Inflation and Disintermediation

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Introduction

- In emerging market economies, large inflation increases are a recurring problem
  - Argentina (20% - 55% in 2018-9), Brazil (6% - 10% in 2015-6), India (6% - 11% in 2007-9), Turkey (10% - 20% in 2018-9)

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- What are the channels through which jumps in inflation affect the macroeconomy?

- Channels highlighted in previous work:
  - Nominal rigidity in New Keynesian macro models
  - Tax distortions, non-indexation of contracts (Auerbach, 1979; Feldstein, 1997)
  - Investment Uncertainty (Ball and Cecchetti, 1990)

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- This paper is the **first to explore a banking channel** through which an unexpected increase in inflation affects the macroeconomy.
  - Banks can be "inflation exposed" because of inflation asset-liability mismatch

This paper

1. Historical/global inflation episodes over 1870-2016
   - Study the response of aggregate credit following historical inflation episodes
   - Use hand-collected balance sheet data to construct a bank-level inflation exposure measure
   - Exploit cross-sectional heterogeneity in banks' exposure to inflation across various historical inflation episodes
     - substantial heterogeneity across banks, with some banks even benefiting from inflation
2. Instrumental variables approach: U.S. in 1977
   - Zoom in on a "clean" episode to isolate the effect of inflation shock
     - unexpected inflation increase, mainly caused by high energy prices
   - Instrument bank "inflation exposure" using state reserve requirements for Fed non member banks
   - Real effects (housing, local employment)

Preview of Results

1. In a country-level panel from 1870 to 2016, **large increases in inflation are associated with lower future bank credit-to-GDP**
   - even in the absence of monetary tightening
   - excluding banking crises, balance-of-payment crises, and sovereign debt defaults

2. Within prominent historical inflation episodes, the **lending contraction is primarily driven by banks with balance sheets most exposed to inflation increases**

3. In the U.S. setting:
   - banks that are highly inflation exposed, reduce lending to households
   - house prices and construction employment negatively affected
   - evidence of 'misallocation' channel

METHODOLOGY

Inflation Exposure Measure

	Assets	Liabilities
"Inflation exposed"	+1 Cash, nominal bonds	+1 Interest-bearing deposits, short-term money market funding
"Inflation protected"	-1 Gold, real estate, foreign assets, indexed bonds	-1 Non-interest-bearing deposits, long-term debt

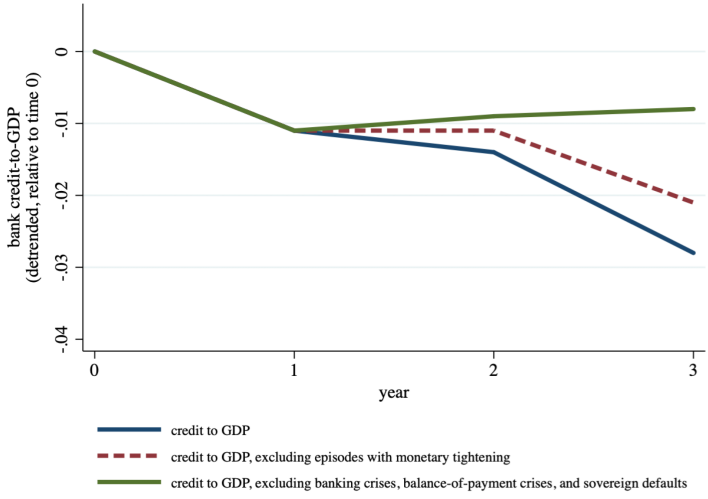
- Asset inflation exposure measure = weighted average of assets' +1 and -1
- Liability inflation exposure measure = weighted average of liabilities' +1 and -1
- Inflation exposure measure = $\frac{asset\ exposure\ +\ liability\ exposure}{2}$
- Correlation of 0.45 with an equity based inflation beta (for the subsample of listed banks)

INTERNATIONAL AND HISTORICAL INFLATION EPISODES

Result 1: Credit contraction following inflation episodes

Inflation episode = increase in inflation rate of 10 percentage points or more

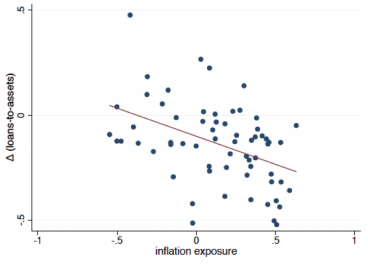
Sample: 1870-2016



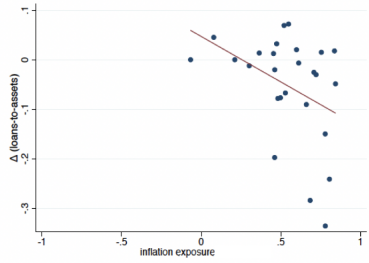
Result 1: Credit contraction following inflation episodes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.:	Δ(credit-to-GDP)$_{i,t,t+1}$			Δ(credit-to-GDP)$_{i,t,t+2}$			Δ(credit-to-GDP)$_{i,t,t+3}$		
Inflation Episodes$_{i,t}$	-0.015***	-0.013**	-0.014***	-0.020**	-0.017	-0.020*	-0.030**	-0.034**	-0.036**
	(0.004)	(0.005)	(0.005)	(0.008)	(0.012)	(0.010)	(0.013)	(0.016)	(0.015)
Real GDP growth$_{i,t-1,t}$		0.183***	0.159***		0.374***	0.225***		0.568***	-0.072
		(0.045)	(0.037)		(0.088)	(0.083)		(0.133)	(0.253)
Currency return$_{i,t-1,t}$		0.017	0.041***		0.065**	0.060**		0.079*	-0.037
		(0.015)	(0.012)		(0.029)	(0.027)		(0.043)	(0.075)
Δ*Interest rate*$_{i,t-1,t}$		0.000	-0.001		-0.011*	-0.014**		-0.030***	-0.023
		(0.002)	(0.002)		(0.006)	(0.006)		(0.010)	(0.017)
Observations	3,890	2,921	2,722	3,792	2,850	2,654	3,696	2,780	2,587
Number of groups	47	38	38	47	38	38	47	38	38
Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

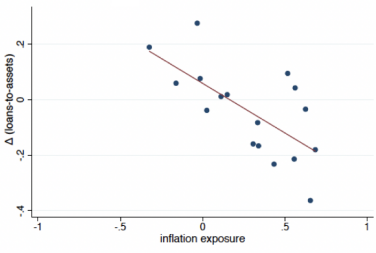
Result 2: Credit contraction driven by inflation exposed banks



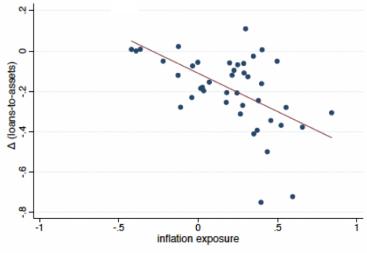
Brazil 1992-93



Indonesia 2005



Mexico 1995

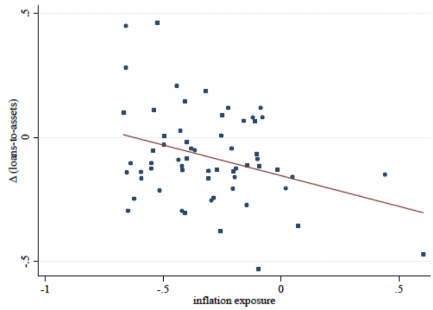


Venezuela 2002

German Hyperinflation of the 1920s

Balderston (1991) reports that the six largest German banks (the *Grossbanken*) lost over two-thirds of their capital.

Furthermore, "a general credit famine developed in 1922. This reflected, on the side of demand for credit, the rising desire to exploit inflation…but on the supply side, it reflected not only the banks' shrinking real resources, but perhaps also a growing reluctance to give their capital away in mark-denominated loans."



Germany 1922

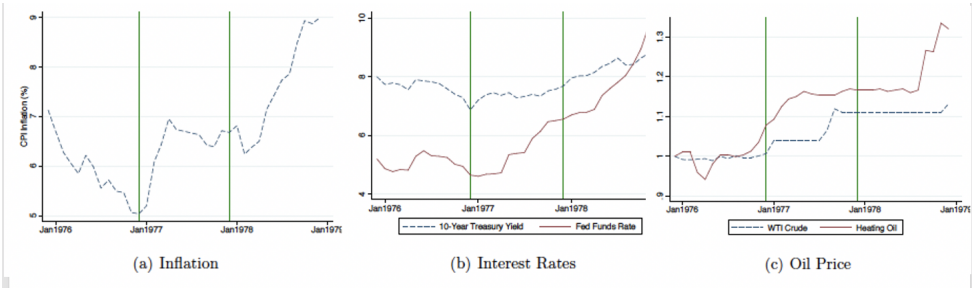
Source of bank-level data:

1. Annual reports from HBS Historical Collections
2. *Der Deutscher Oekonomist*

THE U.S. 1977 INFLATION INCREASE

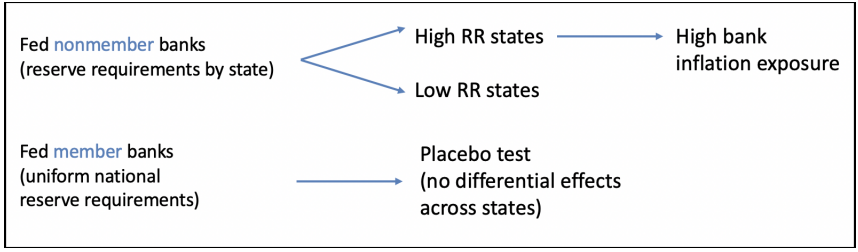
Background

- Unexpected inflation increase from 5% to 7% in the early 1977
  - Mainly caused by energy price shock and fiscal expansion
  - No evidence of subsequent monetary tightening (Romer and Romer 1989) or expectations of future inflation increase (Cochrane 2011)



(a) Inflation (b) Interest Rates (c) Oil Price

Identification



- First Stage
  - Reserve Requirement $\Longrightarrow$ inflation exposure of banks in the state
- Second Stage: Inflation exposure of banks $\Longrightarrow$
  - reduction in bank loans
  - negative consequences for housing and construction employment

Data and Methodology

- Bank Data
  - Call Reports: All institutions regulated by the Fed, FDIC, OCC
  - Retain only depository institutions, as these are subject to reserve requirements
    - commercial banks, saving banks, saving and loan associations, and U.S. branches and agencies of foreign banks
    - exclude banks that do not have national or state charters or those that do not have full two years of data
- Inflation Exposure Measure (December 1976)
  - same bank-level balance sheet measure as before
- Outcome Variables (change between Dec 1976 and 1977)
  - bank variables (from Call Reports)
  - state-level variables (house prices, construction employment, retail employment, etc.)

Reserve Requirements

1. Nonmember bank reserve requirements -- large variation across states:

STATE RESERVE REQUIREMENTS

State	Deposits Subject to Reserve Requirements	Current Reserve Requirement Ratios	Reserve Assets Eligible to Meet Requirements: Vault Cash	Demand Balances Due From Banks	Securities	Other
Alabama	T Dem	10%	X	X		
	TS	3%	X	X		
Alaska[1]	T Dem-US_d-SL_t	20%	X	X		
	TS-US_t-SL_t	8%	X	X		
Arizona[1]	T Dem-US_d-SL_t-R_d	10%	X	X[2]	X[3]	CIPC
	TS-US_t-SL_t-R_t	4%	X	X[2]	X[3]	CIPC
Arkansas	T Dem	FR	X	X[2]		
	S	3%	X	X[2]		CIPC[4]
	T	3% first $5 million, plus 5% over $5 million	X	X[2]		CIPC[4]

Source: Gilbert & Lovati (1978)

2. Member bank reserve requirements -- uniform across all states

Econometric Framework

The Fed membership status and location jointly determine exposure to inflation

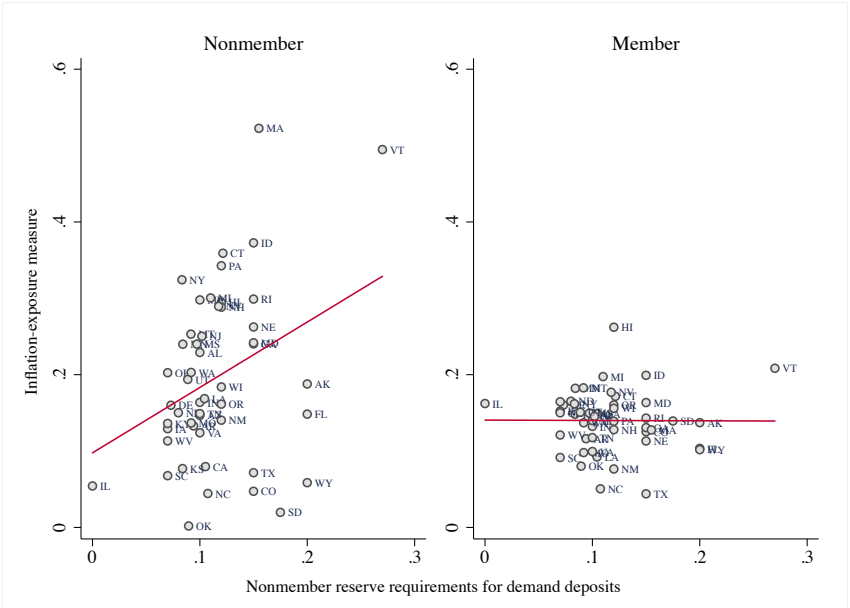
First Stage:

$$(infl.\ exposure)_{i,s} = \alpha + \beta_1 \mathbb{1}_{NM} + \beta_2 (Demand\ Dep\ RR)_s \mathbb{1}_{NM} + \gamma_1 (\mathbf{STATE})_s \mathbb{1}_{NM} + \gamma_2 (\mathbf{BANK})_i + \epsilon_{i,s}$$

Second Stage:

$$\Delta(Y)_{i,s} = \alpha + \beta \widehat{(infl.\ exposure)}_{i,s} + \gamma_1 (\mathbf{STATE})_s \mathbb{1}_{NM} + \gamma_2 (\mathbf{BANK})_i + \epsilon_{i,s}$$

First Stage


Nonmember
Member
Inflation-exposure measure
0
.2
.4
.6
0
.1
.2
.3
Nonmember reserve requirements for demand deposits
MA
VT
ID
CT
PA
NY
RI
NE
AK
FL
WI
OR
NM
WV
CA
TX
WY
IL
SC
NC
CO
SD
OK
HI
MI
MD
NH
NC
TX
NM
OK

First Stage

Dep. Variable:	Inflation Exposure					
	(1)	(2)	(3)	(4)	(5)	(6)
Demand deposit RR	0.453	0.118	0.218	0.219	0.307	0.184
	(0.371)	(0.378)	(0.427)	(0.403)	(0.370)	(0.311)
$\mathbb{1}_{NM}$		-0.007	-0.026	0.001	-0.087	-0.093
		(0.044)	(0.042)	(0.049)	(0.097)	(0.089)
Demand deposit RR $\times$ $\mathbb{1}_{NM}$		0.670*	1.508***	1.403***	1.320**	1.430***
		(0.394)	(0.454)	(0.449)	(0.500)	(0.477)
Time deposit RR			-0.002	-0.000	0.001	0.000
			(0.004)	(0.004)	(0.004)	(0.003)
Time deposit RR $\times$ $\mathbb{1}_{NM}$			-0.017***	-0.022***	-0.018***	-0.019***
			(0.004)	(0.005)	(0.005)	(0.005)
Constant	0.125***	0.128***	0.126***	0.142***	0.072	-0.060
	(0.042)	(0.044)	(0.044)	(0.043)	(0.071)	(0.285)
Time Deposit RR	No	No	Yes	Yes	Yes	Yes
RR rules	No	No	No	Yes	Yes	Yes
State controls	No	No	No	No	Yes	Yes
Bank controls	No	No	No	No	No	Yes
Observations	14590	14590	14590	14590	14590	14590
Adj. R^2	0.011	0.051	0.102	0.132	0.190	0.262
F	1.495	4.224	5.814	5.359	7.792	16.187

Second Stage

Dep. Variable:	% Δ(Total Loans)		Δ(Tot Loans-to-Assets)	% Δ(C&I Loans)		Δ(C&I Loans-to-Assets)	% Δ(Loans to Households)		Δ(Loans to HHs-to-Assets)	% Δ(Assets)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$(\widehat{Inf\ Exp})$	-0.2259**	-0.1839**	-0.1031**	0.0053	0.0623	-0.0221	-0.2667**	-0.2369*	-0.0248*	0.0184	0.0492
	(0.101)	(0.091)	(0.048)	(0.247)	(0.251)	(0.030)	(0.130)	(0.136)	(0.014)	(0.068)	(0.073)
Constant	0.1476***	0.2840***	0.0006	0.2171***	0.2413	0.0095	0.1406***	0.1430	-0.0006	0.0817***	0.2149**
	(0.021)	(0.092)	(0.044)	(0.049)	(0.240)	(0.042)	(0.043)	(0.258)	(0.026)	(0.017)	(0.096)
State Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Observations	14589	14589	14589	14008	14008	14008	14570	14570	14570	14590	14590
Adj. R^2	0.029	0.079	-0.047	0.020	0.033	0.013	-0.009	0.007	0.006	0.028	0.025

Channels

1. Bank net wealth channel
   - we show that net wealth effects are too small in the U.S. setting
   - more compelling evidence for international episodes
2. Deposit outflow channel
   - rising inflation can lead to aggregate outflow of deposits due to ceilings on time and savings deposit rates
   - Drechsler, Savov, and Schnabl (2020) argue this channel is important for explaining the rise of inflation in 1978-1980
   - we do not find evidence of this channel in 1977
3. Shift towards inflation protected assets - misallocation channel
   - can likely account for large lending effects even for moderate inflation increases

Net Wealth Channel

Dep. Variable:	Δ (NIM)	Δ(Interest Income)	Δ(Interest Expense)	Δ(Securities to-Assets)	Δ(Inf. Exposed Assets) All	Δ(Inf. Exposed Assets) Excl Loans	Δ(Total Infl. Exp.)	%Δ(Time & Saving Dep.)	%Δ(Total Deposits)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$(\widehat{Inf\ Exp})$	-0.0692	-0.0092	0.0600	0.1256***	-0.0929***	-0.0419***	-0.0731**	0.1009	0.0692
	(0.055)	(0.047)	(0.052)	(0.035)	(0.031)	(0.015)	(0.029)	(0.077)	(0.073)
Constant	-0.2363**	0.1536**	0.3898***	-0.0838***	0.0509**	-0.0170*	0.0505*	0.1482**	0.1170*
	(0.102)	(0.064)	(0.086)	(0.026)	(0.023)	(0.009)	(0.026)	(0.075)	(0.061)
State and Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14429	14429	14429	14561	14590	14590	14590	14545	14590
Adj. R^2	0.113	0.068	0.100	-0.122	0.017	0.080	0.053	-0.002	0.027

Net Wealth Channel

1. In the U.S. setting
   - impaired profitability of inflation-exposed banks is small in magnitude
     - reduces ROE by 69 pp compared to an average ROE of 12%
   - Difficult to account for 2 percentage point reduction in loan growth
     - assuming the reduced ROE is permanent, bank value decreases by $0.69/12 = 5.8\%$ $\implies$ approximate fall in lending by 0.62% (BVX 2019).

2. International bank stock evidence
   - Larger bank equity losses
   - >10 pp increase in inflation $\implies$ 30% decline in bank equity $\implies$ 3.2% decline in bank equity

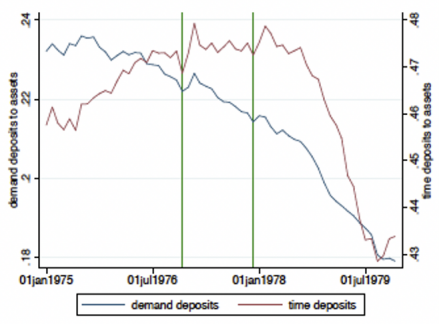
International Bank Stock Evidence

	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep. Var.	Δ(bank real ret.)$_{i,t-1,t+1}$			Δ(bank real ret.)$_{i,t-1,t+2}$			Δ(bank real ret.)$_{i,t-1,t+3}$		
Inflation Episodes$_{i,t}$	-0.311***	-0.253***	-0.258**	-0.291**	-0.232**	-0.218*	-0.334**	-0.249*	-0.255**
	(0.095)	(0.093)	(0.099)	(0.112)	(0.114)	(0.113)	(0.138)	(0.140)	(0.118)
Real GDP growth$_{i,t-1,t}$		0.939**	0.984**		0.973**	-2.574***		1.107**	-4.802***
		(0.463)	(0.476)		(0.425)	(0.694)		(0.522)	(1.265)
Currency return$_{i,t-1,t}$		0.097	0.111		0.080	-0.378		0.340	0.024
		(0.262)	(0.269)		(0.313)	(0.266)		(0.351)	(0.335)
Δ*Interest Rate*$_{i,t-1,t}$		-3.676***	-4.453***		-3.462***	-3.595***		-3.767***	-3.706***
		(0.708)	(0.849)		(0.690)	(0.609)		(0.765)	(1.139)
Constant	0.180***	0.142***	0.132***	0.269***	0.229***	0.172***	0.363***	0.319***	0.277***
	(0.023)	(0.026)	(0.035)	(0.032)	(0.036)	(0.054)	(0.041)	(0.045)	(0.068)
Observations	2,547	2,547	2,418	2,470	2,470	2,338	2,394	2,394	2,264
Number of groups	37	37	37	37	37	37	37	37	37
Additional lags	No	No	Yes	No	No	Yes	No	No	Yes

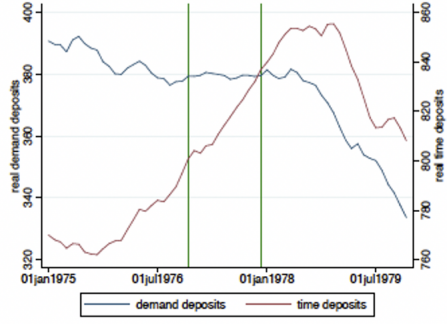
Deposit Outflows Channel

Higher nominal interest rates can lead to outflows of non-interest deposits

- no evidence of this in 1977



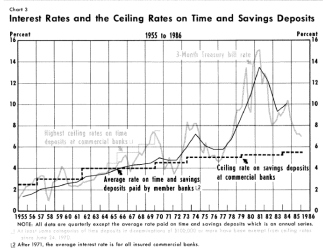
Deposits to Total Assets



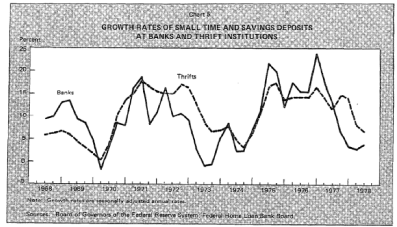
Real Deposits

Regulation Q not binding in early 1977

Panel A: Gilbert (1986)



Panel B: Cook (1987)



Panel C: Koch (2015)

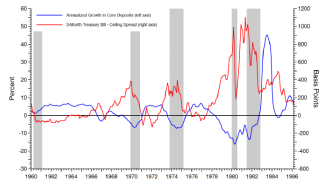
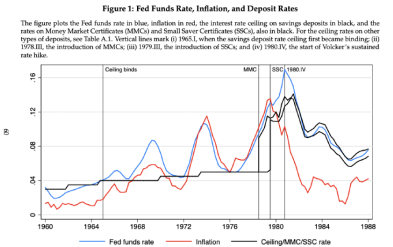


Fig. 4: Bindingness of Rate Ceilings and Deposit Growth

Panel D: Drechsler, Savov, and Schnabl (2020)



No evidence of deposit outflows

Dep. Variable:	Δ (NIM)	Δ(Interest Income)	Δ(Interest Expense)	Δ(Securities to-Assets)	Δ(Inf. Exposed Assets) All	Δ(Inf. Exposed Assets) Excl Loans	Δ(Total Infl. Exp.)	%Δ(Time & Saving Dep.)	%Δ(Total Deposits)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$(\widehat{Inf\ Exp})$	-0.0692	-0.0092	0.0600	0.1256***	-0.0929***	-0.0419***	-0.0731**	0.1009	0.0692
	(0.055)	(0.047)	(0.052)	(0.035)	(0.031)	(0.015)	(0.029)	(0.077)	(0.073)
Constant	-0.2363**	0.1536**	0.3898***	-0.0838***	0.0509**	-0.0170*	0.0505*	0.1482**	0.1170*
	(0.102)	(0.064)	(0.086)	(0.026)	(0.023)	(0.009)	(0.026)	(0.075)	(0.061)
State and Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14429	14429	14429	14561	14590	14590	14590	14545	14590
Adj. R^2	0.113	0.068	0.100	-0.122	0.017	0.080	0.053	-0.002	0.027

Portfolio Rebalancing Channel

Dep. Variable:	Δ (NIM)	Δ(Interest Income)	Δ(Interest Expense)	Δ(Securities to-Assets)	Δ(Inf. Exposed Assets) All	Δ(Inf. Exposed Assets) Excl Loans	Δ(Total Infl. Exp.)	%Δ(Time & Saving Dep.)	%Δ(Total Deposits)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$(\widehat{Inf\ Exp})$	-0.0692	-0.0092	0.0600	0.1256***	-0.0929***	-0.0419***	-0.0731**	0.1009	0.0692
	(0.055)	(0.047)	(0.052)	(0.035)	(0.031)	(0.015)	(0.029)	(0.077)	(0.073)
Constant	-0.2363**	0.1536**	0.3898***	-0.0838***	0.0509**	-0.0170*	0.0505*	0.1482**	0.1170*
	(0.102)	(0.064)	(0.086)	(0.026)	(0.023)	(0.009)	(0.026)	(0.075)	(0.061)
State and Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14429	14429	14429	14561	14590	14590	14590	14545	14590
Adj. R^2	0.113	0.068	0.100	-0.122	0.017	0.080	0.053	-0.002	0.027

Real Effects

Negative effect on construction employment and house prices

	Construction empl. growth	Manu empl. growth	Retail empl. growth	Services empl. growth	State GDP growth	House Price growth	State CPI growth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$(\widehat{Inf\ Exp})$	-0.1419**	0.0399	0.0084	-0.0078	-0.0877	-0.2657**	-0.0158
	(0.064)	(0.035)	(0.014)	(0.020)	(0.059)	(0.119)	(0.010)
Constant	-0.0252	-0.0662*	-0.0196*	0.0055	0.0948***	0.1074*	0.0635***
	(0.028)	(0.038)	(0.011)	(0.009)	(0.034)	(0.054)	(0.003)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50	50	50	50	50	50	50
Adj. R^2	0.727	0.281	0.701	0.638	0.124	0.179	0.291

Conclusion

- This paper documents a new channel through which unexpected increases inflation can affect the macroeconomy
- **Evidence from global international inflation episodes:**
  - In a country-level panel from 1870 to 2016, large increases in inflation are associated with lower future bank credit-to-GDP
    - even in the absence of monetary tightening
    - excluding banking crises, BOP crises, and sovereign defaults
- **Evidence for the 1977 U.S. setting**
  - banks that are highly inflation-exposed:
    - reduce lending to households
    - negative effect on construction employment and house prices
- Important to think about this channel as concerns about higher inflation emerge as the US economy recovers from the Coronavirus pandemic