Do Industries Naturally Hedge?
From Dollarization of Deposits to Loans at the Sectoral Level in Peru

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Motivation

- Peru is a classic case of partial dollarization: financial dollarization fell substantially after inflation targeting and macroprudential reforms, but its decline has moderated.
- Business loans account for around 90% of foreign-currency credit to the private sector.
- Aggregate trends mask substantial cross-sector heterogeneity in FX cash flows and loan dollarization.
- This setting allows us to ask whether sectoral FX exposure helps explain the persistence of loan dollarization.

Why does loan dollarization matter?

- It weakens monetary policy transmission and may hinder financial deepening.
- It may create currency-mismatch risks and vulnerability to exchange-rate shocks when unhedged.
- From a prudential perspective, the key concern is to contain FX-related risks when exposures are not properly hedged.

Research Question

Main question

Does deposit dollarization predict loan dollarization at the bank–sector level?

- Is the relationship stronger in tradable sectors?
- Is the relationship consistent with partial natural hedging through currency matching?
- How much is explained by sectoral matching vs. aggregate bank balance-sheet matching?

Working hypothesis

Foreign-currency deposits reflect sectoral FX liquidity needs and FX cash-flow exposure, and therefore should be positively associated with foreign-currency lending, consistent with partial natural hedging.

Related Literature and Contribution

Three related strands

- **Aggregate dollarization**: MVP, inflation pass-through, exchange-rate volatility, macroeconomic credibility, institutional features, and financial-market imperfections.
- **Banking-side matching and credit risk**: banks align funding, deposits, and loan currency; regulation reinforces currency matching.
- **Corporate hedging**: firms match FX liabilities with FX revenues, assets, cash holdings, or derivatives.

Figure: Exchange rate risk Hedging Instruments

Classification in hedging literature	financial hedges		operational hedges
Classification in financial statements	derivative hedges	natural hedges	
Instruments	forwards (futures), options, swaps	foreign-currency debt, foreign currency assets (cash, deposits or liquid asset)	overseas diversification, operational matching of revenues and expenditure (incl. FC pricing and sourcing to locals)

Source: Adapted from Dohring (2008).

Related literature and contribution

However:

- Aggregate and bank-side explanations do not fully account for broad sectoral differences.
- Firm-level studies often cover selected samples of large or small firms.
- Firm-level evidence does not fully capture banks' incentives to supply dollar loans.

This paper contributes by:

- Bringing a **sector-bank** perspective using previously unexplored balance-sheet data.
- Broad coverage of private firms at the bank–sector level.
- Bridging **firm-side hedging motives** and **bank-side intermediation patterns**.
- Showing that sectoral heterogeneity is central to understanding loan dollarization.

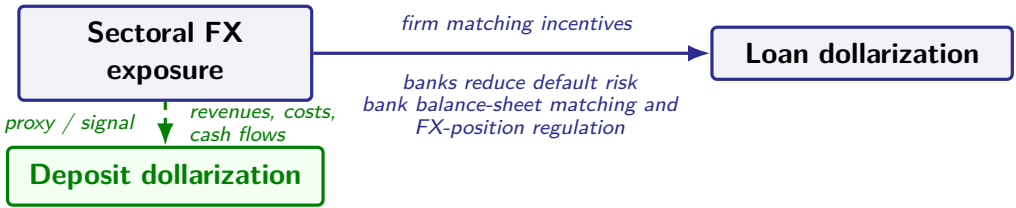
Conceptual Mechanism

Firm-side logic

- The U.S. dollar is the dominant vehicle currency in trade: exporters receive dollars, while importers require dollar liquidity.
- FX exposure and real dollarization lead firms to hold dollar deposits for transactions, liquidity management, and precautionary balances.
- Firms may borrow in dollars to align debt service with FX revenues, cash flows, and assets.

Bank-side logic

- **Firm level:** Banks lend in borrowers' repayment currency to reduce mismatch and default risk.
- **Aggregate level:** Funding, FX positions, and regulation constrain dollar-loan supply.



Data

- Monthly sectorized balance-sheet data for financial institutions (BSI), collected by the BCRP.
- Consolidated credit registry (RCC) for firms' derivative accounts by currency and *Reactiva Perú* loan amounts.
- Customs data on firm-level exports and imports, aggregated to sector-month.
- SBS Financial System Reports, Banks CAR, and FX position.

Sample

- Business loans and deposits only
- 14 sectors
- Monthly frequency
- 2019M1–2025M9

Main Variables

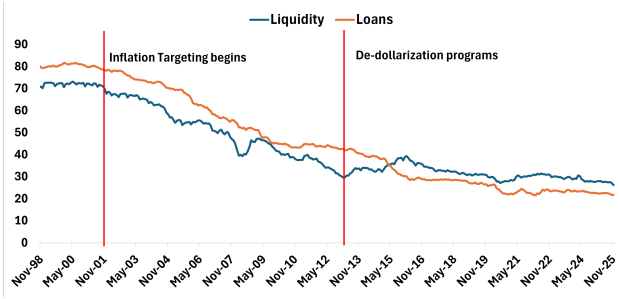
- **Dependent variable**: loan dollarization at the bank-sector-month level
- **Main regressor**: deposit dollarization at the bank-sector-month level
- **Deposit components**: demand, savings, and term deposits
- **Sector controls**: exports, imports
- **Bank controls**: capital adequacy ratio, foreign liabilities, FX position, distance to FX regulatory limit
- **Other controls**: derivatives, Reactiva balances, spreads, exchange rate, depreciation

	mean	*sd*	*min*	*max*
Loan dollarization	21.0	31	0.0	100.0
Deposit dollarization	29.6	32	0.0	100.0
Saving Deposit dollarization	24.7	30	0.0	100.0
Term Deposits dollarization	30.1	38	0.0	100.0
Current Deposit dollarization	40.7	33	0.0	100.0
Derivatives in foreign currency (FX)	12.5	49	0.0	692.4
Derivatives in local currency (LC)	0.8	10	0.0	161.9
Reactiva	45.0	312	0.0	8154.5
Sector level variables:				
Imports	400.3	914	0.0	5395.0
Exports	304.2	606	0.0	3700.1
Bank level variables:				
Capital adequacy ratio (CAR)	16.1	6	5.5	122.4
Foreign Liabilities	2.9	5	0.0	27.5
FX position	70.2	602	−1708.1	1855.1
Macro variables:				
Loan Spread FC-LC (%)	−13.4	4	−20.1	−0.9
Deposit Spread FC-LC (%)	−0.4	1	−2.5	0.9
Exchange Rate	3.7	0	3.3	4.1
Depreciation	0.0	0	−0.1	0.1

Stylized Fact 1: The Pace of Aggregate De-dollarization Has Moderated

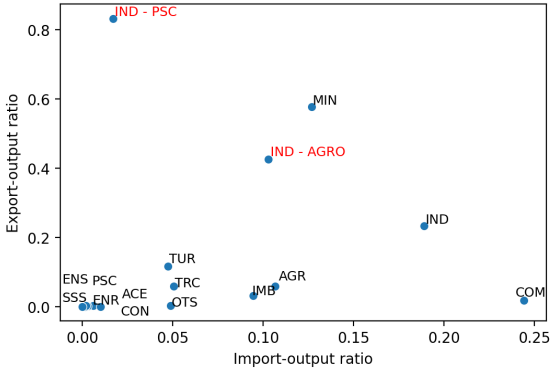
- Aggregate loan and liquidity dollarization fell substantially after inflation targeting and de-dollarization policies.
- Yet, more recently, its pace appears to have moderated or even stagnated.
- Business loans in FC represent nearly 90% of FC credit to the private sector.
- Aggregate de-dollarization hides persistent differences across sectors.

Figure: Peru: Dollarization of total credit and liquidity (percentages)

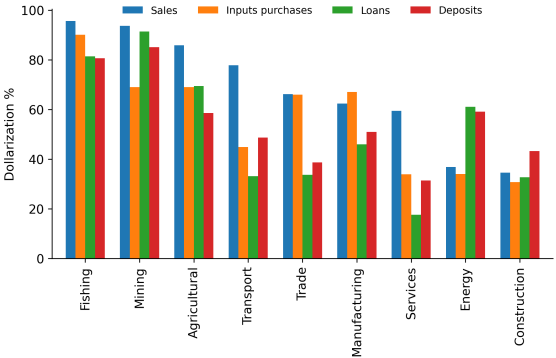


Stylized Fact 2: Sectoral Dollarization Aligns with FX Exposure

Export-output and import-output ratios, 2007



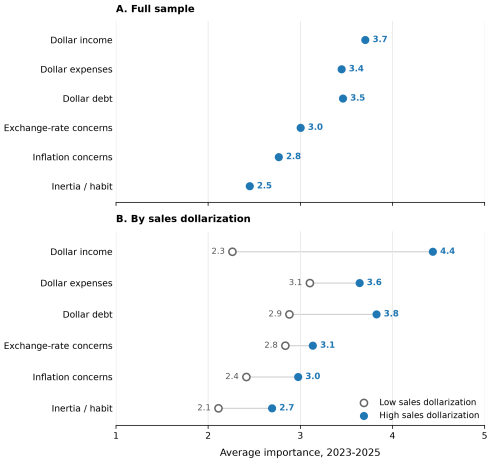
Real and financial dollarization by sector



- Trade exposure and financial dollarization vary substantially across sectors.
- Sectors with more dollarized sales and purchases also tend to hold more dollar deposits and loans.

Sources: 2007 Input–Output Matrix, INEI; BCRP Macroeconomic Expectations Survey; sectorized financial-institution balance sheets.

Stylized Fact 3: Dollar-deposit motives reveal FX exposure

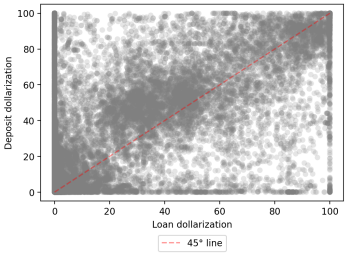


Source: BCRP Macroeconomic Expectations Survey, 2023–2025.

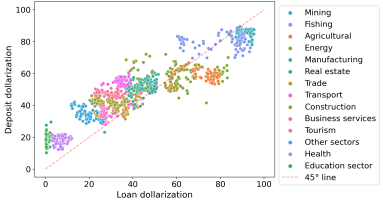
- Dollar income, expenses, and debt are leading motives for holding dollar deposits.
- Dollar income is especially important among firms with highly dollarized sales.
- Deposits therefore contain information about FX cash flows and liquidity needs, not only portfolio choice.

Stylized Fact 4: Currency matching is clearer through a sectoral lens

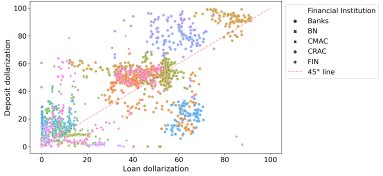
Figure: Dollarization of corporate credit and deposits, 2019-M1 to 2025-M09 (percentages).



(a) By sector and financial institution



(b) By sector



(c) By financial institution

- There is a positive relationship between deposit and loan dollarization at the bank-sector-time level.
- The relationship becomes much clearer when data are aggregated by sector.
- This pattern is consistent with common sectoral FX exposure playing a larger role than purely aggregate bank balance-sheet matching.

Empirical Specification

$$DL_{s,i,t} = \rho\, DL_{s,i,t-1} + \beta\, DD_{s,i,t} + X_{s,i,t} + Z_{j,t} + u_{j,t} + \varepsilon_{s,i,t}$$

- $DL_{s,i,t}$: loan dollarization
- $DD_{s,i,t}$: deposit dollarization
- $X_{s,i,t}$: Reactiva and derivatives, and other bank-sector controls
- $Z_{j,t}$: sector-time or bank-time controls
- $u_{j,t}$: alternative fixed effects

Goal

Estimate whether deposit dollarization is associated with loan dollarization after accounting for persistence and other drivers of FX lending.

Identification and Estimation

- Dynamic panel with a lagged dependent variable
- One-step System GMM with robust standard errors
- Appropriate given persistence and fixed effects

Endogeneity treatment

- Endogenous: deposit dollarization, derivatives, FX position, near-FX-limit variables
- Predetermined: exports, imports, CAR, foreign liabilities
- Strictly exogenous: Reactiva and macro variables

Fixed-effects strategy

- Bank-month fixed effects: absorb bank-specific funding and supply conditions
- Sector-month fixed effects: absorb sector-specific shocks

Baseline Results

	(1)	(2)	(3)	(4)	(5)
Loan dollarization(-1)	0.8290***	0.7846***	0.8447***	0.8680***	0.8809***
	(0.029)	(0.030)	(0.024)	(0.021)	(0.018)
Deposit dollarization	0.0799***	0.0712***	0.0682***	0.0792***	-0.0534
	(0.021)	(0.020)	(0.018)	(0.016)	(0.051)
Exports	0.1069***	0.1346***		0.0868***	0.0526**
	(0.025)	(0.032)		(0.021)	(0.021)
Imports	0.0494	0.3453**		-0.0319	-0.0897
	(0.083)	(0.176)		(0.081)	(0.091)
FC derivatives	0.1198	-0.0674	0.0983	0.0504	0.0942**
	(0.080)	(0.115)	(0.065)	(0.041)	(0.038)
LC derivatives	0.0395	0.0560	0.1530	0.0280	0.0313
	(0.053)	(0.106)	(0.138)	(0.037)	(0.047)
Reactiva	-0.0987***	-0.1723*	-0.0691	-0.0456	-0.0524***
	(0.019)	(0.091)	(0.047)	(0.031)	(0.018)
CAR			0.0510*	0.0372*	0.0398**
			(0.029)	(0.020)	(0.018)
Foreign Liabilities			0.0583	0.0356	0.0495
			(0.058)	(0.038)	(0.036)
FX Position			0.8310	0.7440	0.6267
			(0.601)	(0.593)	(0.562)
Near FX limit >0			-1.2091	-0.9602	-0.6789
			(0.827)	(0.800)	(0.771)
Near FX limit <0			1.9088	1.6281	1.1601
			(1.307)	(1.304)	(1.260)
Deposit dollarization * Exports					0.0027**
					(0.001)
Deposit dollarization * Imports					0.0036
					(0.003)
Loan Spread FC-LC					-0.0592***
					(0.018)
Deposit Spread FC-LC					-0.0109
					(0.076)
Exchange Rate (-3)					-0.8531**
					(0.370)
Depreciation					0.8042
					(1.538)
Fixed Effects:					
Month	No	No	No	Yes	No
Bank-month	No	Yes	No	No	No
Sector-Month	No	No	Yes	No	No
Observations	26384	26384	25932	25932	25932

- Loan dollarization is highly persistent.
- Deposit dollarization is positive and significant in the baseline specifications.
- Exports are positively associated with loan dollarization.
- Reactiva is associated with lower loan dollarization.
- In the full model, the interaction with exports is positive and significant while the standalone deposit coefficient weakens.

Economic Magnitudes

- Baseline coefficient on deposit dollarization: around 0.07–0.08.
- Interpretation: a 10 pp increase in deposit dollarization is associated with roughly a 0.7–0.8 pp increase in loan dollarization on impact.
- Because persistence is high, the long-run effect is much larger.
- Estimated long-run effect: roughly 4–5.5 pp for a 10 pp increase in deposit dollarization.

Takeaway

Even with noisy sector-bank aggregation, the deposit-dollarization signal remains economically meaningful.

Export exposure amplifies deposit–loan currency matching

- Once the DD $\times$ exports interaction is included, the standalone deposit-dollarization coefficient weakens.
- The association is stronger where FX inflows from exports are larger.
- Imports are generally weaker and less robust, consistent with ambiguous theoretical effects.

Interpretation

The interaction is consistent with deposit dollarization capturing FX liquidity and cash-flow exposure, especially in export-oriented sectors.

Sectoral Heterogeneity

Sector	Loan dol.	Deposit dol.	FX Position	NFXL > 0	NFXL < 0	LRE
Fishing	0.975***	0.0250*	1.539**	-1.535*	3.916***	1.00
Manufacturing	0.892***	0.0843***	-0.928	0.0691	0.386	0.78
Mining	0.913***	0.0616*	1.330	-1.357	3.411*	0.71
Agriculture	0.923***	0.0447***	1.155	2.083	5.518**	0.58
Other activities	0.843***	0.0879***	2.527	-0.747	8.632	0.56
Real estate	0.874***	0.0594*	2.672	-0.0476	4.221**	0.47
Business activities	0.924***	0.0330**	-1.421	1.993	-2.702	0.43
Transportation	0.911***	0.0372***	-0.569	-0.161	-2.905*	0.42
Construction	0.911***	0.0231**	0.364	-1.559*	-1.305	0.26
Trade	0.851***	0.0338**	1.684**	-1.455	4.860**	0.23
Tourism	0.840***	0.0261**	-3.136	3.940	-8.331	0.16
Education	0.822***	0.00490	0.346	-0.696**	0.512	0.03
Health	0.850***	-0.00119	2.452	-4.839*	3.275	-0.01
Energy	0.850***	-0.00633	4.619***	-7.731***	9.775***	-0.04

- Strongest deposit-loan matching in:
  - Fishing
  - Manufacturing
  - Mining
  - Agriculture
- Weak or insignificant association in:
  - Education
  - Health
  - Energy

Sectoral Heterogeneity

- Tradable sectors have recurrent dollar cash flows and stronger incentives to borrow in dollars.
- Non-tradable sectors have limited FX income and weaker incentives to take FX debt.
- Energy is highly dollarized, but the deposit-loan coefficient is weak:
  - possible price indexation,
  - stronger productivity,
  - alternative funding sources,
  - larger-bank relationships.

Bottom line

The results are not just about average dollarization levels — they are about whether deposits and loans move together in ways consistent with natural hedging.

Sectoral exposure is more systematic than aggregate bank matching

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Loan dollarization(-1)	0.8228***	0.8672***	0.8752***	0.8856***	0.8915***	0.8698***	0.8717***
	(0.029)	(0.028)	(0.029)	(0.025)	(0.023)	(0.021)	(0.020)
Deposit dollarization	0.0789***					0.0796***	0.0793***
	(0.021)					(0.016)	(0.015)
Exports	0.1179***				0.1096***		0.0808***
	(0.027)				(0.025)		(0.021)
Imports	0.0534				0.0612		-0.0199
	(0.093)				(0.080)		(0.080)
FC derivatives	0.1005	0.2273***	0.2369***	0.1845***	0.1759***	0.0424	0.0428
	(0.083)	(0.061)	(0.066)	(0.053)	(0.049)	(0.040)	(0.037)
LC derivatives	0.0642	0.0300	0.0999*	0.0422	0.0338	0.0257	0.0222
	(0.054)	(0.061)	(0.060)	(0.052)	(0.056)	(0.036)	(0.037)
Reactiva	-0.1122***	-0.1515***	-0.1643***	-0.1211***	-0.1211***	-0.0477	-0.0509*
	(0.042)	(0.045)	(0.042)	(0.036)	(0.033)	(0.030)	(0.028)
CAR		0.0647**		0.0736***	0.0625***	0.0340	0.0297
		(0.028)		(0.027)	(0.024)	(0.021)	(0.020)
Foreign Liabilities		0.1579***		0.1163**	0.1111**	0.0419	0.0406
		(0.057)		(0.048)	(0.044)	(0.039)	(0.036)
FX>0		0.3940	3.7533***	1.5834**	1.3765*	0.6865	0.5309
		(0.454)	(1.223)	(0.758)	(0.737)	(0.684)	(0.677)
FX<0		0.7599	-0.1890	0.6784	0.7318	1.4619	1.5664
		(0.818)	(1.092)	(0.910)	(0.896)	(1.002)	(0.991)
Near FX limit >0			-4.3048***	-1.5271*	-1.3424	-0.8693	-0.7093
			(1.529)	(0.881)	(0.868)	(0.859)	(0.855)
Near FX limit <0			1.9551	2.0798	2.0564	2.8934*	2.8384*
			(1.860)	(1.433)	(1.421)	(1.568)	(1.560)
Observations	26384	28601	29053	28601	28601	25932	25932

- Bank FX position variables matter mainly when regulatory constraints become more binding.
- Once sectoral variables are included, aggregate bank matching becomes less precisely estimated.
- Exports and deposit dollarization remain more robust correlates of loan dollarization.

Interpretation

Sector-level FX exposure explains loan dollarization more systematically; aggregate bank balance-sheet constraints become more relevant near FX-position limits.

Robustness I: Alternative Deposit Measures

	(1) SGMM Term dol.	(2) SGMM Term dol.	(3) SGMM Savings dol.	(4) SGMM Demand dol.	(5) Panel OLS Dep. dol.	(6) Panel OLS Dep. dol.
Loan dollarization (-1)	0.8196***	0.7686***	0.7994***	0.7960***	0.9543***	0.9472***
	(0.040)	(0.049)	(0.035)	(0.030)	(0.002)	(0.002)
Term Deposit Dollarization	0.0220**	0.0361**				
	(0.010)	(0.014)				
Saving Deposit Dollarization			0.0418***			
			(0.014)			
Demand Deposit Dollarization				0.1217***		
				(0.025)		
Deposit dollarization					0.0180***	0.0356***
					(0.002)	(0.011)
Exports	0.1396***		0.0638**	0.1710***	0.0666***	0.0063
	(0.040)		(0.030)	(0.045)	(0.010)	(0.012)
Imports	0.2365		0.1382	0.0971	-0.0855***	0.0260
	(0.168)		(0.126)	(0.214)	(0.026)	(0.034)
FC derivatives	-0.0505	0.1503**	-0.0792	-0.0424	-0.0045	0.0039
	(0.067)	(0.075)	(0.089)	(0.105)	(0.009)	(0.010)
LC derivatives	0.0026	0.2222***	0.0382	0.0626	0.0051	0.0242
	(0.098)	(0.066)	(0.108)	(0.107)	(0.021)	(0.021)
Reactiva	-0.1505	-0.1529***	-0.1954**	-0.2184*	-0.0003	0.0012
	(0.098)	(0.046)	(0.089)	(0.126)	(0.012)	(0.012)
Deposit dollarization * Exports						0.0035***
						(0.000)
Deposit dollarization * Imports						-0.0043***
N	15778	15778	21322	15489	26384	26384

- Results are robust using different dollarization measures.
- Term and saving deposits are less directly tied to contemporaneous loan disbursements, reducing simultaneity concerns.
- Fixed-effects OLS delivers qualitatively similar patterns.

Robustness II: Restricted Samples

	(1)	(2)	(3)	(4)	(5)	(6)
	(LD > 0 & DD > 0)		Excl. Never use of FX		Sample: 2022-2025	
Loan dollarization (-1)	0.8912***	0.8702***	0.8162***	0.8340***	0.7730***	0.8506***
	(0.023)	(0.024)	(0.027)	(0.024)	(0.042)	(0.029)
Deposit dollarization	0.0468***	0.0375**	0.0772***	0.0489***	0.0687**	0.0763***
	(0.017)	(0.015)	(0.023)	(0.019)	(0.027)	(0.024)
Exports	0.1147***		0.1618***		0.1239**	
	(0.039)		(0.043)		(0.053)	
Imports	0.1997		0.1946		0.1020	
	(0.144)		(0.233)		(0.296)	
FC derivatives	-0.0516	-0.0022	-0.0069	0.0386	0.0846	0.1314*
	(0.064)	(0.043)	(0.112)	(0.064)	(0.123)	(0.073)
LC derivatives	0.0092	0.0708	0.0547	0.1879	0.0671	0.1635
	(0.080)	(0.092)	(0.113)	(0.132)	(0.096)	(0.146)
Reactiva	-0.2481**	-0.0634	-0.1698	-0.0766	-0.1901	-0.0462
	(0.098)	(0.040)	(0.109)	(0.055)	(0.215)	(0.072)
CAR		0.0608**		0.0484		0.0429*
		(0.029)		(0.032)		(0.025)
Foreign Liabilities		0.0422		0.0448		0.0042
		(0.041)		(0.058)		(0.060)
FX Position		0.6877		1.0535*		1.8266**
		(0.514)		(0.592)		(0.800)
Near FX limit >0		-1.0490		-1.3947*		-3.4898***
		(0.660)		(0.791)		(1.271)
Near FX limit <0		2.3584*		2.6289*		3.7405**
		(1.212)		(1.363)		(1.755)
Fixed Effects:						
Bank-month	Yes	No	Yes	No	Yes	No
Sector-Month	No	Yes	No	Yes	No	Yes
N	15113	14998	19168	19009	14496	14238

- Excluding contemporaneous zero-zero observations
- Excluding bank-sector pairs that never use FX
- Restricting the sample to the post-2022 period

Result

The positive association between deposit and loan dollarization survives all these sample restrictions.

Synthesis of the Evidence

1. Loan dollarization is highly persistent.
2. Deposit dollarization is positively associated with loan dollarization.
3. The relationship is stronger in tradable/export-oriented sectors.
4. Export exposure amplifies the effect of deposit dollarization.
5. Bank-level FX constraints matter, but mostly at the margin.

Overall interpretation

The evidence is consistent with partial sectoral natural hedging: foreign-currency deposits and FX cash-flow exposure are associated with higher loan dollarization, but do not eliminate exchange-rate risk.

Limitations and Future Research

Limitations

- Bank–sector data do not cleanly separate firm-side credit demand from bank-side loan supply.
- Aggregation masks heterogeneity across firms within the same sector.
- Derivative positions and trade exposure are measured imperfectly at the relevant bank–firm level.

Future research

- Match firm balance sheets, FX cash flows, and bank–firm credit relationships.
- Distinguish firms' hedging choices from banks' currency-specific lending incentives.
- Measure net derivative positions and residual currency mismatch more precisely.

Policy Implications and Conclusions

- De-dollarization policies may have heterogeneous effects across sectors.
- Tradable sectors may sustain higher FX intermediation for structural reasons, without necessarily being fully hedged.
- Monitoring currency risk should combine:
  - sectoral FX exposure,
  - firm cash-flow structure,
  - bank FX-position constraints.

Conclusion

Observed loan dollarization in Peru is consistent with partial sectoral natural hedging, while aggregate bank matching and regulatory constraints still shape outcomes.

Appendix: Sectoral Loan and Deposit Dollarization

Loan and deposit dollarization by sector (%)
Mean, 2019M1–2025M9

Economic sector	Loan dol.	Total DD	Sav. DD	Term DD	Curr. DD
Mining	43.0	60.7	51.4	61.1	73.9
Fishing	40.6	46.8	25.4	56.8	66.1
Agriculture	31.9	38.9	29.2	41.4	54.9
Manufacturing	26.1	32.7	24.0	35.5	50.8
Energy	25.1	33.4	18.8	38.9	42.7
Transport	24.8	32.5	26.2	29.4	44.6
Real estate	22.3	35.4	33.3	29.0	47.4
Trade	19.7	28.2	23.9	28.2	38.5
Business services	17.8	27.6	32.3	26.6	35.9
Construction	15.1	26.6	26.9	27.4	30.9
Other sectors	14.2	22.2	25.6	17.0	24.7
Tourism	10.1	16.8	8.9	26.7	26.9
Health	5.1	11.9	11.6	18.1	17.7
Education	1.2	7.3	9.8	19.2	11.7
Total	21.0	29.6	24.7	30.1	40.7

Note: Total DD and its savings, term, and current-account components are reported separately.