Online Appendix for: Arbitraging Covered Interest-Rate Parity Deviations and Bank Lending

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Contents

A Additional Robustness Tables

Table A.I: Summary Statistics: Banking System's Assets and Liabilities, by Currency and Tenor (%)

This tables shows summary statistics for the banking system's assets and liabilities, by currency and tenor (%). The sample period goes from February 2005 to February 2013, excluding the GFC.

	PEN Assets (%)									USD Assets (%)								
	1 month or less			6 months or less			1 year or less			1 month or less			6 months or less			1 year or less		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Active Credits	40.36	14.14	77	51.96	6.89	77	52.79	6.69	77	36.11	9.97	77	56.13	7.25	77	56.98	5.51	77
Available	29.57	20.09	77	16.10	12.66	77	13.48	11.03	77	59.34	10.66	77	38.62	7.61	77	37.55	4.42	77
Overnight deposits in BCR	6.28	6.43	77	3.17	3.71	77	2.58	3.16	77	27.24	13.58	77	15.43	7.71	77	12.62	6.16	77
Other available	23.29	14.40	77	12.92	9.23	77	10.90	8.10	77	32.10	18.95	77	23.19	10.96	77	24.93	5.57	77
Interbank loans	3.45	2.14	77	1.49	0.89	77	1.16	0.66	77	0.82	1.32	77	0.50	0.91	77	0.42	0.80	77
Investments	20.60	14.40	77	26.23	10.76	77	27.50	11.08	77	1.31	1.27	77	2.61	1.86	77	2.76	1.85	77
CDBCRP	5.78	8.62	77	12.91	10.59	77	22.27	8.38	77									
Peruvian Government's Bonds	0.05	0.11	77	0.31	0.40	77	0.80	0.79	77									
With changes in P&L	0.38	1.79	77	0.75	3.28	77	1.15	4.96	77	0.07	0.35	77	0.17	0.76	77	0.15	0.67	77
Other Investments	14.40	11.02	77	12.25	10.01	77	3.28	9.23	77	1.24	1.39	77	2.43	2.23	77	2.60	2.17	77
Other	3.29	1.84	77	2.28	0.96	77	3.18	1.34	77	0.73	1.00	77	0.51	0.64	77	0.57	0.61	77
Other credit	0.80	0.57	77	0.72	0.35	77	0.78	0.31	77	1.24	1.39	77	1.12	1.19	77	1.14	1.16	77
Receivables	1.93	1.48	77	1.22	0.70	77	1.11	0.58	77	0.45	0.44	77	0.51	0.49	77	0.59	0.50	77
	PEN Assets (%)									USD Assets (%)								
	1 month or less			6 months or less			1 year or less			1 month or less			6 months or less			1 year or less		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Liabilities with Public	80.96	7.31	77	84.09	5.08	77	84.92	4.65	77	73.96	6.54	77	73.67	7.98	77	73.99	6.04	77
Demand deposits	21.72	3.23	77	16.65	2.07	77	17.37	2.28	77	19.89	3.35	77	15.80	3.26	77	16.97	3.39	77
Savings	10.70	2.40	77	15.47	4.42	77	17.85	1.32	77	9.31	3.86	77	12.76	5.44	77	14.80	1.19	77
Term deposits	45.74	6.07	77	49.47	6.01	77	47.26	4.31	77	41.86	3.93	77	42.45	4.29	77	39.76	5.47	77
Other with public	2.80	1.74	77	2.49	1.09	77	2.45	0.99	77	2.89	2.10	77	2.66	1.28	77	2.46	1.19	77
Interbank loans	2.63	1.92	77	1.60	1.17	77	1.39	1.06	77	0.72	0.77	77	0.40	0.44	77	0.33	0.36	77
Financial system deposits	3.63	0.99	77	3.16	0.71	77	2.81	0.68	77	2.79	1.20	77	3.37	1.43	77	3.65	1.98	77
Adeudados and other fin. obligations	2.99	7.10	77	2.53	4.46	77	2.55	3.92	77	8.45	4.82	77	13.80	7.89	77	13.20	6.75	77
Accounts payable	2.40	1.01	77	2.17	1.02	77	2.14	1.01	77	0.79	0.39	77	0.59	0.23	77	0.63	0.25	77
Traded securities	0.38	0.72	77	0.55	0.49	77	0.88	0.49	77	0.16	0.18	77	0.41	0.27	77	0.65	0.23	77
Other	7.01	4.28	77	5.89	2.95	77	5.32	2.20	77	13.13	4.95	77	7.75	3.37	77	7.55	2.94	77

Table A.II: Bank-Level, Firm-Level, and Bank-Firm-Level Summary Statistics

This table shows the summary statistics aggregated at the bank level, the firm level and the bank-firm level. $\hat{\beta}$ is the bank-level coefficient estimated from Equation 7, Section IV.A. "Net Matched Position" refers to the forward and swap position of a bank that is matched with the reverse transaction in its spot position.

	Mean	Median	SD	P5	P95	N
Panel A. Bank-Level Data: Balance Sheet, Liquidity, Profitability and FX						
Balance Sheet						
Assets (Billion USD)	4.22	1.43	6.17	0.23	18.72	873
USD Deposits/ Assets (%)	33.11	34.34	14.92	5.24	53.86	873
PEN Deposits/ Assets (%)	35.71	32.92	12.50	18.76	61.14	873
USD Credit/ Assets (%)	28.12	31.22	13.31	2.45	49.48	873
PEN Credit/ Assets (%)	34.23	26.73	19.19	12.10	72.09	873
Liquidity and Profitability						
Total Liquid Assets/ Total Assets (%)	27.02	25.74	10.03	13.62	48.59	873
PEN Liquid Assets/ Total Assets (%)	12.64	11.34	6.69	4.53	27.19	873
USD Liquid Assets / Total Assets (%)	14.38	14.95	6.97	2.70	25.61	873
Return over Assets (Yr.Cumulative, %)	1.05	0.80	1.29	-0.09	3.56	873
FX Derivatives and $\hat{\beta}$						
$\hat{\beta}^{CIP}$	1.83	1.77	1.90	-0.00	4.96	13
FX Derivatives/ Assets (%)	19.38	9.56	29.95	0.00	83.57	873
Net Matched Position (Million USD)	-6.08	0.00	139.70	-220.20	221.63	873
|Net Matched Position| (Million USD)	74.22	12.24	118.48	0.00	324.23	873
Net Matched Position/ Assets (%)	-0.93	0.00	4.72	-10.35	4.80	873
|Net Matched Position|/ Assets (%)	2.38	0.46	4.18	0.00	11.69	873
Panel B. Firm-Level Data: Share of Firms by Size						
Share of Firms By Firm Size						
Share of Large Firms (%)	3.0	2.3	1.3	1.6	5.1	77
Share of Medium Firms (%)	18.4	14.8	6.6	10.2	28.2	77
Share of Small Firms (%)	78.6	83.0	7.8	66.6	88.2	77
Share of Credit By Firm Size						
Share of Credit to Large Firms (%)	42.2	42.9	4.5	33.0	48.2	77
Share of Credit to Medium Firms (%)	31.8	32.8	2.0	28.1	34.1	77
Share of Credit to Small Firms (%)	26.1	24.7	3.1	23.2	33.4	77
Credit By Firm						
PEN Credit (Th. USD, Cons FX)	368.11	10.35	3,315.55	0.00	847.28	780,359
USD Credit (Th. USD, Cons FX)	1,101.76	134.18	7,140.37	0.00	3,483.38	780,359
Total Credit (Th. USD, Cons FX)	1,469.87	205.68	8,224.86	4.58	4,839.59	780,359
Number of bank relationships	2.14	2.00	1.27	1.00	5.00	780,359
Panel C. Firm-Bank Level Data						
Credit By Firm per Bank						
PEN Credit (Th. USD, Cons FX)	172.36	0.73	1,625.67	0.00	414.87	1,666,605
USD Credit (Th. USD, Cons FX)	515.88	51.97	3,539.25	0.00	1,717.08	1,666,605
Total Credit (Th. USD, Cons FX)	688.24	99.94	3,976.77	1.03	2,367.14	1,666,605

Table A.III: Evidence Consistent With Foreign Investors Being on the Other Side of the Arbitrage

To determine who is on the opposite side of the arbitrage trade, I look at the correlation between Peru's cross-currency basis and the share of trades linked to local banks purchasing dollars forward, after splitting local banks' counterparties by residency. I use a dataset that includes all of the forward trades executed by local banks. I split the forward trades by residency of the counterparty: (a) foreign investors (nonresidents; "NR" in the table) and (b) local investors (residents; "R" in the table). I aggregate all trades on a daily frequency and compute the daily share of trades that local banks used to buy USD forward. With this, I estimate the following regression for each counterparty group:

$$y_t = \beta_0 + \beta_1 \text{CCB}_t + \varepsilon_t$$

where y_t is either the fraction of trades where the local bank buys dollars forward (columns 1 and 3) or the notional fraction of dollars local banks buy (columns 2 and 4). Columns 1 and 2 show the results for trades done with residents, and columns 3 and 4 show the results for trades done with nonresidents. The regression is on a daily frequency, between February 2005 and February 2013, excluding the GFC.

	(1)	(2)	(3)	(4)
	%NumberTrades	%NotionalTrades	%NumberTrades	%NotionalTrades
Peru CCB (%)	-2.540	-2.380	-0.827	-0.621
	(0.525)	(0.532)	(0.351)	(0.345)
Observations	1439	1439	1503	1503
Residency	NR	NR	R	R
Adjusted R2	0.0186	0.0142	0.00398	0.00216

Standard errors in parentheses

Table A.IV: Effect of Arbitraging CIP Deviations on Bank Lending: OLS Estimates

This table presents the OLS baseline results of the effect of arbitraging CIP deviations on bank lending. The specification is given by Equation 8b, without instrumenting the USDPEN basis. The dependent variables in logarithm have been multiplied by 100. The ratio of dollar loans to total loans is expressed on a 0–100 scale. Standard errors are in parentheses. They result from the joint estimation with the first stage and are clustered by date and firm. The sample period is from February 2005 to February 2013, excluding the GFC. To prevent the results of the dollar loans from reflecting changes in the exchange rate, I have converted these loans to soles using a constant exchange rate (corresponding to February 2005).

	OLS				
	Log(PEN)	Log(USD)	Log(Total)	Ratio	Log(USD)-Log(PEN)
$\text{CCB}_{t-1}^{\text{Peru}} * (\hat{\beta})$	-6.818	3.400	0.360	0.365	10.22
	(1.957)	(1.113)	(0.458)	(0.109)	(2.677)
Firm * Month FE	Yes	Yes	Yes	Yes	Yes
Bank * Firm FE	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes
Firm Cluster	18,374	18,374	18,374	18,374	18,374
Month Cluster	77	77	77	77	77
Observations	1,348,040	1,348,040	1,348,040	1,348,040	1,348,040

Table A.V: Effect of Arbitraging CIP Deviations on Bank Lending: Alternative Specifications

This table shows robustness checks under different specifications. The first five columns show the second-stage IV coefficients under different specifications. The last three columns show other statistics (number of observations, number of firm clusters, and number of month clusters). Row 1 displays the baseline second-stage regression shown in Table 4. The baseline regression has bank-firm and firm-month fixed effects, as well as 1-month lagged bank controls. The following rows either drop the bank controls and change the fixed effects specifications. Row 2 has no controls but has bank-firm and firm-month fixed effects. Row 3 has no controls and no fixed effects. Row 4 has no bank controls and only bank fixed effects. Row 5 has no bank controls and only firm and bank fixed effects. Row 6 has no controls and firm, bank, and month fixed effects.
The dependent variables in logarithm have been multiplied by 100. The ratio of dollar loans to total loans is expressed on a 0–100 scale. Standard errors in parenthesis. They result from the joint estimation with the first stage and are clustered by date and firm. The sample period is from February 2005 to February 2013, excluding the GFC. To prevent the results of the dollar loans from reflecting changes in the exchange rate, I have converted these loans to soles using a constant exchange rate (corresponding to February 2005).

	Estimates					*Other Stats*		
	Log(PEN)	Log(USD)	Log(Total)	Ratio	Log(USD)-Log(PEN)	Obs	Firm Cl.	Month Cl.
(1) Baseline	-25.18	16.16	3.08	1.45	41.35	1,348,040.00	18,374.00	77.00
	(7.31)	(4.62)	(1.52)	(0.43)	(11.10)			
(2) Benchmark w/o Controls	-25.10	11.71	1.00	1.25	36.81	1,348,040.00	18,374.00	77.00
	(6.99)	(3.76)	(1.29)	(0.37)	(9.88)			
(3) No Controls, No FE	-31.64	22.37	-3.10	2.51	54.01	1,348,040.00	18,374.00	77.00
	(8.59)	(8.84)	(2.11)	(0.76)	(16.64)			
(4) No Controls, Bank FE	-32.28	32.40	2.00	2.97	64.68	1,348,040.00	18,374.00	77.00
	(9.70)	(9.41)	(1.30)	(0.86)	(18.94)			
(5) No Controls, Firm FE, Bank FE	-30.56	8.63	-6.58	1.80	39.19	1,348,040.00	18,374.00	77.00
	(7.23)	(3.23)	(2.65)	(0.38)	(8.34)			
(6) No Controls, Firm FE, Bank FE, Month FE	-24.43	8.98	1.58	1.04	33.42	1,348,040.00	18,374.00	77.00
	(6.13)	(3.36)	(1.24)	(0.31)	(8.36)			

Table A.VI: Effect of Arbitraging CIP Deviations on Bank Lending: Bank-Level CIP Deviations and Bank-Level Betas

This table shows bank lending OLS regressions using the bank-level cross-currency basis and bank-level betas. All specifications, unless noted otherwise, use the same fixed effects (firm-month and bank-month) and lagged bank controls as those used in the baseline specification. Row 1 shows OLS coefficients using bank-level betas and the cross-currency basis computed with investment and deposit rates. Row 2 shows OLS coefficients using bank-level betas and the cross-currency basis computed with deposit rates. The dependent variables in logarithm have been multiplied by 100. The ratio of dollar loans to total loans is expressed on a 0–100 scale. Standard errors are in in parentheses. They are clustered by date and firm. The sample period is from February 2005 to February 2013, exluding the GFC. To prevent the results of the dollar loans from reflecting changes in the exchange rate, I have converted these loans to soles using a constant exchange rate (corresponding to February 2005).

	Estimates					*Other Stats*		
	Log(PEN)	Log(USD)	Log(Total)	Ratio	Log(USD)-Log(PEN)	Obs	Firm Cl.	Month Cl.
(1) $\text{CCB}^{Inv}_{b,t-1} * \hat{\beta}^{Inv}_b$	-5.41	4.33	0.78	0.42	9.74	1,059,198.00	16,881.00	77.00
	(1.52)	(1.11)	(0.40)	(0.10)	(2.35)			
(2) $\text{CCB}^{Dep}_{b,t-1} * \hat{\beta}^{Dep}_b$	-8.20	5.51	0.81	0.55	13.71	1,057,668.00	16,861.00	77.00
	(2.06)	(1.32)	(0.44)	(0.13)	(3.09)			

Table A.VII: Effect of Arbitraging CIP Deviations on Bank Lending: Arbitrage Main Regressors

This table shows the second-stage results for the baseline regression when using alternative main regressors. All specifications, unless noted otherwise, use the same fixed effects (firm-month and bank-month) and lagged bank controls as those used in the baseline specification.The dependent variables in logarithm have been multiplied by 100. The ratio of dollar loans to total loans is expressed on a 0–100 scale.

Row 1 shows the baseline coefficients and the baseline regression. Row 2 replaces $\hat{\beta}$ estimated by Equation (6) with one where the USDPEN basis is instrumented by the average basis of USDMXN and USDCLP. I use the superscript "IV" to distinguish this beta from the baseline one. Row 3 replaces $\hat{\beta}$ in the baseline regression with a dummy that takes the value of 1 for banks that arbitrage the most, those with $\hat{\beta} > 3.5$. I chose this threshold because there is a significant gap between this set of banks and the next set of banks, which have a $\hat{\beta}$ of less than 2.6. Row 4 does not use any measure to compare arbitrage intensities across banks; it uses just the USDPEN basis as regressor. Because the baseline regression has Firm×Month fixed effects and I cannot use month fixed effects with this specification, the fixed effects for this model use just firm-bank fixed effects. Row 5 uses only the 1-month lag of negative of "Matched/Assets" as the regressor.

Standard errors are in in parentheses. Standard errors are the result from the joint estimation with the first stage and are clustered by date and firm. The sample period is from February 2005 to February 2013, excluding the GFC. To prevent the results of the dollar loans from reflecting changes in the exchange rate, I have converted these loans to soles using a constant exchange rate (corresponding to February 2005).

Main Regressor	*Estimates*					*Other Stats*		
	Log(PEN)	Log(USD)	Log(Total)	Ratio	Log(USD)-Log(PEN)	Obs	Firm Cl.	Month Cl.
(1) IV: $\text{CCB}^{\text{Peru}}_{t-1} * (\hat{\beta})$	-25.18	16.16	3.08	1.45	41.35	1,348,040.00	18,374.00	77.00
	(7.31)	(4.62)	(1.52)	(0.43)	(11.10)			
(2) IV: $\text{CCB}^{\text{Peru}}_{t-1} * (-\hat{\beta}^{IV})$	-24.71	20.58	3.23	1.83	45.28	1,348,040.00	18,374.00	77.00
	(7.61)	(5.70)	(1.69)	(0.51)	(12.36)			
(3) IV: $\text{CCB}^{\text{Peru}}_{t-1} * \mathbf{1}(\text{High Arb Bank})$	-47.56	40.33	7.57	3.60	87.89	1,348,040.00	18,374.00	77.00
	(14.18)	(11.51)	(3.50)	(1.02)	(24.09)			
(4) IV: $\text{CCB}^{\text{Peru}}_{t-1}$	-30.09	27.59	-3.13	3.12	57.69	1,348,040.00	18,374.00	77.00
	(8.51)	(8.19)	(3.44)	(0.80)	(15.20)			
(5) OLS: Matched/Assets$_{t-1}$	-9.12	5.00	0.46	0.58	14.12	1,348,040.00	18,374.00	77.00
	(1.00)	(0.82)	(0.38)	(0.06)	(1.42)			

Table A.VIII: Standard Errors Robustness Check: Using Different Clusters

This table checks the validity of the standard errors in the baseline regression specification. Row 1 shows the baseline coefficients of the second-stage regression. The six "standard errors" rows show the standard errors under alternative clusters. The first five columns show the standard errors for each of the five dependent variables. The last four columns show the number of observations and the number of clusters in each regression (if applicable).

Model			*Estimates*			*Other Stats*			
	Log(PEN)	Log(USD)	Log(Total)	Ratio	Log(USD)-Log(PEN)	Obs	Firm Cl.	Month Cl.	Bank. Cl.
Baseline Coefficient	-25.18	16.16	3.08	1.45	41.35				
Standard Errors:									
(1) Baseline	7.31	4.62	1.52	0.43	11.10	1,348,040.00	18,374.00	77.00	
(2) Firm	3.01	2.71	1.22	0.19	4.30	1,348,040.00	18,374.00		
(3) Month	6.90	3.94	1.05	0.39	10.58	1,348,040.00		77.00	
(4) Bank	5.85	8.58	2.35	0.56	11.19	1,348,040.00			12.00
(5) Bank and Firm	5.07	7.15	2.06	0.47	9.42	1,348,040.00	18,374.00		12.00
(6) Bank and Month	7.40	7.59	2.02	0.56	12.59	1,348,040.00		77.00	12.00

B Cross-Currency Basis Definition

In this section, I show that the general definition of *cross-currency basis* used in the literature, which is defined in dollar terms, is the same as the definition I use in this paper, but in soles terms.

Typically, the definition used in the literature for the cross-currency basis is

$$x_{t,t+n} = y^{\$}_{t,t+n} - y^{\$,fwd}_{t,t+n} \tag{A.1}$$

This definition is equivalent to the one I use in this paper (Equation (3), in Section I). This is because the definitions of dollar- and soles-implied forward yields are

$$y^{\$,fwd}_{t,t+n} \approx y_{t,t+n} - \frac{1}{n} ln\left(\frac{F_{t,t+n}}{S_t}\right) \tag{A.2}$$

and

$$y^{fwd}_{t,t+n} \approx y^{\$}_{t,t+n} + \frac{1}{n} ln\left(\frac{F_{t,t+n}}{S_t}\right) \tag{A.3}$$

Therefore, my definition of *cross-currency basis* just regroups the literature's cross-currency terms:

$$\text{Literature:} \quad x_{t,t+n} \approx y^{\$}_{t,t+n} - \overbrace{\left[y_{t,t+n} - \frac{1}{n} ln\left(\frac{F_{t,t+n}}{S_t}\right)\right]}^{y^{\$,fwd}_{t,t+n}} \tag{A.4}$$

$$\text{This paper:} \quad \equiv \overbrace{\left[y^{\$}_{t,t+n} + \frac{1}{n} ln\left(\frac{F_{t,t+n}}{S_t}\right)\right]}^{y^{fwd}_{t,t+n}} - y_{t,t+n} \tag{A.5}$$

C Setting: Macroeconomic Environment and FX Policies

Peru has a small, open economy; its flows in the forward market are largely determined by foreign investors. Peru's currency fluctuations are largely correlated with those of other emerging economies and the global strength of the dollar.

FX fluctuations concern policy makers in emerging economies because these economies, including Peru's, share a central characteristic: many of them are partially dollarized. For example, according to the Financial Soundness Indicators database (IMF), economies such as Paraguay, Uruguay, Poland, and Turkey had loan-dollarization rates of 47%, 56%, 22% and 39%, respectively, as of 2018. In these countries, these high rates of bank lending in foreign currency are explained by similarly high rates of foreign currency deposits from local agents. This means that firms and households borrowing in dollars from the local banking system can be particularly vulnerable to FX fluctuations since they are, for the most part, not hedged.

To limit FX risk, the Central Bank of Peru uses various tools that are common among emerging economies. These include hedging regulation, limits on carry trade flows/capital controls, and a combination of FX intervention by the Central Bank and changes in reserve requirements. In this section, I describe these tools, discuss how these are common in other economies, and show robustness checks that such policies do not affect the results of the paper.

1. Hedging Regulation. First, it is extremely common in other emerging economies for banks to have a regulation that allows them to have only very limited FX risk. For example, Canta, Collazos and Shiva (2007) list more than 40 countries with such regulations; this type of regulation has also been discussed in other papers (e.g., Tobal (2018); Alfaro, Calani and Varela (2023)). As in these other countries, Peru also has a regulation limiting banks' FX risk. Therefore, as shown in Figure A.1, banks unwind their forward positions in the spot market. However, since banks can have different positions in spot and forward as long as these fall below a threshold, this regulation does not prevent them from arbitraging CIP deviations. This is because arbitraging CIP deviations requires banks to offset forward and spot transactions, leaving the net spot-plus-forward position null. As I will explain later, however, as part of capital controls, in 2011, the bank regulator introduced limits to the forward positions of banks. This regulation differs from the hedging regulation studied in Keller (2020) in that it set a limit to the forward position alone, independently of the spot position.

2. Exchange-Rate Interventions. Second, several central banks intervene frequently in the exchange-rate market to smooth exchange-rate fluctuations and manage expectations (e.g., Mohanty and Berger (2013); Blanchard, Adler and de Carvalho Filho (2015); Fratzscher et al. (2019); Candian, De Leo and Gemmi (2023)). These practices have been common throughout history (e.g., Sarno and Taylor (2001); Fratzscher et al. (2019)), particularly at times of high volatility.

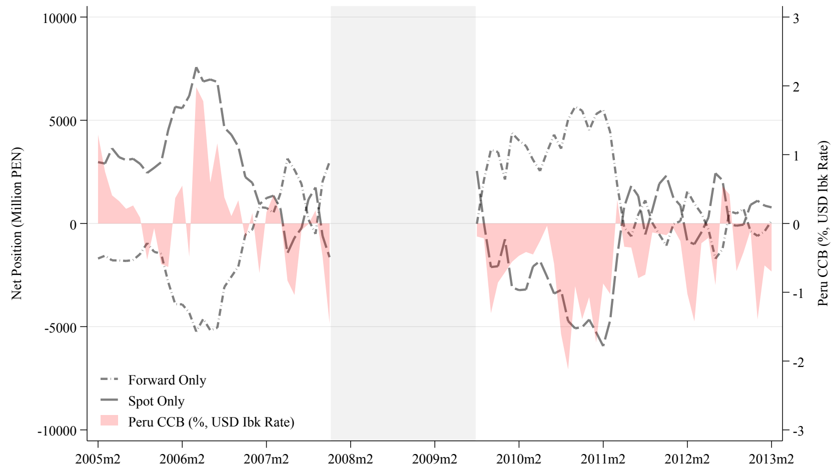

Figure A.1: Peruvian Banks' FX Positions

This figure plots Peruvian banks' aggregate spot and forward FX positions, and Peru's cross-currency basis. The dotted grey line is the banks' forward FX position. The dashed grey line is the banks' spot FX position. The red area is Peru's cross-currency basis computed using dollar interbank rates. All positions are presented in millions of soles. The shaded gray area represents the GFC. I am not showing these months, to prevent an outlier period from affecting the results and because the significant deviations affect the scale.

Recently more countries have been intervening more frequently, such as Brazil, Chile, Colombia, and Turkey (Cavallino, 2019). Adler et al. (2021) have compiled a new dataset of exchange-rate interventions that shows the intensity of such interventions by a large number of countries. Peru falls only slightly above the median distribution across emerging economies, with a significant number of emerging and advanced economies intervening more frequently.

During my sample period, the Central Bank purchased an annual average of \$6 billion (equivalent to 4% of GDP) and sold an annual average of \$1.2 billion in order to mitigate exchange-rate volatility. These interventions impacted liquidity in dollars, but they had minimal effect on soles liquidity. This discrepancy arises because only the change in soles liquidity is sterilized.

3. Restrictions on carry trade inflows/capital controls. Third, because of the monetary policy trilemma, central banks cannot have independent monetary policy while at the same time controlling the FX and having free capital flows.

Amid a surge of capital flows, various countries decided to implement capital controls, also known as macroprudential policy tools. Evidence of this was seen during the Global Financial Crisis (GFC). At that time, when the United States decreased the dollar rate, a significant number of countries observed carry trade inflows. These inflows aimed at earning the interest-rate differential between the country they were investing in and the dollar. During this time, a new consensus emerged among economists regarding the implementation of capital controls on inflows. A significant number of economists suggested that countries should adopt controls on inflows.[1] Several countries followed suit, including Brazil, Indonesia, Peru, South Korea, and Thailand.

Peru has a floating currency that has experienced important episodes of appreciation and depreciation. However, at such times, the Central Bank has intervened in the exchange-rate market to reduce these pressures and has implemented restrictions to reduce short-term capital flows. My sample period includes the aftermath of the GFC and therefore includes the restrictions on carry trade inflows described before.

As described in Keller (2020), these controls typically involve a series of regulations that affect money-markets as well as the forward markets. This is because various regulations are needed to block the two channels in which carry trade is done. One channel is borrowing dollars and buying soles short-term debt (bond channel). The second channel is buying soles against dollars forward (forward channel). In both cases, the foreign investor would receive the profits from an asset delivered in soles and a liability in dollars.

In Peru, as in various other emerging economies, the controls included (a) setting fees at 4% over notional to foreigners when purchasing soles certificates of deposit (CDs) of the Central Bank (implemented in early 2008), (b) limiting the amount of dollars banks can purchase in the forward market[2] (implemented in early 2011), and (c) setting 40% to 120% reserve requirements when local banks borrowed dollars from abroad (implemented in early 2008). Setting high fees on foreigners' soles bond purchases prevents carry trade through the bond channel. Limiting banks' forward holdings and making it costly for banks to borrow dollars limits banks' ability to absorb the flows coming from foreigners doing the carry trade through the forward channel.

The way these regulations limit carry trade flows is as follows. The fee foreign investors would need to pay to purchase sovereign short-term debt makes this channel unprofitable. This can induce foreign investors to perform the carry trade by selling dollars in the forward market.[3]

[1]See the change in stance of the IMF regarding capital controls at "IMF Adopts Institutional View on Capital Flows" in 2012. Also, more than 250 economists signed a letter voicing their support for such controls.

[2]See Keller (2020) for more details on the implementation of these controls as well as a detailed study of the effects of limits on banks' forward holdings.

[3]There are other reasons for foreign investors to prefer to do the carry trade in the forward market (via nondelivery forwards) rather than in the spot market. First, to trade in the spot market, they need to trade soles cash. For this, they need a bank account in Peru. This can add to transaction costs for foreign investors, as local banks in Peru already have bank accounts in soles. Second, the regulator of foreign investors is likely to consider Peru's short-term sovereign debt as risky and can add to balance-sheet costs (even in my sample period, which is before the introduction of Basel

Because local banks are market makers, they will buy dollars forward, but they need to sell them in the spot market to comply with hedging regulation.[4]

Selling dollars in the spot market requires banks to fund dollars. Here is where a second regulation on limiting carry trade flows, the high reserve requirements on foreign borrowing, kicks in. Setting high reserve requirements on foreign borrowing restricts banks from obtaining liquidity from abroad and increases banks' reliance on local dollar funding. However, dollars in the local market are constrained at this time. A combination of additional USD reserve requirements on local deposits and FX intervention by the Central Bank makes dollar funding scarce in the domestic market. As a result, banks can struggle to find dollar liquidity to hedge their long forward positions. This limits their absorption capacity in the forward market. And even when banks manage to find dollar liquidity, their absorption capacity in the forward market is further limited by the explicit limits to banks' forward positions.

4. Reserve requirements The Central Bank also imposes different reserve requirements in dollars and soles with the intention of changing liquidity in these currencies. This is also a common practice across central banks. In the sample period, these do not change often. When they change, dollars and soles move in the same direction. Broadly speaking, there have been two important discrete increases during carry trade inflows (early 2008 and July 2010). There was also a decrease in November 2008 due to the GFC.

C.1 Robustness of Results to Previous Regulations

This section performs robustness checks and shows that the previous regulations do not affect the conclusions of the paper.

As discussed before, Peru's Central Bank and bank regulator set regulations and intervene in the FX markets to reduce the volatility of the FX. Since we know the FX is correlated with CIP deviations (Section IV.D of the paper), and large swings in the FX also trigger a response of monetary and banking authorities, naturally CIP deviations will covary with the policies described earlier in this section. Next, I describe how these affect the results. In sum, FX interventions

III). This is less likely for banks operating in Peru. In addition to these disadvantages foreign investors face relative to local banks when trading local debt in Peru, local banks have other advantages, such as accessing primary auctions.

[4]While one could argue this could also be done in the forward market, during carry trade inflows, there is limited depth in the market with respect to those willing to take the other side of the trade.

help the mechanism outlined in this paper, while the rest have no effect on the conclusions of this paper.[5]

1. FX interventions. FX interventions could help enable the mechanism I propose here. When the currency required to do the arbitrage is scarce, CIP deviations can affect bank lending activities. However, I refrain from specifying why the currency required to do the arbitrage is scarce. One possible reason for this scarcity is the Central Bank's purchases of dollars. This limits banks' absorption capacity by making the currency required to do the arbitrage scarce.

There is no concern that the FX intervention will likely affect more the banks that arbitrage the most. This is because since they arbitrage more, they are more likely to be unwinding their forward positions in the spot market as part of the arbitrage. Whether the counterparty is the Central Bank or a different institution is of no importance. The result is the same. They need to perform the arbitrage, and hence will need to fund the spot position.

2. Local reserve requirements. My sample shows few changes in local reserve requirements.[6] This is shown in Figure A.2, which plots the changes in reserve requirements. The local reserve requirements in dollars are shown in blue. The local soles reserve requirements are shown in red for the base requirement, and in orange for the marginal soles requirement. Since I exclude the GFC, I observe only one important change in reserve requirements, which happened simultaneously in soles and dollars. This lack of variability makes it unlikely that reserve requirements affect my results. Moreover, my baseline regression also controls for lagged shares of soles and dollar deposits, which themselves are affected by the reserve requirements. Therefore, heterogeneous effects on banks coming from changes in reserve requirements should be controlled for.

Having said this, I still do various robustness checks. First, I compute CIP deviations using deposit rates adjusted by the cost of the reserve requirements. Table A5 of the Appendix of the paper, row (5), shows that this does not affect my results. Second, since a concern exists that reserve requirements may have affected more the banks that arbitrage the most, and thus explain my bank lending results, I perform a similar analysis to the one done for the correlation between CIP and FX. I find that changes in reserve requirements do not affect my results.

[5] I skip the implications FX hedging has on my results because I have already discussed how it affects the interpretation of the results in Section II.A, Page 9 of the paper.

[6] There were some during the GFC, but the GFC is not part of my sample.

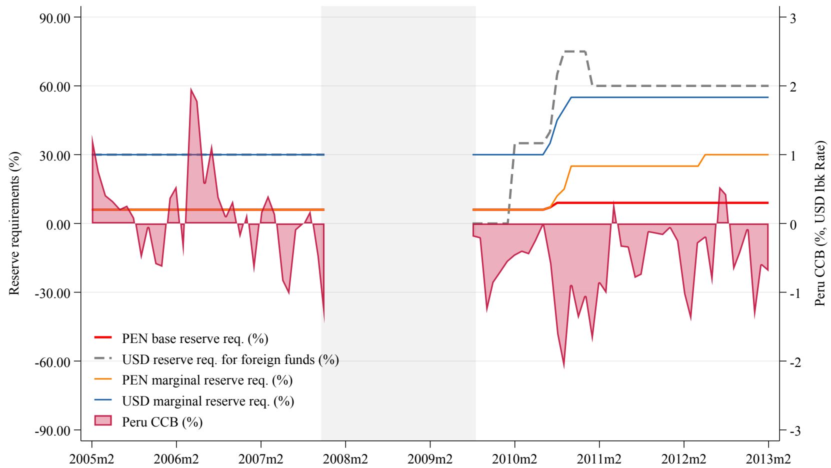

Figure A.2: Reserve Requirements vs. Peru's CCB

This figure plots the reserve requirements in PEN and USD, and Peru's cross-currency basis. The solid red line is the base reserve requirement in PEN. The dashed grey line is the reserve requirement for foreign funds in USD. The solid orange line is the marginal reserve requirement in PEN. The solid blue line is the marginal reserve requirement in USD. The red area is Peru's cross-currency basis. The shaded grey area marks the GFC.

If the reserve requirement is correlated with the basis, and the changes in the reserve requirement affect some banks more than others, one might worry that my results could be explained by changes in banks' liquidity coming from changes in reserve requirements rather than from arbitraging CIP deviations. Consider, for example, that banks with lower dependence on soles deposits are also the ones with higher betas. We know that as the basis decreases, the synthetic soles rate is lower than the cash soles rates, and banks profit from lending soles (and borrowing soles synthetically, which involves borrowing dollars cash). From the baseline regression, we know that as the basis decreases, banks with higher betas will also lend more soles. At the same time, assume the basis and the reserve requirements are negatively correlated. In this case, during times of lower basis, the reserve requirements are higher. Banks with lower dependence on soles deposits in terms of soles funding will be less affected by the higher reserve requirements and will therefore lend more soles than those with higher dependence on soles deposits.

Therefore, two different channels could yield similar results. One would be through the mechanism I propose in the paper on CIP deviations. The other would be through the reserve-requirement channel. One can carry out a similar analysis for dollars. If the correlation between the basis and dollar reserve requirements is negative, one would be concerned that banks with greater reliance on dollar deposits as a source of dollar funding are those with higher betas.

Indeed Figure A.2 shows that at the time of the increase in the reserve requirements, the cross-currency basis was more negative than the average during the time before the increase in requirements. This would imply that there is a negative correlation between the reserve requirements and the basis.[7] We know that for this to be a concern, banks with the lowest dependence on soles deposits as a source of soles funding should have higher betas. However, I do not find this to be the case. This can be seen in Panel A of Table A.IX, which shows the summary statistics of the share of soles, dollars, and total deposits for banks with different arbitrage intensity, $\hat{\beta}$. Similarly, we can be concerned when banks with the highest dependence on dollar deposits as a source of dollar funding are also those with higher betas. Table A.IX shows that this is marginally the case, but overall, the share of dollar and soles deposits across groups is very similar.

Table A.IX: Summary Statistics: Local Reserve Requirements and Capital Controls

This table shows summary statistics of bank-level variables across the sample, split by arbitrage intensity ($\hat{\beta}$). The sample period is between February 2005 to February 2013, excluding the GFC.

	Low $\hat{\beta}$ $0 \leq \hat{\beta} < 0.2$		Medium $\hat{\beta}$ $1.6 \leq \hat{\beta} < 2.6$		High $\hat{\beta}$ $3.5 < \hat{\beta}$	
	Mean	Sd	Mean	Sd	Mean	Sd
$\hat{\beta}$	0.08	0.07	2.11	0.32	4.24	0.57
Panel A: Local Reserve Requirements						
Deposits Share						
PEN Dep/Liab	81.74	12.67	85.54	4.81	84.44	10.28
USD Dep/Liab	71.92	13.86	72.66	10.61	74.05	11.21
Total Dep/Liab	76.13	10.95	78.02	6.29	78.41	8.77
Panel B: Capital Controls						
(i) Foreign reserve requirements						
USD foreign Liab/USD Liab	3.52	3.93	6.82	4.86	9.60	9.31
USD foreign Liab/Total Liab	1.78	2.43	4.10	2.94	5.72	5.64
(ii) Forward limits						
% use at announcement	2.29	0.69	105.66	35.49	78.33	22.61
% use (sample)	1.59	2.81	12.10	47.31	34.33	48.61

Since I find that banks with higher betas also depend marginally more on dollar deposits as a source of funding, I perform a robustness check similar to the one I do for FX rates. In the regression on bank lending, I add to the baseline regression the interaction between the $\hat{\beta}$

[7] This is expected. In the paper, I discuss how the basis is negatively correlated with carry trade inflows. These inflows occur during periods of economic growth in Peru, and this is when the Central Bank increases reserve requirements.

and $\frac{\text{deposits in 'y' currency}}{\text{total liabilities in 'y'}}$, where *'y' currency* is the currency of the dependent variable. Panel A of Table A.X shows that the change in the reserve requirement does not affect my results.

Table A.X: Baseline Results After Controlling for Domestic Reserve Requirements and Capital Controls

All specifications, unless noted otherwise, use the same fixed effects (firm-month and bank-month) and lagged bank controls as those used in the baseline specification.The dependent variables in logarithm have been multiplied by 100. The ratio of dollar to total loans is expressed on a 0–100 scale. Standard errors are in parentheses. Standard errors are from the joint estimation with the first stage and are clustered by date and firm. The sample period is from February 2005 to February 2013, excluding the GFC. To prevent the results of the dollar loans from reflecting changes in the exchange rate, I have converted these loans to soles using a constant exchange rate (corresponding to February 2005).

	Log(PEN)	Log(USD)	Log(Total)	Ratio	Log(USD)-Log(PEN)
Panel A: Domestic Reserve Requirements					
$CCB_{t-1} * \hat{\beta}$	-25.53	14.98	3.31	1.60	45.54
	(7.99)	(4.68)	(1.56)	(0.49)	(12.92)
PEN Deposits/ PEN $Liab_{t-1} * \hat{\beta}$	-0.07			0.07	1.79
	(0.24)			(0.01)	(0.36)
USD Deposits/ USD $Liab_{t-1} * \hat{\beta}$		0.53		0.09	1.99
		(0.16)		(0.01)	(0.36)
Total Deposits/ Total $Liab_{t-1} * \hat{\beta}$			0.22		
			(0.11)		
Panel B.1: Capital Controls: Foreign reserve requirements					
Regression 1:					
$CCB_{t-1} * \hat{\beta}$	-25.18	16.17	3.09	1.45	41.35
	(7.34)	(4.64)	(1.53)	(0.43)	(11.16)
USD foreign Liab/ Total $Liab_{t-1} * \hat{\beta}$	0.14	-0.12	-0.06	-0.02	-0.25
	(0.29)	(0.19)	(0.08)	(0.02)	(0.43)
Regression 2:					
$CCB_{t-1} * \hat{\beta}$	-25.18	16.16	3.08	1.45	41.34
	(7.35)	(4.64)	(1.53)	(0.43)	(11.16)
USD foreign Liab/ USD $Liab_{t-1} * \hat{\beta}$	0.10	-0.04	-0.03	-0.01	-0.14
	(0.18)	(0.12)	(0.04)	(0.01)	(0.27)
Panel B.2: Capital Controls: Forward limits					
Regression 3:					
$CCB_{t-1} * \hat{\beta}$	-24.73	16.29	3.27	1.44	41.02
	(7.02)	(4.62)	(1.55)	(0.42)	(10.82)
% Use Fwd $limit_{t-1} * \hat{\beta}$	-0.05	-0.01	-0.02	0.00	0.04
	(0.03)	(0.02)	(0.01)	(0.00)	(0.04)
FE					
Firm * Date FE	Yes	Yes	Yes	Yes	Yes
Bank * Firm FE	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes
Observations					
Firm cluster	18,374	18,374	18,374	18,374	18,374
Month cluster	77	77	77	77	77
Number obs	1,348,040	1,348,040	1,348,040	1,348,040	1,348,040

3. Restrictions on carry trade inflows/capital controls Since restrictions on carry trade inflows and capital controls on inflows involve various restrictions, I analyze each of these. First, capital controls include a restriction on foreign investors' purchases of the Central Bank's CDs. This restriction can shift foreign investors' demand for soles forward, and with this, the amount banks can arbitrage. However, this restriction does not affect bank lending, except through the mechanism I describe in this paper. That is, by changing banks' ability to arbitrage. Therefore, since this restriction does not involve an alternative channel correlated with banks' arbitrage that can explain bank lending, this restriction is not a threat to the validity of my results.

Second, capital controls also include high reserve requirements when borrowing dollars short-term from abroad. For my results to be valid, this requirement should not affect my results from a channel other than banks arbitraging CIP deviations. This is likely because the requirement has changed little during my sample period (as shown by the dotted gray line in Figure A.2). However, out of caution, I also try to rule out the possible confounder that some banks lend less in dollars when the basis decreases because of the higher foreign-reserve requirements rather than arbitraging the basis. To do so, I take an approach similar to the one used to analyze the possible FX and local reserve-requirement confounders.

As in the case of local reserve requirements, one could be concerned that some banks use foreign funds that have been subject to the higher reserve requirement after 2010 to lend. Since the increase in such reserve requirements happens at a time when the basis is negative, the possible heterogeneous effect of this reserve requirement on banks could in principle explain my results. This would be problematic if the high-arbitrage banks are also those that depend more on this funding for lending purposes. Since, as seen in Panel B, Part (i) of Table A.IX, high-arbitrage banks use more of this funding, we cannot easily rule out the alternative mechanism of higher reserve requirements affecting lending of high-arbitrage banks through a different channel that is not arbitrage.

However, the correlation between $\hat{\beta}$ and this type of funding is expected if this funding was used to arbitrage (and hence the Central Bank set high requirements on these funds to prevent such arbitrage). An indication of this could be that the basis is negatively correlated with this type of borrowing. And it is: ($\rho = -0.3547$). As the basis decreases and the soles synthetic rate is lower than the cash rate, banks borrow more in dollars from abroad. This is what is needed to arbitrage the basis, as banks need to borrow in the soles synthetic rate, which implies borrowing dollars.

To alleviate these concerns, I check whether the bank-lending results would be affected by introducing into the regression the interaction between the share of dollar foreign liabilities and arbitrage intensity. This is shown in Panel B, part (i) of Table A.X. I find my baseline results are robust.

Finally, in January 2011, as part of restricting capital inflows, the Central Bank imposed limits on banks' purchases of dollars forward. Keller (2020) shows that this regulation affected bank lending.[8] While Keller (2020)'s results are consistent with the ones in this paper, they do not explain the results here. First, Keller (2020) focuses only on the reaction to the announcement of capital controls on a limited sample. This paper, in contrast, looks at a larger sample. Second, as shown in Table A.IX, the banks mostly affected by the capital controls (the treated banks in Keller (2020)) are not the ones that arbitrage the most here. Hence, the results in this paper are coming from a different source. Finally, the imposition of capital controls cannot explain the co-movement between banks' arbitrage and the basis. I also add the interaction between the lag of the percentage use of forwards, activated after the limit is imposed, and the arbitrage intensity, and I find that the baseline results are also not affected (see Panel B, part (ii) of Table A.X).

D Market Segmentation

In Peru, as in many emerging markets, the local banking system has an advantage when trading its local currency and money-market instruments. This is, in part, a result of market segmentation in the exchange rate and money-market instruments to which local banks have access but other market participants, such as foreign banks, do not. Below, I detail the advantages of local banks over other investors in arbitraging the CIP deviations that arise from market segmentation.[9]

[8] Keller (2020) shows that at the time of the announcement, some banks were above the forward limit. They had three months to liquidate such positions and be within the limits. Since the forward positions of banks are hedged, as banks reduced their long forward positions, they increased their long dollar spot positions. This meant increasing dollar assets and reducing soles liabilities. As such, banks that were more affected by the regulation (i.e., those above the limit), increased their lending in dollars and decreased their lending in soles by more than banks less affected by it.

[9] There are other advantages too. One is having a soles deposit base. Another is that regulators in developed economies might consider emerging economies' sovereign securities as risky and apply risk-weight factors to foreign banks purchasing these securities. In contrast, regulators in emerging economies might consider the sovereign debt of the country as risk-free.

Central Bank primary auctions. In contrast to foreign banks and to most nonbank domestic participants,[10] local banks have access to the Central Bank's primary auctions. These include, among various other instruments, CDs in soles as well as repos. The CDs and repos are at the core of arbitraging CIP deviations. Without access to the primary auction, foreign banks and other domestic participants are constrained to trading CDs in the secondary market. This allows local banks to charge a premium.

In addition, local banks can always deposit any excess soles and dollars at the Central Bank, using the overnight Central Bank deposits. Any balance in excess of that required to satisfy the reserve requirement in each corresponding currency is taken as a dollar deposit at the Central Bank. In soles, the deposit rate is established in conjunction with the soles target rate after its monthly monetary policy meeting. In dollars, the Central Bank publishes the rate on a daily basis to local banks. This rate was a function of the Libor (during my sample period), and now of the secured overnight funding rate, SOFR. However, the exact calculation is not public information.

Interbank USDPEN spot market. In addition, only local banks have access to the interbank spot exchange-rate market. That is, only local banks have access to the trading platform for the interbank spot market, which is where most interbank spot trades are conducted and the reference "live" price for the USDPEN. This difficulty is not only present in Peru. Foreign investors also have difficulties accessing the spot market in Chilean pesos, so local banks are the ones conducting the arbitrage in Chile (Aldunate et al., 2023).

Additional constraints on foreign investors at different points in time. The market segmentation in money-market and spot transactions described before is a general description that applies to all my sample. However, there have been times in which this segmentation has been even stronger.

First, there have been times in which the Central Bank has mostly issued term deposits or only issued CDs that can only be negotiated among local banks.[11] This was specifically done to prevent foreigners from purchasing these CDs at times of capital inflows when foreign investors wanted to purchase such CDs (Central Bank of Peru, Inflation Report, December 2010). That is, even in the

[10] The participants authorized to trade certificates of deposit (CDs) in primary auctions and repos are described in "circulares" the Central Bank publishes on its website for each of the different CDs it issues (the various types include fixed rate, floating rate, and liquidated in USD).

[11] Examples of these types of deposit include CDBRP-NR (i.e., "certificate of deposit with restricted negotiation"), CDLD (a CD bought with US dollars but that gives a soles return), and CDV (CD with a variable rate).

secondary market, these instruments can only be traded among local banks. This restricts the set of possibilities in which foreign banks (or other investors) can invest short term in soles to do the arbitrage. This is especially important because the times in which these instruments are in most demand — to arbitrage negative CIP deviations — are when the Central Bank issue more of these CDs with restricted access.[12]

Second, at times with important carry trade inflows, such as at the end of 2007 and early 2008, the Central Bank imposed a transfer fee when foreign institutions buy the Central Bank's CDs in the secondary market. The transfer fee was 4% of the notional value in January 2008, eliminating any carry trade and CIP arbitrage that foreign investors could have.[13] Since this fee is not applicable to trades among local banks, they can obtain arbitrage profits that foreign banks cannot.

At this point, one could imagine that local banks and foreign investors could work around this restriction. Foreign banks could give funds to local banks to invest in the CDs. At the end of the term, local banks could provide the return to foreign banks. Indeed, starting in February 2008, when the aforementioned 4% fee was set, foreign investors increased soles-linked deposits in local banks. However, just two months later, the Central Bank set a 120% reserve requirement on any borrowing from foreign investors — by May 2008, these deposits had dropped by more than 70% (Central Bank of Peru, Nota Informativa, 2008). This made this intermediation also very costly.

Similar restrictions on capital inflows were set in various other emerging economies at the same time.

E Sample Restrictions: Regulations After 2013 and Robustness

My sample period is February 2005 to February 2013. After this date, two regulations were enacted that contaminate the main variables of my analysis. These regulations coincide with a 40%

[12]This is because the times in which the cross-currency basis is negative is when foreign investors want to do the carry trade. The Central Bank wants to restrict foreign investors, because they worry about "speculative flows" affecting the exchange rate.

[13]The regulation can be found on the Central Bank's website, at: https://www.bcrp.gob.pe/docs/Transparencia/Normas-Legales/Circulares/2008/Circular-006-2008-BCRP-Comisiones.pdf

depreciation of the sol that occurred from the taper tantrum in 2013 up to 2016.[14] Since various firms were borrowing in dollars, there were important financial losses for these firms (Humala, 2019). Other emerging-market economies also implemented similar regulations around this time, probably due to similar depreciation losses incurred by companies that had liabilities in dollars.[15] Below I summarize these regulations.

1. Regulations on the lending market. In March 2013, the Central Bank started a program to reduce banks' dollar lending. It required banks to pay additional reserve requirements over their dollar liabilities if they surpassed certain thresholds. When this program started, it targeted only mortgages and car loans. In October 2013, the program expanded to all types of loans.

Initially, the thresholds allowed for limited dollar credit growth. However, in December, the thresholds implied a reduction in banks' stocks of dollar debt. Therefore, to avoid having to pay additional reserve requirements, banks would need to substitute a share of their balances of dollar lending for soles. To enable banks to substitute part of the balances of dollars lent to soles, the Central Bank started to provide funding in soles, using as collateral banks' dollar deposits. This was particularly important: given the depreciation of the sol during this time, households and firms shifted part of their soles deposits to dollars.[16]

2. Regulations on the forward market. In response to the significant depreciation of the sol after the taper tantrum, in addition to the de-dollarization policies described before, in January 2015, the Central Bank also introduced reserve requirements to banks' sales of dollars in the forward market. The Central Bank argued this was to limit "speculation" from foreigners and because this is where

[14]There is an important difference in sample and context compared to Bryan Gutierrez, Victoria Ivashina and Juliana Salomao (2023), whose sample starts from 2013. Since the economic outlook differs significantly during their sample, the behavior I observe in my sample differs from theirs.

[15]For example, India set additional provisioning and capital requirements on banks when lending to firms with unhedged currency mismatches. Indonesia set regulations at the end of 2014, forcing firms to hedge at least 20% of their unhedged foreign liabilities that are due in the near term. Turkey also introduced regulations on corporate foreign currency borrowing, although these came later, in 2018. For India's regulation, see Reserve Bank of India, Capital and Provisioning Requirements for Exposures to Entities With Unhedged Foreign Currency Exposure, at: https://www.rbi.org.in/scripts/NotificationUser.aspx?Id=8694&Mode=0. For Indonesia's regulation, see KPMG, Prudential Principles for Offshore Borrowing, at: https://assets.kpmg.com/content/dam/kpmg/pdf/2016/07/id-prudential-principles-offshore-borrowings.pdf. For Turkey's regulation, see Central Bank of Turkey, New Foreign Exchange Restrictions in Turkey: Why and How?, at: https://www.lexology.com/library/detail.aspx?g=41336a71-1abf-4141-8ae9-738a76994e17

[16]This funding took the form of various types of repos. One of these was only to substitute banks' dollar balances. Others were to allow banks to expand their soles lending.

the depreciation pressure on the sol was coming from.[17] These reserve requirements applied when banks surpassed specified daily, weekly, and balance position limits and became progressively stricter during 2015.[18]

In addition to this new regulation, there was also another change in the forward markets. Starting from October 2014, with the same purpose of mitigating the depreciation of the sol, the Central Bank started selling dollars with foreign-exchange-rate swaps (FX swaps), instead of selling in the spot market as they had done before. The Central Bank's October 2014 Inflation Report describes that they used this instrument to sell dollars without affecting its international reserves and without affecting the soles liquidity in the banking system.

To sum up, various restrictions and new policy interventions occurred after the taper tantrum that affected both my outcome variables and my explanatory variables. To prevent my results from being affected by such regulations, which also caused outliers in CIP deviations, I decided to exclude the sample after 2013 from my analysis. Though the taper tantrum occurred after May 2013, I decided to end the sample in February 2013 to have complete years from the start of my sample (February 2005, the start of the credit-registry data I was given). The results are robust to changing to ending the sample in April 2013.

F Explanations for Arbitrage Heterogeneity

An underlying question is why some banks are able to arbitrage more than others. One possible set of explanations includes constraints on the balance sheet. That is, banks with more constraints

[17] See Gestion, "BCR tomara medidas agresivas para restringir credito en dolares en 2015" (December 17, 2014) at: https://gestion.pe/impresa/bcr-tomara-medidas-agresivas-restringir-credito-dolares-2015-87287-noticia/; and Gestion, "Medidas mas potentes del BCR podrian frenar alza del tipo de cambio" (August 27 2015) at: https://gestion.pe/impresa/medidas-potentes-bcr-frenar-alza-tipo-cambio-98377-noticia/

[18] These limits differ from those implemented by the Bank Regulator in 2011. First, the Central Bank had daily, weekly, monthly, and balance limits on banks' sales of dollar forwards, while the Bank Regulator limited only the net forwards' balance. Second, the Central Bank does not impose a hard limit on forward transactions, as the Bank Regulator does. Hence, banks could decide to surpass the Central Bank limits (which are lower than those of the Bank Regulator) and pay a cost for doing so. Third, the Central Bank limits are on banks' *sales* of dollar forwards (on a daily, weekly, monthly, and balance basis). In contrast, the limits implemented by the Bank Regulator apply to the *net* position of forwards. Hence, the Bank Regulator's limit implies that banks can have large sales of dollar forward positions as long as these are compensated by purchases of dollar forwards. The Central Bank's limits would not allow that, as they consider only the sales of dollar forwards without any netting. Finally, the Central Bank limits are also more binding than those of the Bank Regulator regarding the balance.

on their balance sheet arbitrage less. Another possible set includes the type of client in the forward market.

Below, I present correlations to show suggestive evidence of potential explanations. One important limitation, however, is that explaining the cross-section of banks is difficult because there are only few banks, meaning regressions at the bank level lack observations to draw deeper conclusions.

While constraints to the balance sheet can be a reason for banks to differ in the degree they arbitrage, it might not be the only reason. For example, banks that have clients whose demand on the forward market goes against market flows could be more likely to arbitrage to a greater extent. This is because these clients offer banks an opportunity to unwind part of their forward position in case they need to. Therefore, they could be more confident in taking larger arbitrage positions if they know they can easily liquidate them if needed.

Banks have various incentives to unwind. First, they may have limited funding capacity to arbitrage CIP deviations, and, if they expect these deviations to amplify, they might want to liquidate previous positions to make room for more profitable arbitrages. Second, if they have maturity mismatches between their forward contracts and their funding, and if their funding is becoming more expensive, they might want to close forward positions (and hence spot positions). Third, after limits on forward contracts, they might have limited capacity to buy new contracts and they could want to unwind part of their position. These are only three examples of situations in which banks value having a vast set of clients who enable them to unwind their positions. There could be additional reasons.

I find evidence that suggests that banks arbitrage more when they think they can count on clients with whom to unwind positions.[19] In my sample, on average, banks' forward positions have been long dollars forward (i.e., clients are selling dollars forward). If the premise that banks value having clients with offsetting flows is valid, then banks that have greater arbitrage sensitivity to changes in the basis (have higher $\hat{\beta}_b$) should be those with a greater share of clients who trade relatively often — and that when they do, they buy dollars forward. This indeed is what I find. Panel A, Figure A.3 shows the fit line of $\hat{\beta}_b$ against each bank's share of clients buying dollars forward.

[19] This excludes local banks.

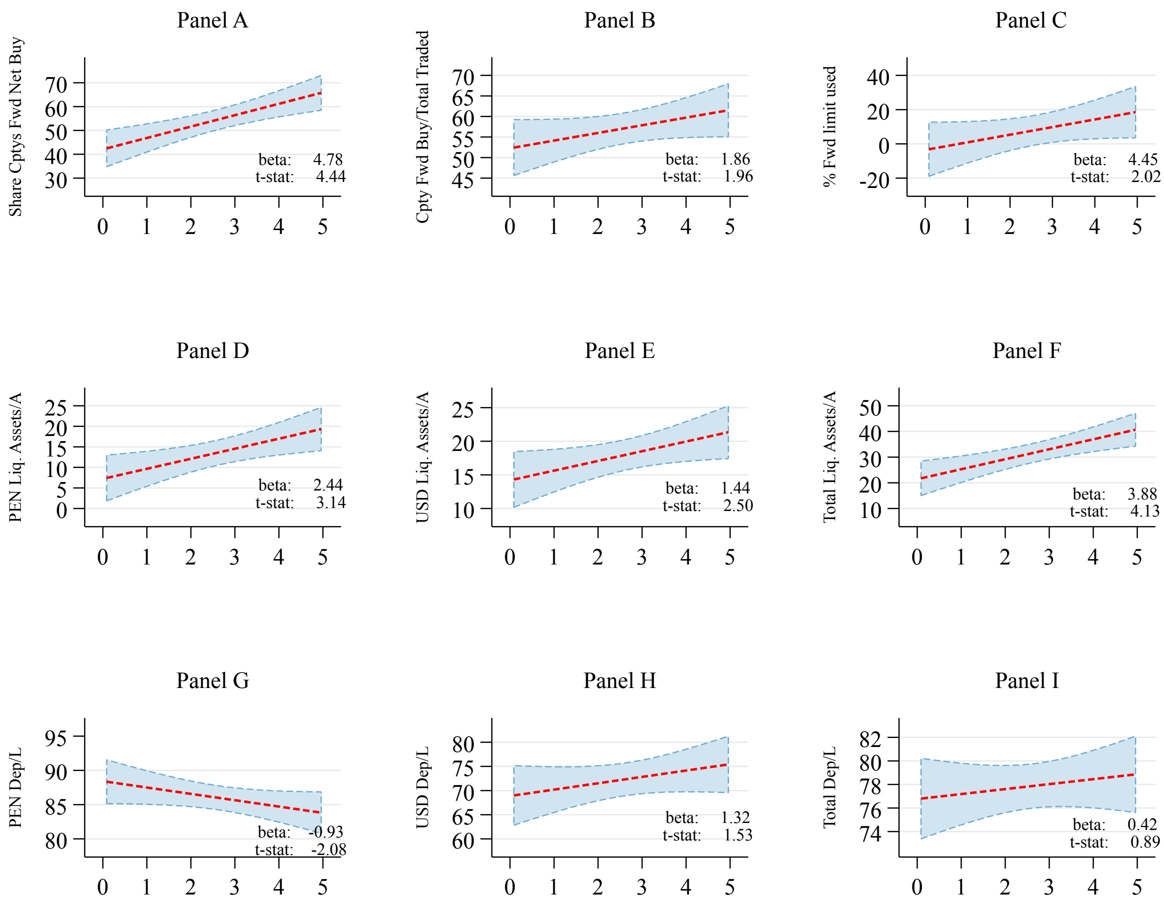

Figure A.3: Arbitrage Intensity and Bank Indicators

The x-axis for all panels is $\hat{\beta}_b$. The dependent variable for each panel (y-axis) is as follows. Panel A: share of clients buying dollars forward. Panel B: share of clients' dollar buy transactions over total transactions. Panel C: forward limit used. Panel D: PEN liquid assets over assets. Panel E: USD liquid assets over assets. Panel F: total liquid assets over assets. Panel G: PEN deposits over liabilities. Panel H: USD deposits over liabilities. Panel I: total deposits over liabilities. All dependent variables are in %, on a 0–100 scale. For Panels A and B, I compute, for each bank, the average among their clients. For Panels C to I, I compute, for each bank, the average over time for each variable. I then regress these on beta. The red line is the line of best fit. The shaded blue area is the 95% confidence interval. The sample period is from February 2005 to February 2013, excluding the GFC.

To compute this share, I first restricted the sample of clients to those that traded frequently (at least 38 times during the 77-month sample[20]). Second, I classify each client as either a *net buyer* or a *net seller*. This classification comes from netting all of their forward transactions across my sample. If in net they bought dollars forward, then the client is a buyer; if not, the client is a

[20] 77 months comes from 96 months minus the length of GFC

seller. Third, with this classification, I map each client to banks that traded at least once with said client. The assumption is that each counterparty that traded with a bank in any of the 77 months of the sample is a potential client with whom banks could trade and unwind part of their position (particularly because I restrict the sample to those trading relatively often). Finally, I compute each bank's share of net buyer clients as the ratio between the sum of all of the bank's clients who bought in net during the sample and their total number of clients.

I validate the interpretation of the previous variable by computing alternative measures that can capture banks' ease of unwinding their long dollar forward positions. For example, this relationship also holds when comparing banks' $\hat{\beta}_b$ with their client's average share of dollars bought (i.e., dollars bought/total negotiated). This is shown in Panel B, Figure A.3 . Furthermore, these coefficients presented are tilted downwards by banks that do not trade much (banks with $\hat{\beta}$ very close to 0). Conditional on being a bank that trades more often ($\hat{\beta}$ >0.5), the relationships become significantly stronger. An increase in 1 of $\hat{\beta}$ is associated with an increase of 2.5 percentage points in the clients' average share of dollars bought. This result is statistically significant.

While the above suggests that other factors beyond balance-sheet constraints could explain arbitrage heterogeneity, it is likely that balance-sheet constraints play a role. Precisely, the variables that likely constrain banks from arbitraging include restrictions on funding and being close to a capital-controls limit — this includes a limit, established in 2011, on the amount banks can buy in the forward market.

Constraints to arbitrage coming from banks' balance sheets are more endogenous to banks' arbitrage actions than banks' counterparties.

The endogeneity of constraints to arbitrage, such as liquidity variables and the percentage use of the forward limit, pose some challenges. First, one can learn less about a regression specification of rolling betas against these variables because of inverse causation. With enough autocorrelation, even lagged variables could be contaminated by inverse causation. Second, regressions adding various covariates may not be informative. All covariates could be affected by the arbitrage itself. Therefore, it is hard to disentangle the correlation between a variable and $\hat{\beta}$. This seems to be the case.

The results from using month fixed effects and regressing 12-month rolling $\hat{\beta}$ regressions on 12-months lagged of the 12-month moving average of liquidity, deposit variables, and forward limits[21] shows that no variable, except dollar and soles shares of liquid assets, is statistically significant. These results are not stable, and they vary when running contemporaneous regressions. Those results also differ from the ones obtained from Figure A.3 and the $\hat{\beta}_b$ rolling regressions that regress one variable at a time, where all, except dollar deposits, are statistically significant.

Given this, my analysis is restricted to fit plots of the correlation between $\hat{\beta}$s and the bank-level averages of various liquidity variables, and the use of forward limits. These fit plots are displayed in Figure A.3. In line with the argument that liquidity is important to execute the arbitrage, the plots show that banks with higher $\hat{\beta}$s have more soles and dollar liquid assets. I also find that they have more dollar deposits (as a share of total liabilities). This is consistent with the sign of the CIP deviations. In my sample, CIP deviations have been mostly negative. In this situation, banks require mostly dollar funding. Therefore, banks with higher $\hat{\beta}$s have a higher share of dollar deposits but not a higher share of soles deposits as a fraction of total liabilities.

G Additional Robustness Checks

In this section, I complement the robustness results from Section IV.D of the paper.

Firms with foreign trade. The correlation between the cross-currency basis and the exchange-rate could affect the results through an alternative channel: the effect that the exchange-rate has on foreign trade. Exporters could face greater demand as the sol depreciates, in which case these firms may increase their credit demand. Given that their revenues are in dollars, it is also possible they demand dollar loans. If banks that arbitrage more specialize in lending to firms that engage in foreign trade, then the results could be driven by demand from net exporters.

[21] The exact regression is:

$$\begin{aligned}\text{12mo } \hat{\beta}_b \text{ rolling}_{bt} = {} & \gamma_1 \text{FwdLimUsed}^{\text{MA 12m}}_{b,t-12} + \gamma_2 \text{PENLiqA/A}^{\text{MA 12m}}_{b,t-12} + \gamma_3 \text{USDLiqA/A}^{\text{MA 12m}}_{b,t-12} \\ & + \gamma_4 \text{PENDep/L}^{\text{MA 12m}}_{b,t-12} + \gamma_5 \text{USDDep/L}^{\text{MA 12m}}_{b,t-12} + \text{Month-FE} + \varepsilon_{bt}\end{aligned}$$

where 12mo $\hat{\beta}_b$ rolling is the estimated $\hat{\beta}_b$ using 12-month rolling regressions for each bank. All covariates are a 12-month moving average (to coincide with the 12-month rolling $\hat{\beta}$, lagged 12 months. This means that the covariates are computed over a window that does not coincide with the rolling $\hat{\beta}$. The covariates are as follows. FwdLimUsed is the percentage utilization of the forward limit. This variable is zero before its imposition, in January 2011. PENLiqA/A and USDLiqA/A are the share of liquid assets (over assets) of the corresponding currency. PENDep/L and USDDep/L are soles and dollar deposits as a share of total liabilities.

To mitigate this problem, I estimate the baseline regression after dropping all exporter and importer firms from the sample.[22] To do so, I merged the baseline dataset with a dataset that contains importers and exporters from Superintendencia Nacional de Aduanas y de Administracion Tributaria (SUNAT). The baseline results are robust to excluding firms with foreign trade. Row 3 of Table A2 in the paper's Appendix shows the results. I have also done robustness checks dropping firms that hedge with derivatives. The results remain very similar, because very few firms hedge.

Type of loan. Another concern is that credit demand for a particular type of loan could lead some firms to borrow from a specific bank and in a specific currency. To alleviate this concern, I narrow the sample to the most common type of loan: commercial loans.[23] These constitute 50% of loans to firms in Peru. Row 4 of Table A2 shows that the baseline results are even strengthened by this modification. The coefficients in soles and dollars are larger in absolute terms, while still being statistically significant at 1% significance level. This indicates that the baseline results are not driven by particular demands for specific types of loans or bank specialization in a specific type of loan.

Alternative arbitrage intensities. Another concern is that the baseline specification uses a common estimated $\hat{\beta}$ between OLS and IV estimations. However, the "matched" position of the bank is affected when banks that decide first to lend in dollars and then hedge by selling dollars forward. As the bank sells dollars forward, the basis can decrease, while selling dollars forward also makes the matched position more negative. Because of this, $\hat{\beta}$ could be biased. Therefore, as a robustness check, I estimate $\hat{\beta}$ in Equation (7) of the paper but instrumenting the USDPEN basis with that of the average between USDCLP and USDMXN. The results (see the second row of Table A.VII) are robust to the change in the estimation of $\hat{\beta}$.

Similarly, Table A.VII shows that the results are robust to a variety of changes in the regressors, including not using $\hat{\beta}$ to sort banks. This table compares the banks that arbitrage the most with those that either do not arbitrage or arbitrage significantly less (row 3), only using the USDPEN basis (row 4), and using the lagged arbitrage position, Matched/Assets, as the regressor (row 5).

[22] I define an exporter/importer as a firm that exports or imports every year. Defining an exporter/importer as a firm that has ever exported/imported yields similar results.

[23] The sample excludes several other types of loans, including foreign trade loans, leasing, real estate, credit cards, and overdrafts.

This last row shows only the OLS regression, because there is no IV for Matched/Assets. Also, because month fixed effects cannot be added when using only the USDPEN basis as the regressor, row 4 uses only bank-firm fixed effects and lagged bank controls.

Standard errors. I also perform various robustness checks regarding the standard errors and show that the statistical significance of the results holds. This check is important because the banking system in Peru, as in most countries, is composed of a small number of banks.

Hence, clustering at the bank level can yield inconsistent standard errors with so few clusters. Because of this, the regressions I report use firm and month clusters. To confirm that the significance of the results is not driven by the choice of clustering, Table A.VIII reports the baseline specification under different clustering options, including at the bank level. In particular, I show that the statistical significance of the results holds when clustering by bank only, by bank and firm, by bank and date, by firm, and by firm and bank.

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