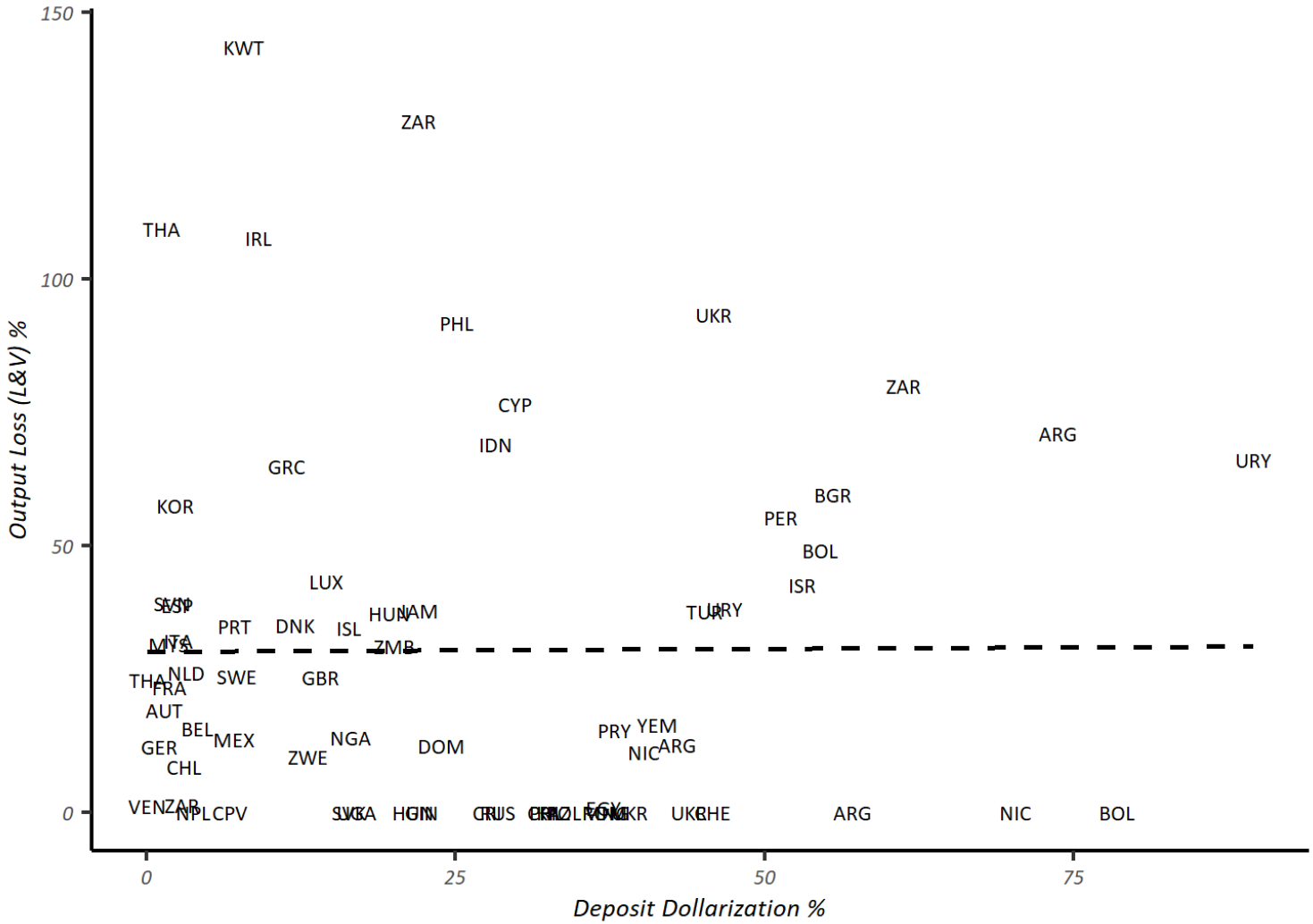
Probability of a Banking Crisis versus Deposit Dollarization



Loss of Output In a Banking Crisis versus Deposit Dollarization



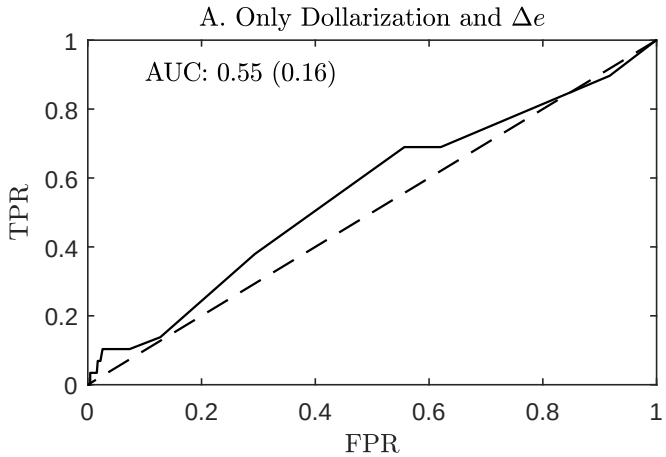
Frequency of Banking Crises vs Dollarization

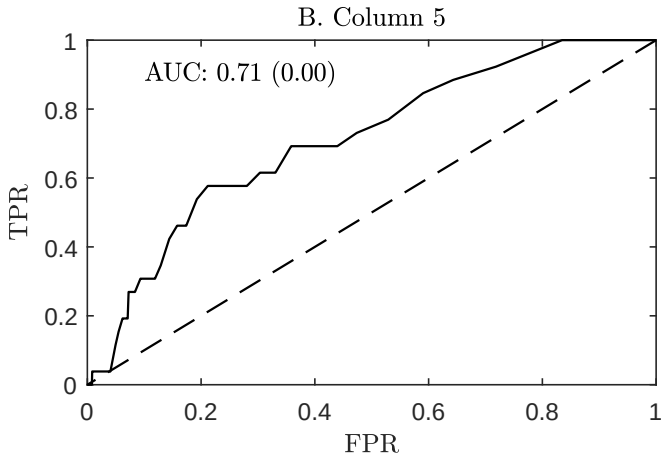
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dollar (20), $\beta(1)$	-0.318	-0.362	-0.358	-0.449	0.427	-0.105	-0.455	-1.083*
	(-0.50)	(-0.61)	(-0.53)	(-0.73)	(0.80)	(-0.16)	(-0.76)	(-1.66)
$\Delta e, \beta(2)$	-0.939*	-2.122	0.710	1.461	0.303	2.620	3.501	4.373
	(-1.90)	(-1.12)	(0.19)	(0.38)	(0.28)	(1.31)	(1.58)	(1.39)
Dollar(20)*Δe, $\beta(3)$	1.628**	2.454	0.780	0.276	0.407	-1.612	-2.431	-3.920
	(2.36)	(1.63)	(0.20)	(0.07)	(0.36)	(-0.66)	(-0.87)	(-0.95)
High FL/FA, $\beta(4)$			1.690***	1.245		1.503**	1.296	0.899
			(2.83)	(1.41)		(2.54)	(1.46)	(0.97)
High FL/FA *Δe, $\beta(5)$			-4.526*	-5.221*		-2.470	-2.693	-4.807*
			(-1.72)	(-1.80)		(-1.42)	(-1.40)	(-1.74)
Low Reserve, $\beta(6)$				-0.872			-1.240	-2.224**
				(-0.88)			(-1.17)	(-2.14)
Dollar(20) * Low Reserves, $\beta(7)$				0.338			1.022	2.448*
				(0.42)			(0.75)	(1.75)
High FL/FA * Low Reserves, $\beta(8)$				1.128			0.580	0.503
				(0.98)			(0.41)	(0.32)
External Debt, $\beta(9)$								0.381***
								(7.37)
Real GDP Growth, $\beta(10)$	-0.0386	-0.0448	0.0334	0.0301	-0.0379	0.0303	0.0269	0.0550
	(-0.99)	(-1.05)	(0.41)	(0.36)	(-0.94)	(0.35)	(0.31)	(0.72)
VIX, , $\beta(11)$	0.189***	0.203***	0.155***	0.157***	0.104***	0.124***	0.126***	0.117***
	(2.65)	(2.83)	(3.09)	(3.15)	(2.67)	(3.02)	(3.07)	(2.87)
Δrer, $\beta(12)$		1.211	-0.739	-0.851	-0.0942	-1.411	-1.640	-2.365
		(0.71)	(-0.57)	(-0.72)	(-0.08)	(-1.05)	(-1.12)	(-1.12)
Constant	-8.065***	-8.403***	-8.775***	-8.490***	-6.774***	-8.093***	-7.679***	-7.668***
	(-5.44)	(-5.47)	(-6.13)	(-5.40)	(-6.55)	(-6.80)	(-5.88)	(-5.96)

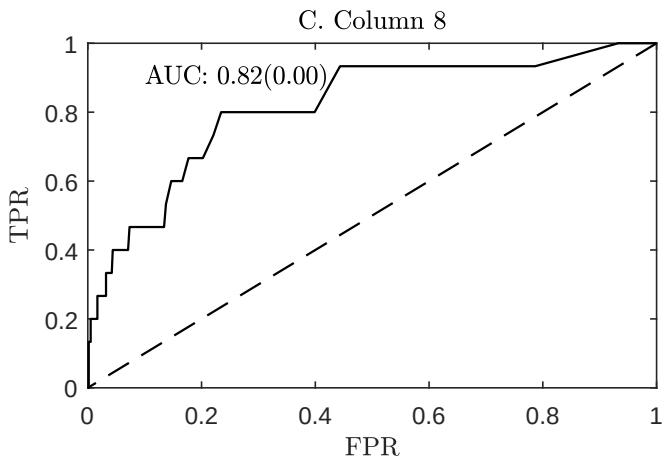
Does Dollarization Predict Banking Crises?

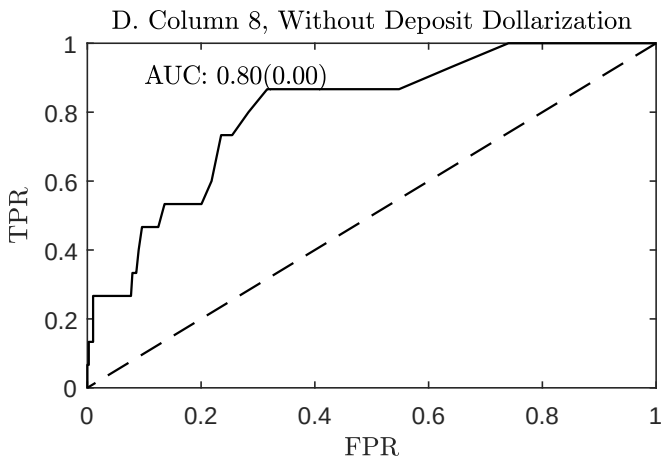
- We use area under the ROC curve (AUC) measure
  - Suss & Treitel (2020), Fuster et al. (2020)
- Model prediction: $p(x)$
  - Signal crisis if $p(x) > \bar{p}$
  - Low $\bar{p}$: Predict most crisis (high TPR) but too many false positives (high FPR)
  - Good model: High TPR with low FPR
- For $\bar{p} \in [0, 1]$ plot TPR against FPR, measure the area under the curve
- Random guess: AUC is 0.5
  - Good model AUC above 0.75

Does Dollarization Predict Banking Crises?









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