Digital Payments and Monetary Policy Transmission

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Motivation

- Banks' **market power** is an impediment to **monetary transmission**

- Central bank $\uparrow$ rates by x b.p. $\not\Rightarrow$ banks $\uparrow$ deposit rates by x b.p.

- Reasons: services offered, deposit stickiness, switching costs

- Digitalization makes switching between banks easier:

  Question: How do cashless payments change monetary transmission?

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Overview of results

- Empirically, cashless payments (Pix) *reduce* banks' market power
  - Banks' deposit rates *respond more* to policy rate changes
  - Banks retain more deposits
  - Banks' loans flow out *more* after the policy rate increases
- Dynamic banking model to study counterfactuals and channels
  - Monetary policy transmits *more* after Pix
  - Mainly driven by the deposit channel

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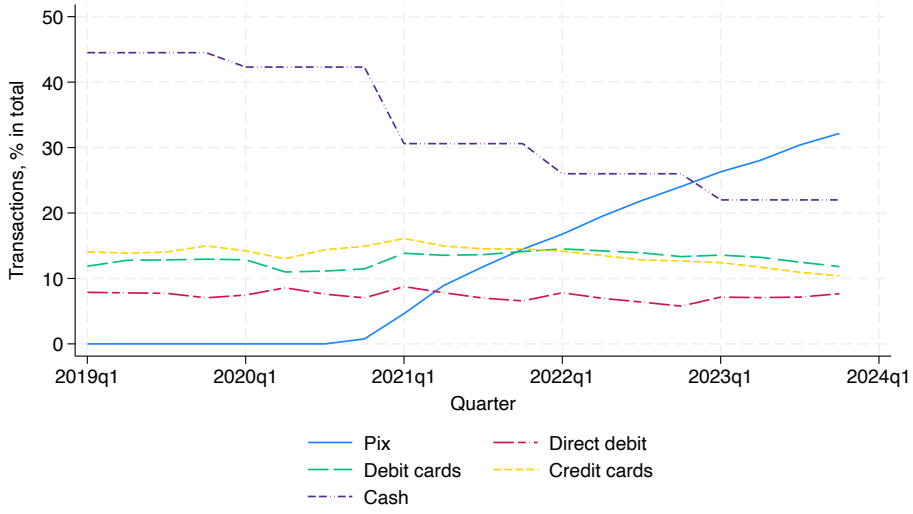
Outline

Setting: Pix in Brazil

- Launched by Central Bank of Brazil in November 2020
- Pix became a preferred means of payments
- Covers $> 90\%$ of banks and 86% of adult population
- **Free** and **instant** transfers and cashless payments, 24/7

"Pix promotes lower financial costs, digitization of the retail payments market, ... ***higher market competition and efficiency*** *..."* – Central Bank of Brazil

Pix vs other payments



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Pix and bank competition

- Pix facilitates transfers and payments among banks
  - Lower switching costs, payment costs
- Less usage of cash $\Rightarrow$ less dependence on physical branches
  - Allows banks with a limited branch network to better compete with larger banks
- Potential to facilitate monetary policy transmission

  by **promoting** competition among banks

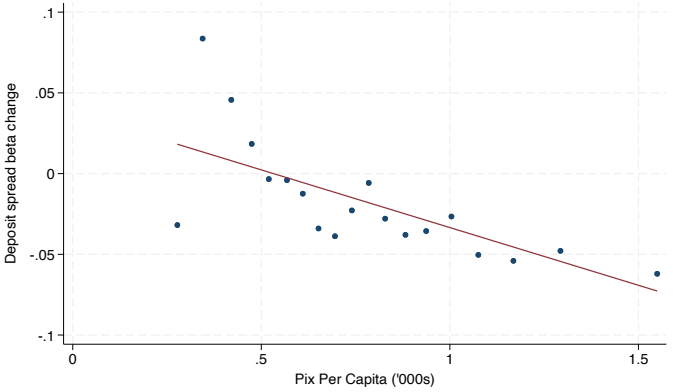
Outline

Data

- **Municipality-level monthly** data on **Pix transactions** (Central Bank of Brazil)
  - Number of transactions, value of transactions
- **Branch-level monthly** data on **banks' balance sheet** (ESTBAN)
  - Deposits, loans, and assets
- **Bank-level** data on **interest rates and equity** (Central Bank of Brazil and Bloomberg)
  - Deposit rates (interest expense), loan rates (interest income), equity returns
- **Municipality-level** demographic and economic data (IBGE)
  - HHI, Census, capital investments, savings, GDP
- Macro variables (IPEA and Central Bank of Brazil)

Deposit spread betas are lower in areas with more Pix usage

$$\Delta DepSpread_{i,t} = \beta_i \Delta Selic_t + \varepsilon_{i,t}, \qquad \Delta\beta_i = \beta_{i,\text{after 2020m11}} - \beta_{i,\text{before 2020m11}}$$



Flow betas | Quantity per capita | Users per capita

Challenges

- **Challenge 1:** banks are different and local unobservable demand
- **Solution:** run within-bank regressions:

$$Y_{imt} = \beta MS_t \cdot PixPerCap_{mt} + \gamma X_{imt} + \alpha_{im} + \theta_i + \varepsilon_{imt}$$

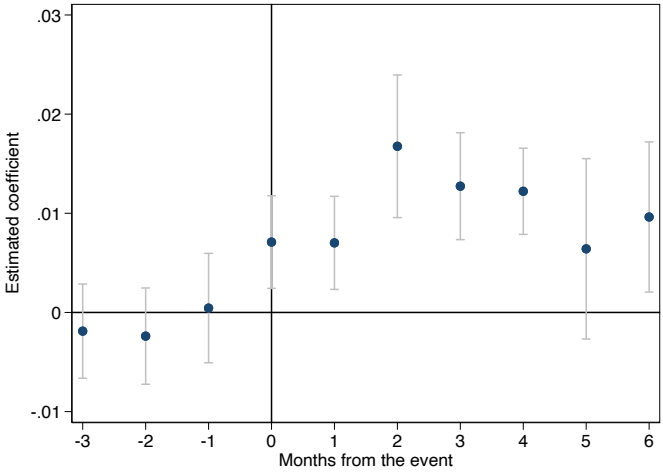
  where $PixPerCap_{mt}$ is value of Pix transactions per capita

- **Challenge 2:** Pix is endogenous
- **Challenge 3:** missing digital banks because they do not have branches

Instrumenting Pix

- *Pix Saque* was introduced in November 2021
- Especially popular in small enterprises (MEIs)
- **Instrument:** $Post\_Saque \times Sh.MEIs$
- **Relevance:** new functionality increases the use of Pix in areas with many MEIs
- **Exclusion:** Pix Saque impacts bank variables in high-MEI areas only through Pix

Pix Saque increases Pix in high-MEI areas



Adding digital banks

- Digital banks attracted many clients thanks to Pix
- We only observe bank-level data
- Use share of Pix transactions going to digital banks by state and interact with muni-level Pix transactions:
- Derive municipality-level proxy for digital banks

Lower spreads, more deposits and less loans

$$Y_{imt} = \beta MS_t \cdot \widehat{PixPerCap}_{mt} + \gamma X_{imt} + \alpha_{im} + \theta_i + \varepsilon_{imt}$$

	Dependent variable:					
	Deposit spreads		Lending flows		Deposit flows	
	(1)	(2)	(3)	(4)	(5)	(6)
Pix Per Capita × MS	−0.034***	−0.034***	−2.66***	−2.699***	0.522**	0.522***
	(0.005)	(0.005)	(0.06)	(0.059)	(0.067)	(0.067)
Pix Per Capita	−0.064***	−0.065***	−0.818***	−0.77***	−0.9***	−0.852***
	(0.001)	(0.001)	(0.012)	(0.012)	(0.023)	(0.022)
MS	1.026***	1.025 ***	3.402***	3.44***	−3.088***	−3.068***
	(0.005)	(0.005)	(0.049)	(0.049)	(0.084)	(0.084)
Branch FE	Yes	No	Yes	No	Yes	No
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	269,252	269,313	895,453	895,474	867,674	867,815
R^2	0.246	0.245	0.063	0.012	0.006	0.006

Standard errors are clustered at the municipality level
Significance: 10%*, 5%**, 1%***

Monetary shocks | Persistence and speed

Increase in safe assets

$$Y_{imt} = \beta MS_t \cdot \widehat{PixPerCap}_{mt} + \gamma X_{imt} + \alpha_{im} + \theta_i + \varepsilon_{imt}$$

	Dependent variable:					
	Reserve flows		Gov flows		Safe flows	
	(1)	(2)	(3)	(4)	(5)	(6)
Pix Per Capita × MS	4.372	4.374	−0.281	−0.201	2.283***	2.277***
	(2.994)	(2.985)	(0.338)	(0.338)	(0.172)	(0.173)
Pix Per Capita	0.242	0.245	0.344***	−0.042	−0.159***	−0.188***
	(0.323)	(0.357)	(0.104)	(0.098)	(0.027)	(0.027)
MS	−6.431	−6.407	0.547	0.443	−3.675***	−3.686***
	(9.099)	(9.133)	(0.615)	(0.624)	(0.241)	(0.243)
Branch FE	Yes	No	Yes	No	Yes	No
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	5,318	5,318	86,999	86,963	531,675	531,652
R^2	0.001	0.001	0.001	0.000	0.000	0.000

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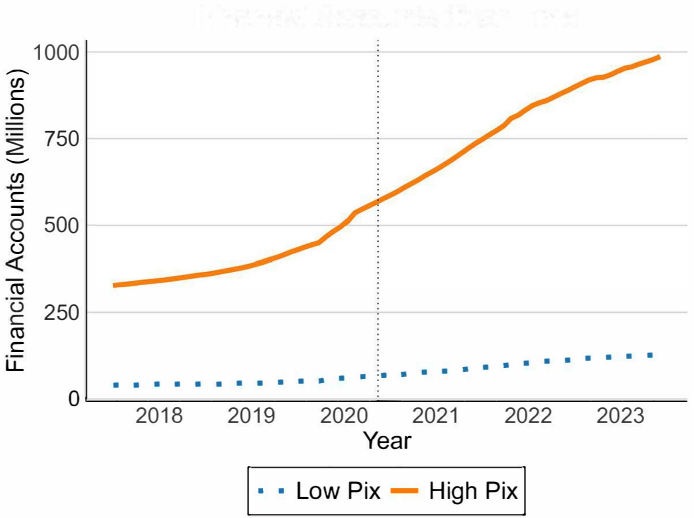
Why do loans fall?

- Loans fall despite retained deposits
- High funding costs lead to higher loan rates
- Banks invest new deposits in safe assets
- Liquidity matching

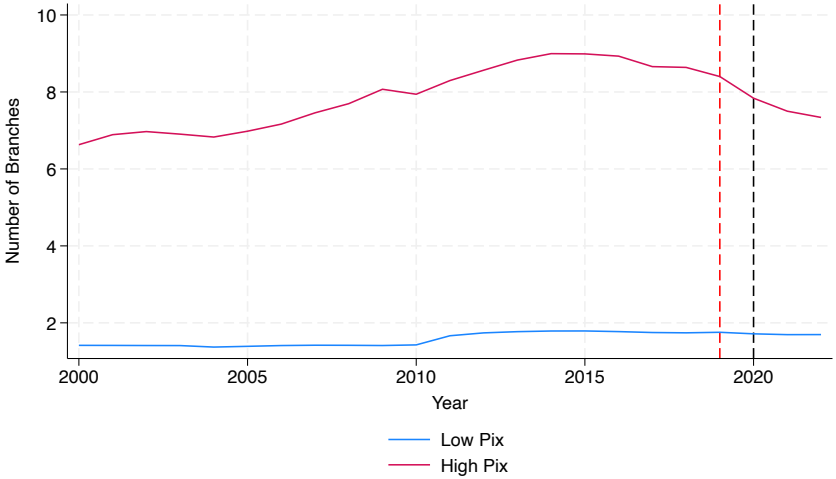
Robustness

- Falsification test: no increase in saving deposits
- Robust to excluding digital banks
- Robust to using monetary shocks
- The effects get stronger over time

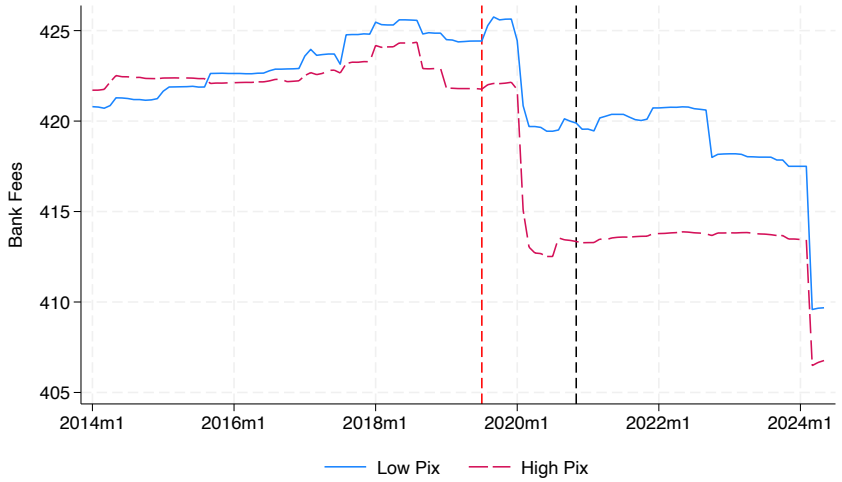
Number of bank accounts rises – Sampaio and Ornelas (2024)



Number of branches declines in high-Pix areas



Payment-related fees decline more in high-Pix areas



Financial inclusion does not explain the results

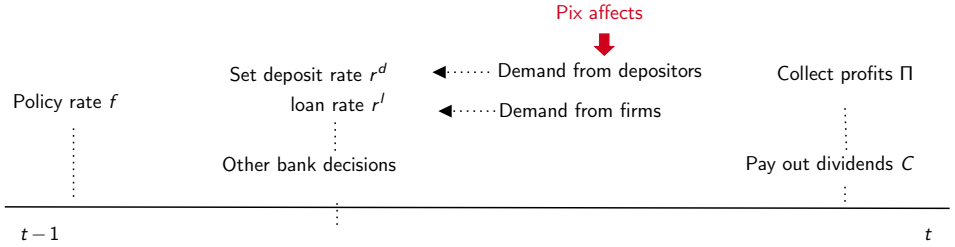
	Depositors per capita	
	(1)	(2)
Pix Per Capita		0.058***
		(0.006)
Post Pix	0.132***	0.132***
	(0.001)	(0.001)
Pix Per Capita × Post Pix	0.007	0.007
	(0.008)	(0.008)
Controls	Yes	Yes
Municipality FE	Yes	No
Obs.	49,797	49,797
R^2	0.887	0.371

Standard errors are clustered at the municipality level
Significance: 10%*, 5%**, 1%***

Outline

Infinite-horizon bank industry equilibrium model

- Households: discrete choice on savings
  - Linear utility, Pix affects households' sensitivity to deposit rate
- Firms: discrete choice on financing
- Banks: imperfect competition as in Wang, Whited, Wu and Xiao (2022)
  - Financial frictions such as market power, capital and reserve requirements
- Government: set monetary policy



Households

- Continuum with wealth W, each household endowed with R$ 1

- Each household i makes saving decision between $J+2$ options:

$$\mathscr{A}^d = \{\underbrace{0}_{\text{Cash}}, 1, ..., J, \underbrace{J+1}_{\text{Short-term bond}}\}$$

- Banks offer Pix after Oct 2020

Households' deposit demand

- Households choose the best investment to maximize their utility:

$$\max_{j \in \mathscr{J}^d} u_{i,j} = \alpha^d r_j^d + \beta^d p_j^d r_j^d + \gamma^d x_j^d + \mu_j^d + \varepsilon_{i,j}^d$$

  - α^d – sensitivity of households to rate $r_{j,m}^d$
  - β^d – additional sensitivity to interest rates with Pix
  - μ_j^d – product invariant quality difference (bank FEs)
  - $\varepsilon_{i,j}^d$ – relation-specific shock, with type II extreme value distribution

- IV with fixed costs/assets and loss provisions
- Aggregate deposit demand

$$D_j\left(r_j^d | f\right) = \underbrace{s_j^d\left(r_j^d | f\right)}_{\text{Share of bank } j \text{ deposits}} W$$

Banks

- Imperfect competition, J banks
- They choose deposit and loan spreads, join Pix in Nov 2020
- Banks' balance sheet

Assets	Liabilities
Loans	Deposits
Reserves	Wholesale funds
Gov't Securities	Equity

Estimation procedure

- Step 1: Calibrate parameters
  - Based on banking data and regulations in Brazil
  - Set number of banks, reserve ratio, capital ratio, tax rate, etc.
- Step 2: Estimate deposit and loan demands via BLP
  - Supply shifters: fixed operation costs and loss provisions
  - Key non-rate characteristic: number of branches
- Step 3: Estimate bank parameters via SMD
  - 8 moments directly estimate parameters, 2 free moments for model fits

BLP Estimation

Parameter	Symbol	Estimate	Standard error
Sensitivity to deposit rates	α	0.012	(0.019)
Sensitivity to deposit rate with Pix	β	0.004^{**}	(0.002)
Observations		6,744	
R^2		0.944	

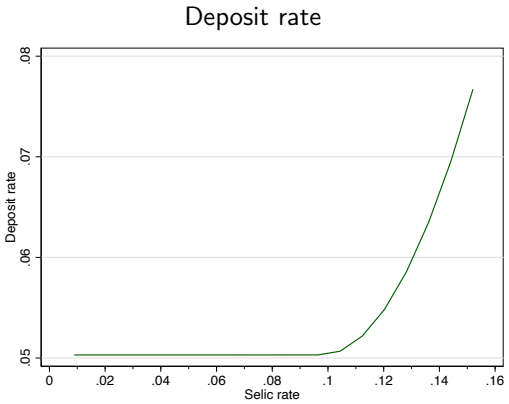
Standard errors are clustered at the bank level
Significance: 10%*, 5%**, 1%***

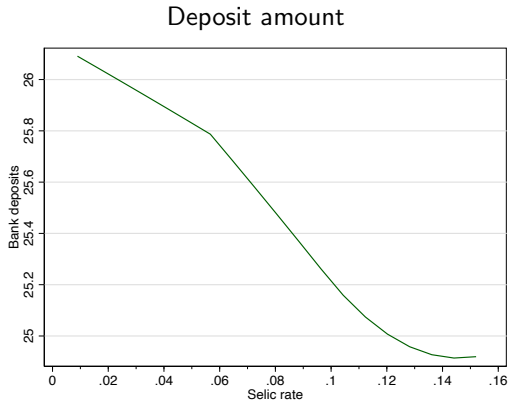
Dummy for Pix | Salaries as instruments | State-level estimation

Moment matching

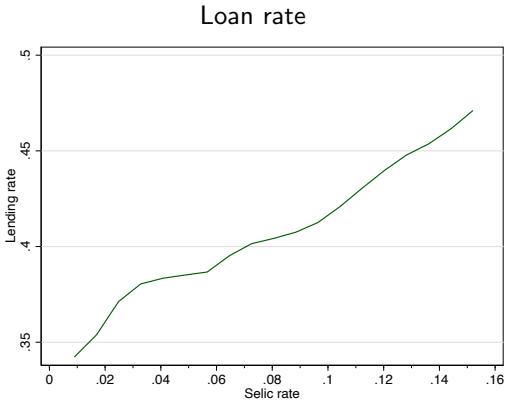
	Actual	Sample	S.E.
Deposit spread	0.0185	0.0173	[0.003]
Loan spread	0.1678	0.4932	[0.011]
Deposits/Assets	0.3301	0.4811	[0.040]
Net non-interest expense/Assets	0.007	−0.0149	[0.001]
Leverage	16.9	17.2	[2.528]
Credit - Selic rate sensitivity	−0.578	−0.4445	[0.243]
Bank loan - Selic rate sensitivity	−0.789	−0.4463	[0.338]
Market-to-book ratio	1.447	10	[0.409]

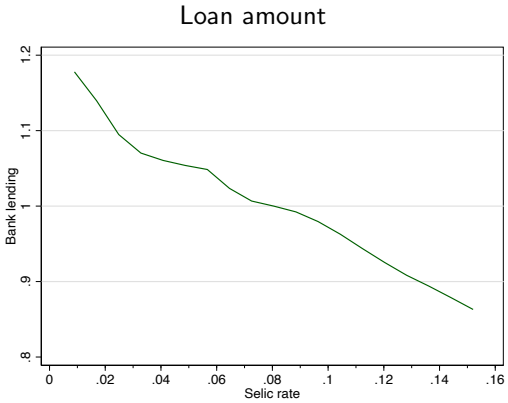
Baseline deposit rates and deposits



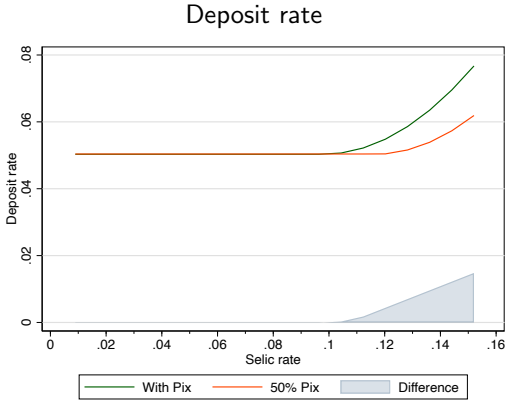


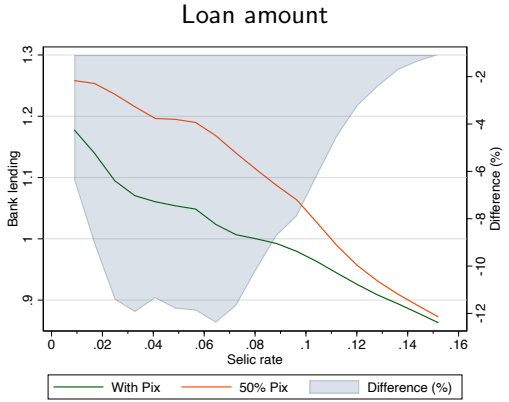
Baseline loan rates and lending





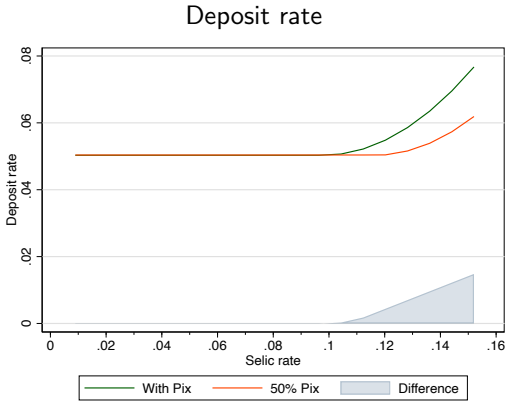
Counterfactual: impact of Pix on deposit rates and lending





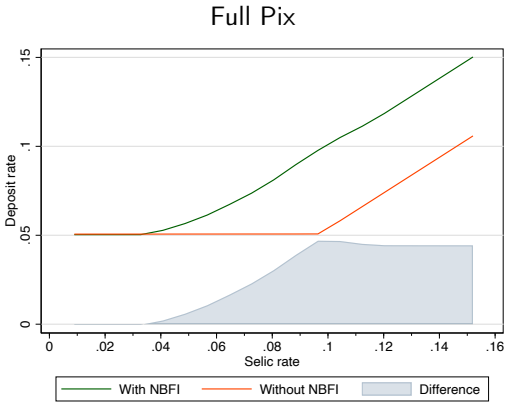
- Banks offer more competitive rates, and their lending declines more

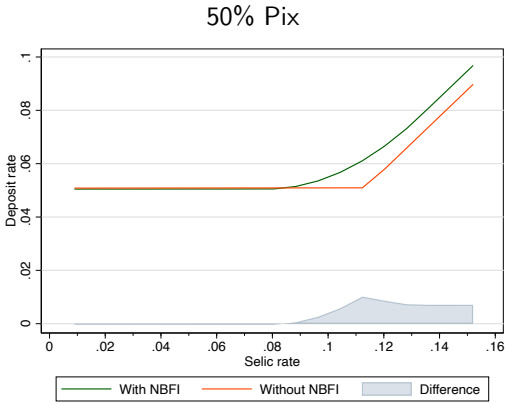
Counterfactual: impact of Pix on deposit rates and deposits



- Banks offer more competitive rates, and retain more deposits

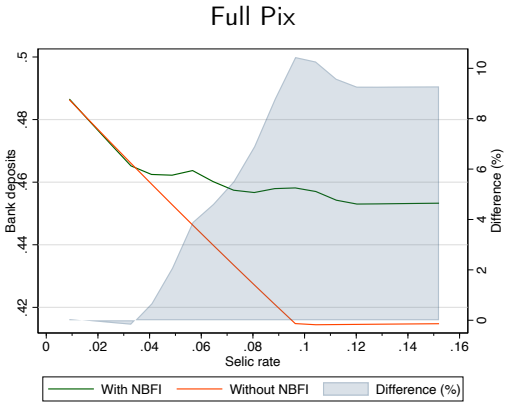
Counterfactual: no FinTechs, deposit rates

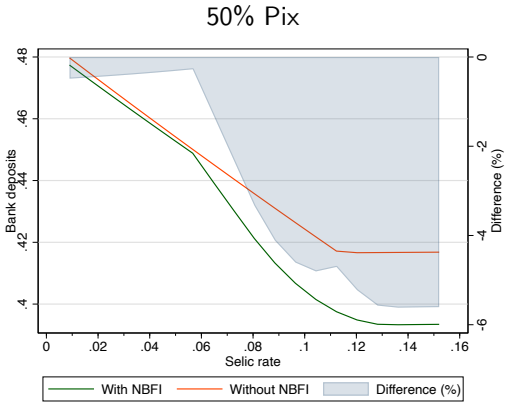




- Higher deposit rates with FinTechs and bigger differences with Pix

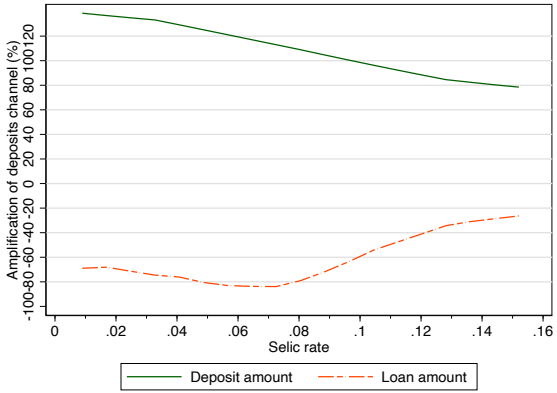
Counterfactual: no FinTechs, deposits





- Depositors value deposits at FinTechs with Pix

Counterfactual: deposit channel effects are impacted by Pix



- 40% amplification of deposits
- 20-80% limitation of lending

Takeaways

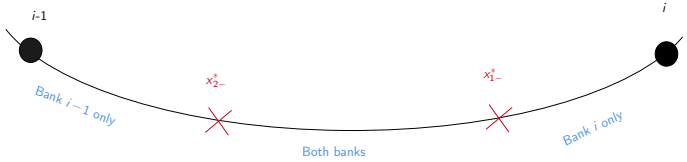
- Empirically, digital payments *reduce* banks' market power
  - Banks' deposit rates *respond more* to policy rate changes
  - Banks retain more deposits
  - Banks' lending flows out *more* after the policy rate increases
- Dynamic banking model to study counterfactuals and channels
  - Higher transmission of monetary policy after Pix
  - Mainly driven by the deposit channel

Appendix

Circular city model and households' banking decision

- n banks located equidistantly in a circular city
- HH utility based on deposit rate r, auxiliary services u, and travel cost $t_d \times$ distance
  - $Bank_i$ only: $v = r_i + u_i - t_d x_-$
  - $Bank_{i-1}$ only: $v = r_{i-1} + u_{i-1} - t_d(\frac{1}{n} - x_-)$
  - Deposit α_- at $Bank_i$ and rest at $Bank_{i-1}$: $v = \alpha_- r_i + (1-\alpha_-) r_{i-1} + \max(u_i, u_{i-1}) - t_d \frac{1}{n}$
- Mix region exists if benefits from splitting deposits compensate for the travel costs

$$\frac{1}{n} t_d \leq (2\alpha_- - 1)(r_i - r_{i-1}) + |u_i - u_{i-1}|$$



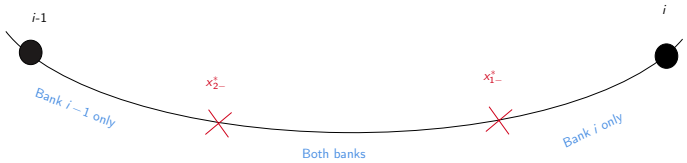
Deposit demand from households

- Sum up deposit demand from left of $Bank_i$ and right of $Bank_i$
- If mix region exists on both side, deposit share is

$$DepShare_i = \overbrace{x^*_{1-} + \alpha_-(x^*_{2-} - x^*_{1-})}^{\text{Left of bank } i} + \overbrace{x^*_{1+} + \alpha_+(x^*_{2+} - x^*_{1+})}^{\text{Right of bank } i}$$

- Share of households who will choose bank i and a neighboring bank is

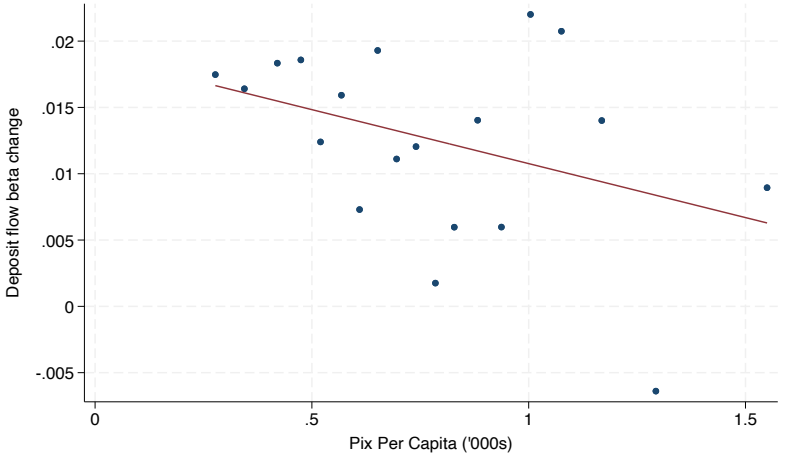
$$MixDepositors_i = (x^*_{2-} - x^*_{1-}) + (x^*_{2+} - x^*_{1+})$$



Comparative statics for the simple model

- Reduction in transportation costs: t_d decreases
  - Deposit demand $\uparrow$ for banks with higher benefits of deposit rate and banking services
  - Households are more likely to have two bank accounts
- Equal payment service utility: $u_i = u_{i-1}$
  - More benefits to the bank that originally had **inferior** payment convenience
- Decrease in concentration: n increases
  - Number of banks $\uparrow \Longrightarrow$ Less costly to travel to nearby banks
  - Choosing both banks is more likely
  - Deposit demand $\downarrow$ for bank i

Deposit flow betas



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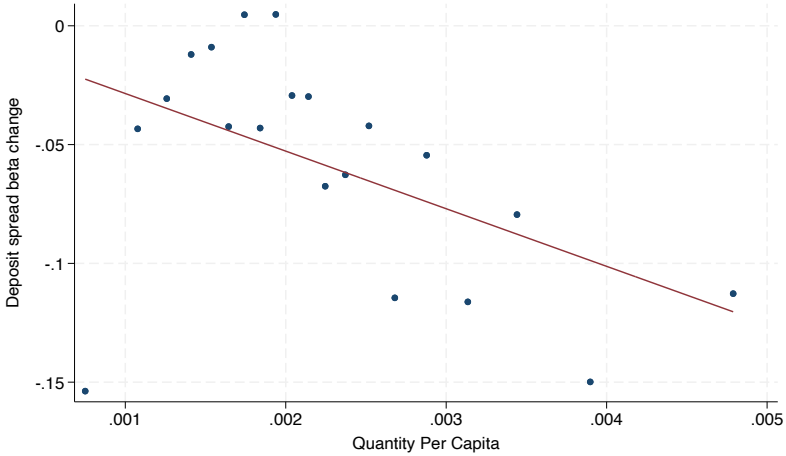
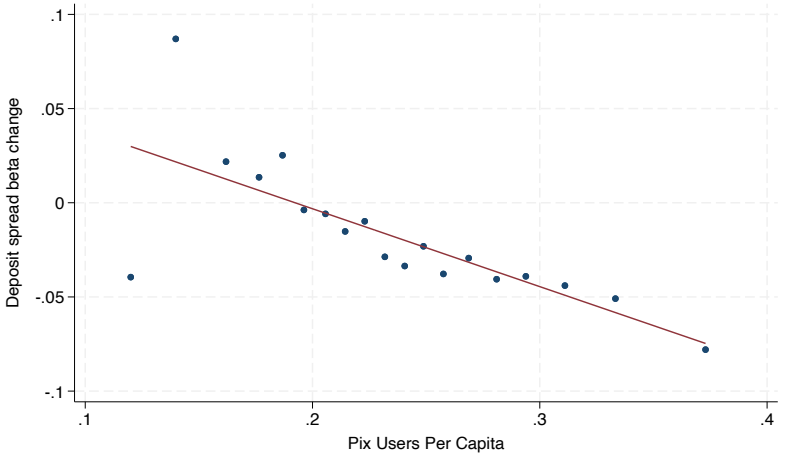
Deposit spread betas: quantity of Pix usage



Back

Deposit spread betas: users of Pix



Back

Monetary shocks

	Dependent variable:					
	Deposit spreads		Lending flows		Deposit flows	
	(1)	(2)	(3)	(4)	(5)	(6)
Pix Per Capita × MS	-0.54^{***}	-0.36^{***}	-1.60^{***}	-1.66^{***}	-0.47^{**}	-0.98^{***}
	(0.04)	(0.04)	(0.12)	(0.14)	(0.23)	(0.31)
Method	OLS	IV	OLS	IV	OLS	IV
Branch FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time FE	No	No	No	No	Yes	Yes
Obs.	126,945	126,945	388,323	388,323	365,090	365,090
R^2	0.129		0.063		0.066	
Wald $F-$stat		5.1		106.9		5,243.8

Standard errors are clustered at the municipality level
Significance: 10%*, 5%**, 1%***

Back

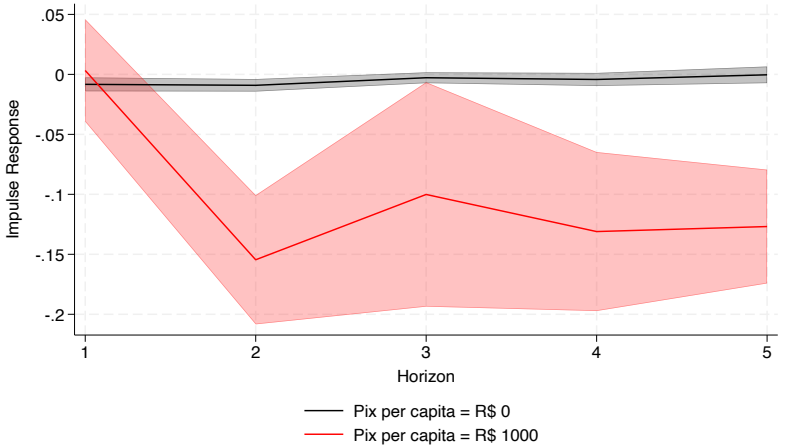
Z-scored Pix values

	Dependent variable:					
	Deposit spreads		Lending flows		Deposit flows	
	(1)	(2)	(3)	(4)	(5)	(6)
Pix Per Capita (Z-score) × MS	−0.17***	−0.17***	−0.50***	−0.49***	−0.15**	−0.14**
	(0.01)	(0.01)	(0.04)	(0.04)	(0.07)	(0.07)
Branch FE	Yes	No	Yes	No	Yes	No
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time FE	No	No	No	No	Yes	Yes
Obs.	126,945	126,970	388,323	388,345	365,090	365,113
R^2	0.129	0.127	0.063	0.012	0.066	0.043

Standard errors are clustered at the municipality level
Significance: 10%*, 5%**, 1%***

Back

Persistence and speed of the transmission



Back

BLP Estimation: salaries

Parameter	Symbol	Estimate	Standard error
Sensitivity to deposit rates	α^d	0.037	(0.022)
Sensitivity to deposit rate with Pix	β^d	0.002^{***}	(0.001)
Observations		7,679	
R^2		0.924	

Standard errors are clustered at the bank level
Significance: 10%*, 5%**, 1%***

Back

BLP Estimation: dummy for Pix

Parameter	Symbol	Estimate	Standard error
Sensitivity to deposit rates	α^d	0.027	(0.019)
Sensitivity to deposit rate with Pix	β^d	0.127^{***}	(0.048)
Observations		6,584	
R^2		0.934	

Standard errors are clustered at the bank level
Significance: 10%*, 5%**, 1%***

Back

BLP Estimation: state-level

Parameter	Symbol	Estimate	Standard error
Sensitivity to deposit rates	α^d	0.4456^{***}	(0.0563)
Sensitivity to deposit rate with Pix	β^d	0.0961^{***}	(0.0265)
Observations		22,356	
R^2		0.936	

Standard errors are clustered at the bank level
Significance: $10\%^{*}$, $5\%^{**}$, $1\%^{***}$

Back

References I