The Rise of Alert Depositors: Real Benefits of Fast Payments

Xu Lu (UW Foster), Yang Song (UW Foster), Yao Zeng (Wharton)

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Bank deposits as the means of payment

- Banks possess market power over deposits. (Drechsler, Savov, Schnabl 2017)
  - Source of the market power: payment convenience and access.

    (Benmelech, Yang, Zator 2023; d'Avernas, Eisfeldt, Huang, Stanton, Wallace 2023)
- Emerging technologies may challenge this market power.
  - Faster payment systems and digital disruption affect depositor behavior and bank liquidity management.

    (Duffie 2019; Erel, Liebersohn, Yannelis, Earnest 2023; Jiang, Yu, Zhang 2023; Karkisyan 2023; Koont 2023)
- **How much do depositors value payment? What are the benefits of fast payments to depositors?**

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- **How much do depositors value payment? What are the benefits of fast payments to depositors?**
- This paper:
  - Provides the first evidence of how depositors actively manage deposit flows across bank accounts.
  - Quantifies the benefits of fast payments on depositors' rate sensitivity & consumer welfare.

Overview

| A NEW DEPOSITOR-LEVEL METRIC: DEPOSIT TURNOVER.

- The gross fund transfer across bank accounts derived from transaction data.

|| FAST PAYMENTS AND DEPOSIT TURNOVER.

- Fast payment increases deposit turnover & lowers overall deposit balance.

- Interaction effects: fast payment amplifies the impact of interest rates and consumer debt.

||| QUANTIFICATION.

- The benefits of fast payment systems on consumer spending and deposit rate sensitivity.

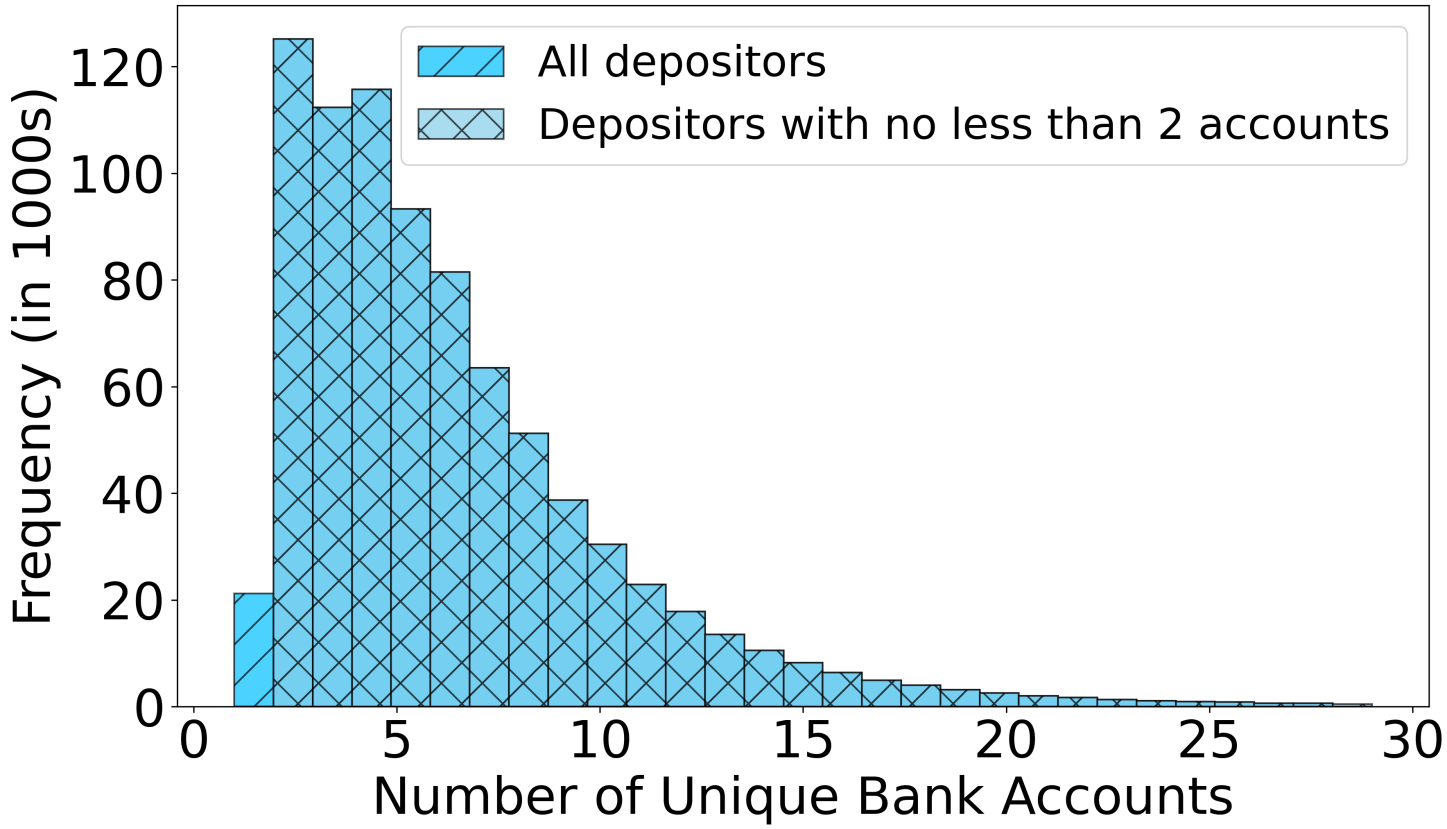
Measuring depositor alertness from transaction data

- **Transactions and account balances** from a leading financial analytics firm:
  - Unique user ID tracked across 1,400+ major national and regional banks and credit unions;
  - 1.26m+ active users, 50 billions of transaction records;
  - Sample period: January 2014 to October 2022;
  - Structure of the transaction data:

Date	Description	Type	Amount
Sep 03, 2024	UNIVERSITY OF WA 110011 PPD ID: 9160015371	ACH credit	$3,745.65
	ATM WITHDRAWAL 008521 09/0110550 NE	ATM transaction	–$900.00
	ATM WITHDRAWAL 008535 09/0110550 NE	ATM transaction	–$100.00
Aug 27, 2024	Online Transfer to SAV ...8919 transaction#: 21853983027 08/27	Account transfer	–$70,000.00

*This is a snapshot of authors' own bank statement, **not** from the database.*

How many bank accounts do American depositors have?



- 95%+ depositors in the sample have 2+ bank accounts
- Cross-verification: 5.3 accounts per depositor in Mercator Survey of American Deposits
- **Interbank fund transfers are relevant for most depositors.**

Uncovering depositor alertness from transaction data: the algorithm

All transaction records for actively banked depositors

Date	Description	Type	Amount
Aug 27, 2024	Online Transfer from CHK ...7825 transaction#: 21853983027	Account transfer	$70,000.00
Aug 15, 2024	APA TREAS 310 MISC PAY PPD ID: 9101036151	ACH credit	$42,000.00

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Account transfers; ATM/Cash withdrawals.

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$t' - t = 0$

YES

Transfers settled same day

$0 \leq D_{iat} - C_{ia't'} \leq 50$

YES

$T_{iat} = D_{iat}$

(wire, intrabank transfers , fast payment applications)

NO

$T_{iat} = 0$

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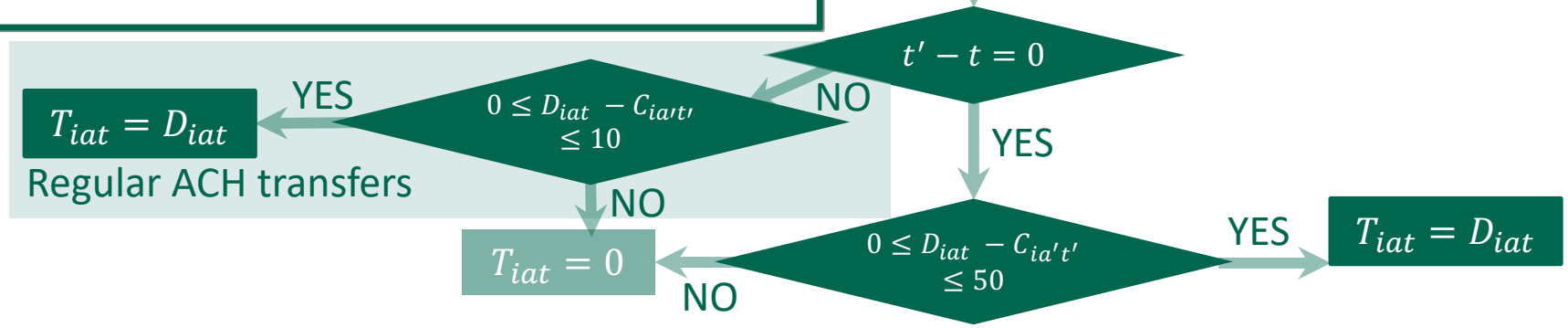

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$t' - t = 0$

NO

YES

$0 \leq D_{iat} - C_{ia't'} \leq 10$

YES

$T_{iat} = D_{iat}$

NO

$T_{iat} = 0$

$0 \leq D_{iat} - C_{ia't'} \leq 50$

YES

$D_{iat} - C_{ia't'} =$ 0 & No fast payment app

YES

$T_{iat} = 0$

Intrabank transfers: free transfers with instant settlement

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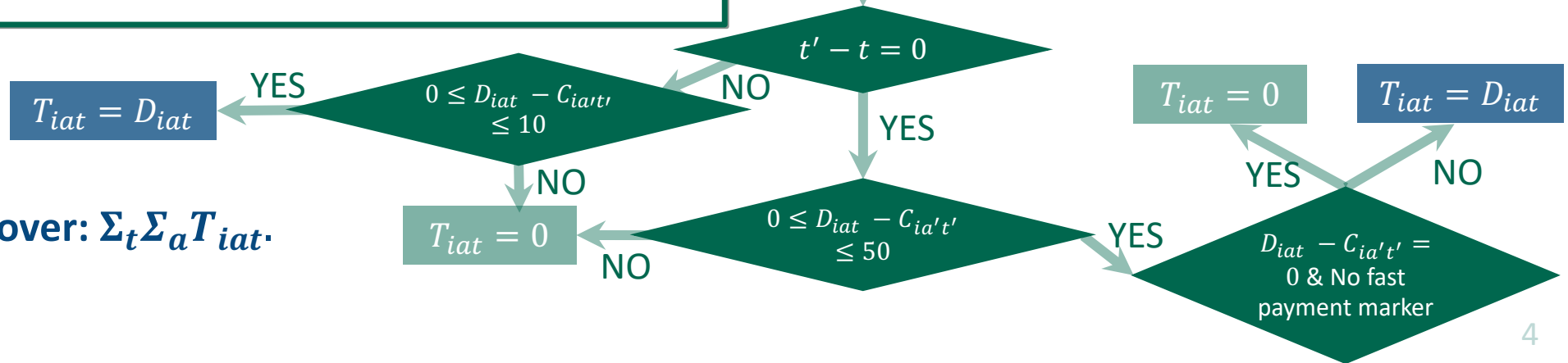
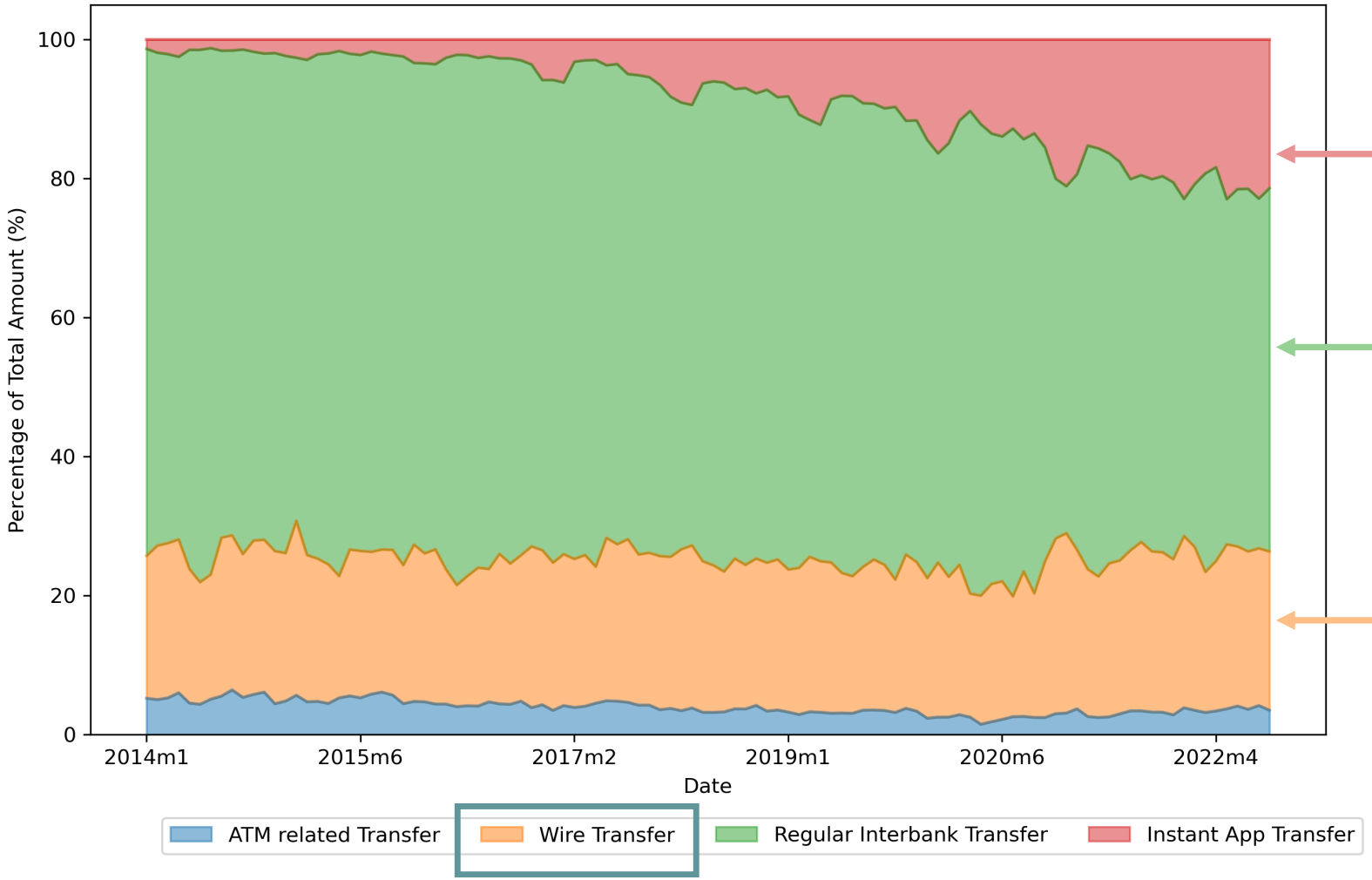


(Interbank) deposit turnover: $\Sigma_t \Sigma_a T_{iat}$.

Evolution of interbank deposit turnover

The majority of interbank transfers are settled via ACH.



Transfers made with instant payment apps, including Zelle, PayPal, Venmo, and Cash, which we identify using the transaction labels in our sample

Regular interbank transfers are settled via ACH and **involve significant delays**.

Wire transfers are required to settle within a business day (Reg CC); banks settle them via Fedwire or CHIPS

Imputing transfer delays

- We measure transfer delays by aggregating delays from paired interbank transactions.
- For each pair with credit transaction C and debit transaction D:
  - Payment lag for transaction *k*:

$$Lag_{i,a,k,t} = Business\ Day_{C_{i,a,k,t}} - Business\ Day_{D_{i,a,k,t}}.$$

- **Account level transfer delay:**
  - For account a of depositor *i* in month *t*:

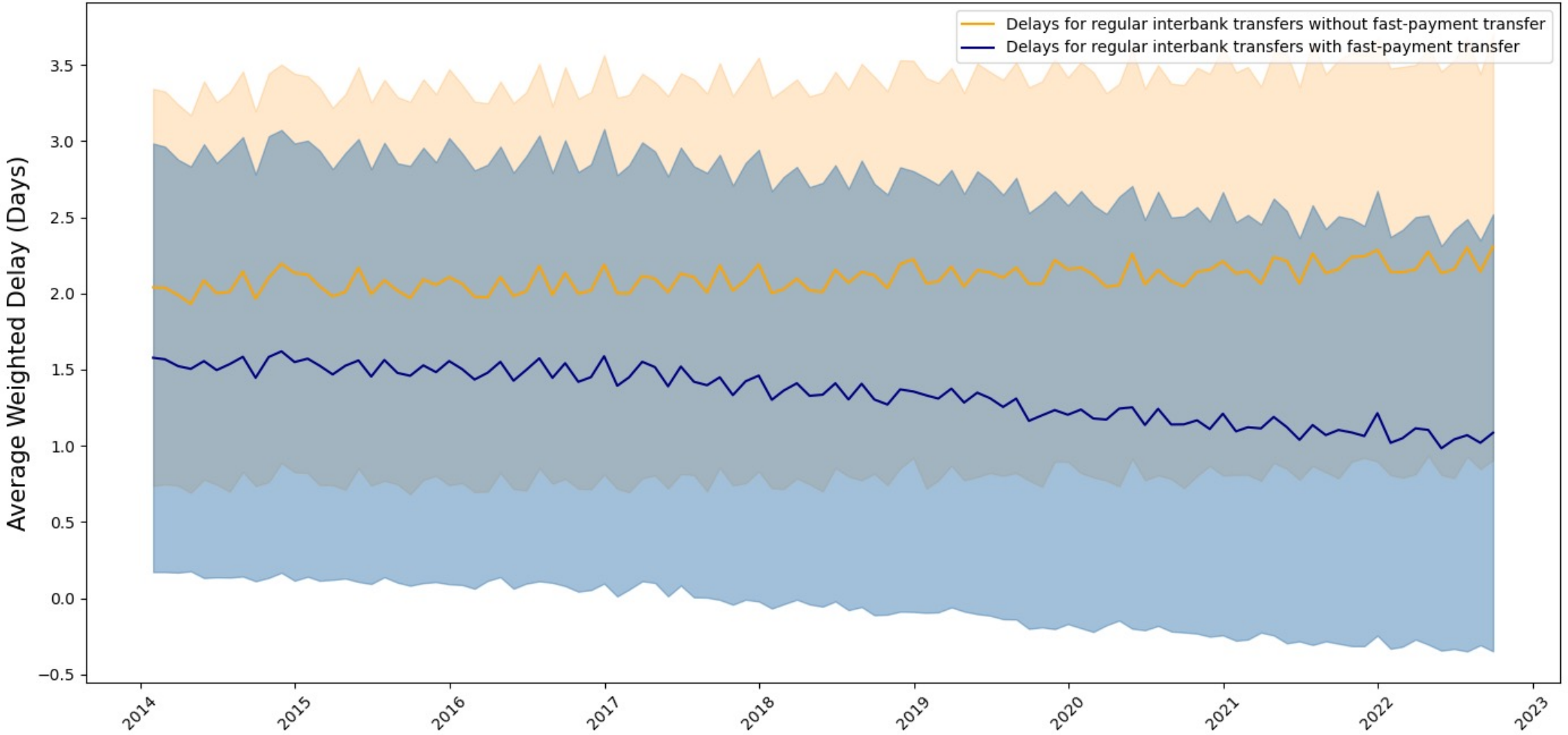
$$Delay_{i,a,t} = \frac{\sum_k Lag_{i,a,k,t}}{\sum_k |Lag_{i,a,k,t}|}.$$

- **Depositor level transfer delay:**
  - For depositor *i* in month *t*:

$$Delay_{i,a,t} = \frac{\sum_a Delay_{i,a,t} \cdot \sum_k D_{i,a,k,t}}{\sum_a \sum_k D_{i,a,k,t}}.$$

How slow are bank payments?

- An average of 2.01 business days with considerable variations across bank accounts



Additional metrics for depositors

- **Lumpy financial obligations.**
  - Including mortgage, loans, and credit card repayment, measures uncertainty in meeting spending needs.
- **Interest rate dispersion.**
  - Imputed from interest income and end-of-month balances.
  - The difference in interest rates between the highest and lowest rates across different bank accounts for a depositor.
- Labor income.
  - Constructed from credit transactions related to salary or regular income.
- Consumption volatility.
  - Consumption smooth efficiency defined as the rolling mean over rolling standard deviation of spending over 12 months.
- Financial sophistication.
  - Measures digital transaction preferences as the ratio between spending via non-physical transactions over total spending.

Summary Statistics

	mean	sd	p50	p10	p90	count
Transfer Fees	4.40	4.35	3.42	0.00	10.00	418,697
Transfer Delay	2.01	0.94	1.85	1.00	3.25	256,322
Salary	4759.14	3827.81	3900.24	817.13	9527.33	289,181
Rate Dispersion (%)	0.18	0.30	0.07	0.01	0.48	418,697
Payment Advance Ratio	0.32	0.27	0.29	0.10	0.60	417,930
Mean Interest Rate (%)	0.09	0.15	0.04	0.01	0.20	418,697
Financial Obligations	4490.12	3816.07	3498.19	778.24	9412.09	404,434
Deposit Turnover	2155.86	1695.39	1612.68	405.75	5032.22	418,697
Consumption Smoothing Efficiency	2.72	1.44	2.55	1.06	4.59	418,663
Account Balance	25471.91	55998.65	6671.17	1470.72	62834.91	418,697
% Depositors with Overdraft Protection	5%					418,697
% Depositors with Outflows from Fast Payment Apps	61%					418,697
% Depositors Used Fast Payment Apps	66%					418,697
% Depositors Overdrafted	18%					418,697

- Deposit turnovers are lumpy;

- Among depositors who transfer across banks, more than half have used Zelle, Venmo, Cash App or Paypal.

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- Interaction effects: fast payment amplifies the impact of interest rates and consumer debt.

||| QUANTIFICATION.

- The benefits of fast payment systems on consumer spending and deposit rate sensitivity.

Faster payments, more interbank deposit turnover

	(a) Interbank Deposit Turnover			(b) Log(Scaled Interbank Deposit Turnover)		
	(1)	(2)	(3)	(4)	(5)	(6)
Transfer Delay	-151.9***	-150.3***	-145.0***	-0.134***	-0.133***	-0.113***
	(2.986)	(3.395)	(3.217)	(0.0113)	(0.0112)	(0.00983)
Rate Dispersion	537.8***	537.8***	505.4***	0.573***	0.566***	0.492***
	(19.25)	(19.25)	(18.70)	(0.0166)	(0.0163)	(0.0148)
Transfer Delay × Rate Dispersion	-67.90***	-67.91***	-66.03***	-0.0995***	-0.0928***	-0.0924***
	(5.918)	(5.920)	(5.825)	(0.0129)	(0.0127)	(0.0119)
Debt Repayment		0.00545	0.00486		0.588***	0.545***
		(0.00409)	(0.00401)		(0.0112)	(0.0105)
Transfer Delay × Debt Repayment		-0.00133	-0.00138		-0.0157	-0.0145
		(0.00132)	(0.00129)		(0.0105)	(0.00978)
Month fixed effect	Y	Y	Y	Y	Y	Y
Depositor controls	Y	Y	Y	Y	Y	Y
N	1181728	1181728	1181728	458241	458241	458241
Adj. R^2	0.0217	0.0217	0.0309	0.0676	0.0891	0.138

Effect of faster payments amplified by consumer debt and rate dispersion

	(a) Interbank Deposit Turnover			(b) Log(Scaled Interbank Deposit Turnover)		
	(1)	(2)	(3)	(4)	(5)	(6)
Transfer Delay	-153.0***	-143.1***	-137.4***	-0.115***	-0.120***	-0.108***
	(3.016)	(3.657)	(3.473)	(0.00820)	(0.00801)	(0.00669)
Rate Dispersion	539.6***	533.4***	505.2***	0.105***	0.0944***	0.0803***
	(19.45)	(19.36)	(18.88)	(0.00367)	(0.00338)	(0.00298)
Transfer Delay × Rate Dispersion	-68.24***	-67.84***	-66.36***	-0.0210***	-0.0187***	-0.0169***
	(5.970)	(5.958)	(5.885)	(0.00318)	(0.00297)	(0.00273)
Financial Obligations		0.0211***	0.0187***		0.438***	0.296***
		(0.00131)	(0.00130)		(0.00819)	(0.00755)
Transfer Delay × Financial Obligations		-0.00176***	-0.00190***		-0.00311	-0.00148
		(0.000419)	(0.000413)		(0.00525)	(0.00466)
Month fixed effect	Y	Y	Y	Y	Y	Y
Depositor controls	Y	Y	Y	Y	Y	Y
N	1121834	1121834	1121834	432418	432418	432418
Adj. R^2	0.0219	0.0243	0.0322	0.0461	0.106	0.172

Overview

I MEASURING DEPOSITOR ALERTNESS

II HOW PAYMENT AND INTEREST DRIVE DEPOSITOR DYNAMICS

III A NATURAL EXPERIMENT ON PAYMENT TECHNOLOGY

IV MODEL AND IMPLICATIONS

Identifying the effect of payment delays

- Payment delays are likely correlated with deposit turnover via bank-depositor sorting.
  - Alert depositors with large deposit turnover also choose faster banks.
- Instrumenting payment delays using **exogenous shocks to adoption of fast payment technologies:**
  - **Instrument**: first time of receiving incoming funds using a fast payment application.
    - Fast payment applications: Zelle, PayPal, Venmo, and Cash App.
    - The instrument hinges on peer interactions / network exposure.

      Hong-Kubik-Stein '04, Hirshleifer '20, Bailey-Johnston-Kuchler-Stroebel-Wong '22, Roussanov '10
  - **Relevance:** adoption of faster payment technology lowers transfer delays.
  - **Exclusion**: timing of first fast-payment inflow uncorrelated with deposit alertness and the formation of social networks.
    - Only using a subset of depositors with fast-payment inflows *before* first outflows.

Identifying the effect of payment delays: 2SLS

	T	Delay
	(1)	(2)
Transfer Delay	-57.63***	
	(1.615)	
Rate Dispersion	491.9***	-0.154***
	(6.059)	(0.00853)
Transfer Delay × Rate Dispersion	-70.79***	
	(2.748)	
Financial Obligations	0.0124***	0.00000481***
	(0.000500)	(0.000000748)
Transfer Delay × Financial Obligations	-0.00134***	
	(0.000210)	
$\mathbf{I}_{PostFirstInflow}$		-0.0130***
		(0.00487)
$\mathbf{I}_{PostFirstOutflow}$		
Month FE		Y
Depositor Controls		Y
N		1339432

First stage F-stat: 79.

Identifying the effect of payment delays: 2SLS

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	(1)	(2)
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		(0.00487)
$\mathbf{I}_{PostFirstOutflow}$		
Month FE	Y	
Depositor Controls	Y	
N	1339432	

ver

igations

Identifying the effect of delays through technology adoption

	T	Delay	T	Delay	$\mathbf{I}_{PostFirstOutflow}$
	2SLS			3SLS	
	(1)	(2)	(3)	(4)	(5)
Transfer Delay	-57.63***		-57.63***		
	(1.615)		(1.615)		
Rate Dispersion	491.9***	-0.154***	491.9***	-0.146***	-0.00287***
	(6.059)	(0.00853)	(6.059)	(0.00738)	(0.000331)
Transfer Delay × Rate Dispersion	-70.79***		-70.78***		
	(2.748)		(2.748)		
Financial Obligations	0.0124***	0.00000481***	0.0124***	0.00000356***	0.000000173***
	(0.000500)	(0.000000748)	(0.000500)	(0.000000667)	(2.88e-08)
Transfer Delay × Financial Obligations	-0.00134***		-0.00134***		
	(0.000210)		(0.000210)		
$\mathbf{I}_{PostFirstInflow}$		-0.0130***			0.957***
		(0.00487)			(0.000471)
$\mathbf{I}_{PostFirstOutflow}$				-0.0108**	
				(0.00443)	
Month FE		Y		Y	
Depositor Controls		Y		Y	
N		1339432		1339432	

- Technology adoption: exogenous inflows strongly predict outflows

Identifying the effect of delays through technology adoption

	T	Delay	T	Delay	$\mathbf{I}_{PostFirstOutflow}$
	2SLS			3SLS	
	(1)	(2)	(3)	(4)	(5)
Transfer Delay	-57.63***		-57.63***		
	(1.615)		(1.615)		
Rate Dispersion	491.9***	-0.154***	491.9***	-0.146***	-0.00287***
	(6.059)	(0.00853)	(6.059)	(0.00738)	(0.000331)
Transfer Delay × Rate Dispersion	-70.79***		-70.78***		
	(2.748)		(2.748)		
Financial Obligations	0.0124***	0.00000481***	0.0124***	0.00000356***	0.000000173***
	(0.000500)	(0.000000748)	(0.000500)	(0.000000667)	(2.88e-08)
Transfer Delay × Financial Obligations	-0.00134***		-0.00134***		
	(0.000210)		(0.000210)		
$\mathbf{I}_{PostFirstInflow}$		-0.0130***			0.957***
		(0.00487)			(0.000471)
$\mathbf{I}_{PostFirstOutflow}$				-0.0108**	
				(0.00443)	
Month FE		Y		Y	
Depositor Controls		Y		Y	
N		1339432		1339432	

- Instrumented adoption of fast payments reduce future payment delays

Identifying the effect of delays: consumption and balances

	C	*Bal.*	log(*scaled T*)	log(scaled *C*)	log(*scaled Bal.*)
	(1)	(2)	(3)	(4)	(5)
Transfer Delay	-40.42*	898.9***	-0.157***	-0.0140***	0.0374***
	(22.54)	(212.3)	(0.00473)	(0.000779)	(0.00136)
Rate Dispersion	496.3***	1503.0*	0.189***	0.0189***	0.00668***
	(84.56)	(796.6)	(0.00262)	(0.000594)	(0.00104)
Transfer Delay × Rate Dispersion	63.88*	-1908.0***	-0.0314***	0.00375***	-0.00678***
	(38.36)	(361.3)	(0.00332)	(0.000649)	(0.00113)
Financial Obligations	0.554***	9.122***	-0.0152***	-0.00312***	0.00203
	(0.00697)	(0.0657)	(0.00478)	(0.000938)	(0.00164)
Transfer Delay × Financial Obligations	-0.0157***	0.245***	-0.0152***	-0.00312***	0.00203
	(0.00293)	(0.0276)	(0.00487)	(0.000816)	(0.00142)
Month FE	Y	Y	Y	Y	Y
Depositor Controls	Y	Y	Y	Y	Y
N	1338737	1024351	234927	1301470	978642

- Faster payment decreases total deposit balance & increases spending

Overview

| A NEW DEPOSITOR-LEVEL METRIC: DEPOSIT TURNOVER.

- The gross fund transfer across bank accounts derived from transaction data.

|| FAST PAYMENTS AND DEPOSIT TURNOVER.

- Fast payment increases deposit turnover & lowers overall deposit balance.

- Interaction effects: fast payment amplifies the impact of interest rates and consumer debt.

||| QUANTIFICATION.

- The benefits of fast payment systems on consumer spending and deposit rate sensitivity.

Deposit demand with payment delays: set up

Interbank transfers are lumpy and infrequent; transfers are sensitive to payment delays.

→ An inventory model of deposits with uncertainty in payment settlement.

Other relevant extensions of Baumol-Tobin with two accounts: Alvarez Lippi 2009 (uncertainty in transfer cost), Kaplan Violante 2014.

Deposit demand with payment delays: set up

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- A representative depositor has two bank accounts, account C and account S.
  - Deposits in C are non-interest-bearing and used to repay consumer debt $cr > 0$.
  - Deposits in S bear interest rate $r > 0$ (interest rate dispersion).
  - Balance of account C: $m \geq 0$.
- Deposit turnover: sum of transfers x_i between C and S.
- Transfer settlement happens at i.i.d. Poisson rate $0 < \kappa < 1$ in both directions.
  - Yet-to-settle delayed transfers bear no interest;
  - A transfer from S to C at $m = 0$ has no delays but a penalty $b > 0$.
- Looking for an optimal policy that minimize the expected present cost

$$V(m) = \min_{x_i, t_i} E_0 \left[r \int_0^\infty m(t) e^{-rt} dt + r \sum_i E_{t_i} \left[\int_{t_i}^{t_i'} |x_i| e^{-rt} dt \right] + b \sum_j e^{-rt_j} \right]$$

Deposit demand with payment delays: solution

Solution characterized by two thresholds $(\underline{m}, \overline{m})$ and target balance m^*

$$rV(m) = \begin{cases} rm - crV'(m) + \kappa(V(m^*) - V(m)) + r(m^* - m), & 0 \leq m \leq \underline{m}, \\ rm - crV'(m), & \underline{m} \leq m \leq \overline{m}, \\ rm - crV'(m) + \kappa(V(m^*) - V(m)), & m \geq \overline{m}, \end{cases}$$

s.t. boundary condition and smooth pasting for $V(m^*)$,

and value matching and super contact at $\underline{m}$ and $\overline{m}$.

$\rightarrow$ Closed-form solution when $r \ll \kappa$:

$$\Delta m = m^* - \underline{m} = c \cdot f\left(\tfrac{\kappa}{r+\kappa}\right) \approx \tfrac{c}{\kappa+r} - \tfrac{c}{r}\sqrt{\tfrac{2r}{\kappa+r}} + O\left(\tfrac{\kappa}{\kappa+r}\right).$$

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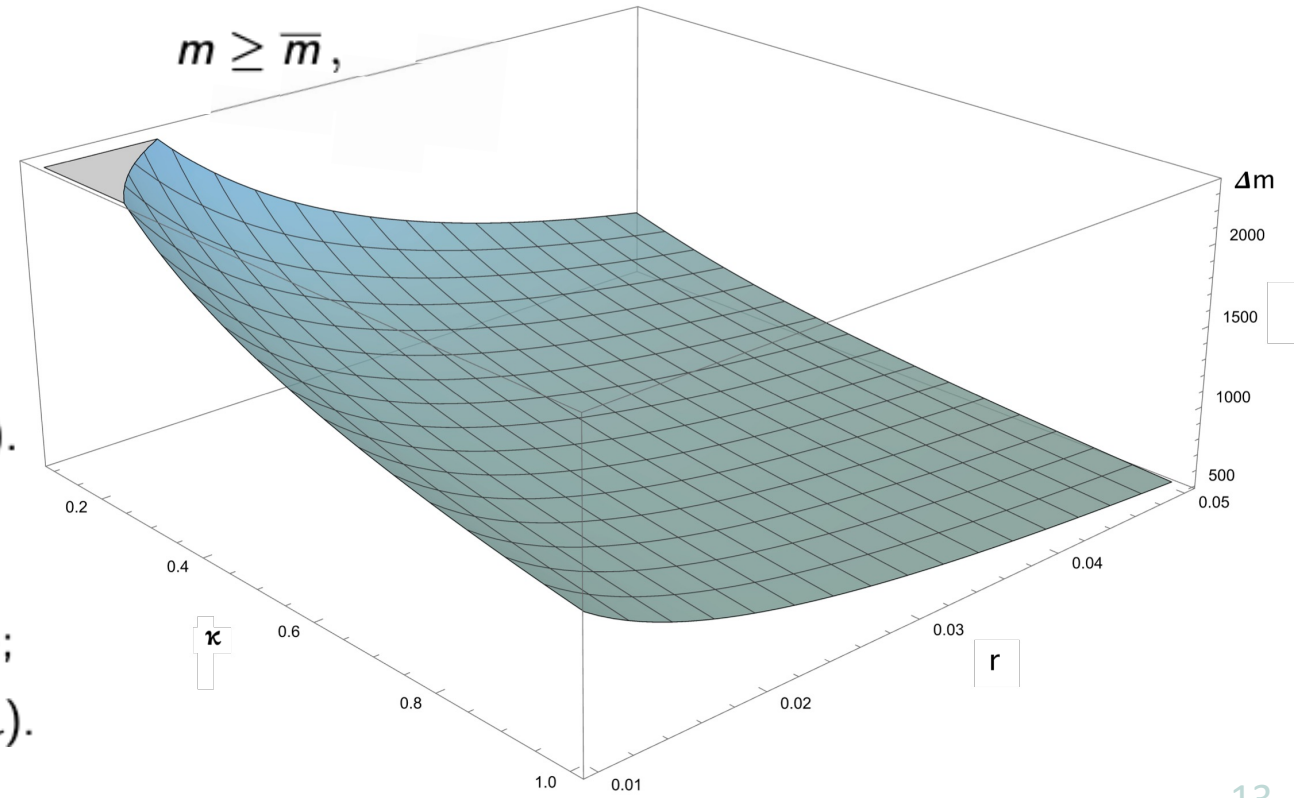
Δm reflects the "leeway" before depositor reacts.

Higher rate dispersion ($r \uparrow$), depositor is more alert ($\Delta m \downarrow$);

Smaller payment friction $\kappa \uparrow$, depositor is more alert ($\Delta m \downarrow$).



Deposit demand with payment delays: implications

The interplay between payment delay, interest rate, and consumer debt

	Data (median) (1)	Benchmark (2)	No Lag (3)	No Lag & 50bps Cut (4)	Indebted (5)	No Lag & Indebted (6)
Moments						
Deposit Balance (M^*)	6,671.17	6,617.23	5,144.57	5,560.32	8,344.53	6,482.21
Deposit Turnover ($\Sigma_t \lvert X_t \rvert$)	1,612.68	1,637.82	1,724.76	1,616.96	2,063.65	2,176.15
Parameters						
Interest rate (r)		2.00%	2.00%	1.50%	2.00%	2.00%
Payment Delay ($-ln(\kappa)$)		2.00	1.00	1.00	2.00	1.00
Financial Obligations (C)		900.00	900.00	900.00	1,134.00	1,134.00

- Shorter payment delays decrease deposit balances while increasing deposit turnover.
  - Cost to depositor as the forgone interest from balances: \$1473×2%=\$30

Deposit demand with payment delays: implications

The interplay between payment delay, interest rate, and consumer debt

26% increase in *C*

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Parameters						
Interest rate (r)		2.00%	2.00%	1.50%	2.00%	2.00%
Payment Delay ($-ln(\kappa)$)		2.00	1.00	1.00	2.00	1.00
Financial Obligations (C)		900.00	900.00	900.00	1,134.00	1,134.00

- Shorter payment delays decrease deposit balances while increasing deposit turnover.
  - Cost to depositor as the forgone interest from balances: \$1473×2%=\$30
- Larger consumer debt leads to increased depositing activity and larger total deposit balances.
  - Cost to depositor as the forgone interest from balances: \$1862×2%=\$37.24

Takeaway

- Why and how much do depositors value payment?
  - A new measure of depositing activities from transaction data: deposit turnover.
  - Two driving factors:

1) Payment technology ⟷ **2) Rate dispersion & financial obligations**

Amplification

- What are the benefits of fast payments to depositors?
  - Payment efficiency: more spending, lower balance.
  - Rate sensitivity: more sensitive to policy rate.