

The Fisher Channel According to HANK: Unexpected Inflation and the Missing Recession

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Views are my own and do not necessarily reflect those of my current or past employers

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December 18, 2025

Introduction

- Inflation creates winners and losers through many channels
 - ▶ Heterogeneity in consumption baskets, degree of wage stickiness, devaluation of nominal assets and liabilities, response of asset prices, fiscal drag ...
- Focus of this paper: "Fisher channel", i.e. redistribution from creditors to debtors
 - ▶ Many financial assets and liabilities in the US are *nominal*
 - ★ E.g. regular bonds, deposits, fixed-rate mortgages ...
- Research questions:
 - ① How much wealth redistribution among US households did this inflation shock generate?
 - ② How does this wealth redistribution transmit to consumption?
 - ③ How does accounting for the Fisher channel change our understanding of monetary policy in HANK?

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Methodology and preview of the answers

Q1 How much wealth redistribution did the current inflation shock generate?

- ▶ Estimate the reduction in the real value of nominal assets and liabilities generated by the 2021 inflation shock.

A: Losses concentrated among **rich** middle-aged and elderly, *gains* for the rest of hhs.

Q2 How does this wealth redistribution transmit to consumption?

- ▶ Construct a HANK model matching well households' exposure to inflation surprises.
- ▶ Test model implications using administrative data on $\approx 500,000$ U.S. households.

A: Strong and persistent tailwind to aggregate demand ($\approx 0.3\text{-}0.5\%$ of US consumption).

Q3 How does accounting for the Fisher channel influence monetary policy?

- ▶ Simulate monetary policy shocks in the HANK model.

A: Stronger effects of monetary policy, degree of nominal rigidity less crucial for its effects.

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Q1: Wealth redistribution

Constructing Net Nominal Positions (NNP)

- Obtain household direct holdings of nominal assets and liabilities through the SCF

Sources

Instruments

- To account for indirect positions, unveil investment intermediaries and the business sector, using their balance sheets from the Financial Accounts

Sectors

- I.e. e.g. nominal assets held in a mutual fund or a firm are assigned to their shareholders

- Obtain the net nominal position (NNP) of household i simply as:

$$NNP_i = NA_i - NL_i \quad (1)$$

Net Nominal Positions - within the US household sector

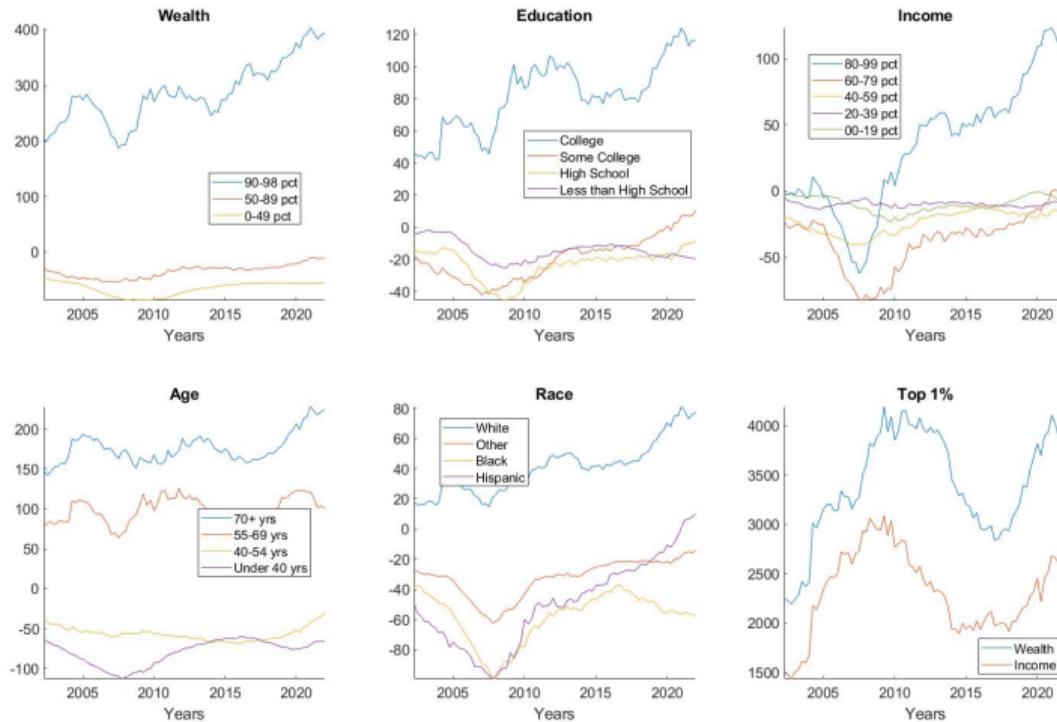


Figure 1: Average net nominal positions per hh, 2020 \$ '000. Source: Distributional Financial Accounts

NNP @ macro level

Average gain or loss for groups of households from the 2021 inflation shock

	Age cohort					
	≤ 35	36-45	46-55	56-65	66-75	>75
A. Low income						
\$ '000	0.8	3.1	1.5	0.2	-0.2	0.2
% Income	4	10	6	1	-1	1
B. Middle class						
\$ '000	6.8	9.9	6.0	0.2	-2.4	-3.1
% Income	10	10	5	0	-3	-6
C. Rich						
\$ '000	10.2	17.1	-33.5	-89.5	-116.7	-88.1
% Income	6	5	-6	-16	-29	-31

- Evolution of nominal position within the household sector in 2021 Results for macro sectors

Q2: Transmission to consumption

One-account HANK model with a long-term nominal asset

- HHs subject to idiosyncratic risk make consumption choices facing a borrowing constraint
- Key deviation from 'canonical': hhs save and borrow in a *long-term nominal* asset Λ
 - A la Woodford (2001): at price Q_t gives the stream of nominal payments $1, \delta, \delta^2 \dots$
- Sticky wages, flexible prices that generates a New Keynesian Wage Phillips Curve
 - No profits and constant real wage - consistent with US experience (Autor et al. (2023))
 - All redistribution after unexpected inflation happens on the asset side
- Government issues debt held by households, set taxes to finance spending
- Monetary policy follows a standard Taylor rule

Household problem

$$\max_{c_{it}} \mathbb{E} \left[\sum_{t=0}^{\infty} \beta^t \{u(c_{it}) - v(N_t)\} \right] \quad s.t.$$

$$P_t c_{i,t} + Q_t \Lambda_{i,t} = (1 + \delta) Q_t \Lambda_{i,t-1} + \tau_t (W_t e_{i,t} N_t)^{1-\theta}$$

$$Q_t \Lambda_t \geq \underline{a} P_t$$

- No arbitrage:

$$Q_t = \frac{1 + \delta E_t[Q_{t+1}]}{(1 + i_t)}$$

Supply side

Policy and Market Clearing

Extension with behavioural friction

Calibration matching distribution of NNPs and their covariance with MPC

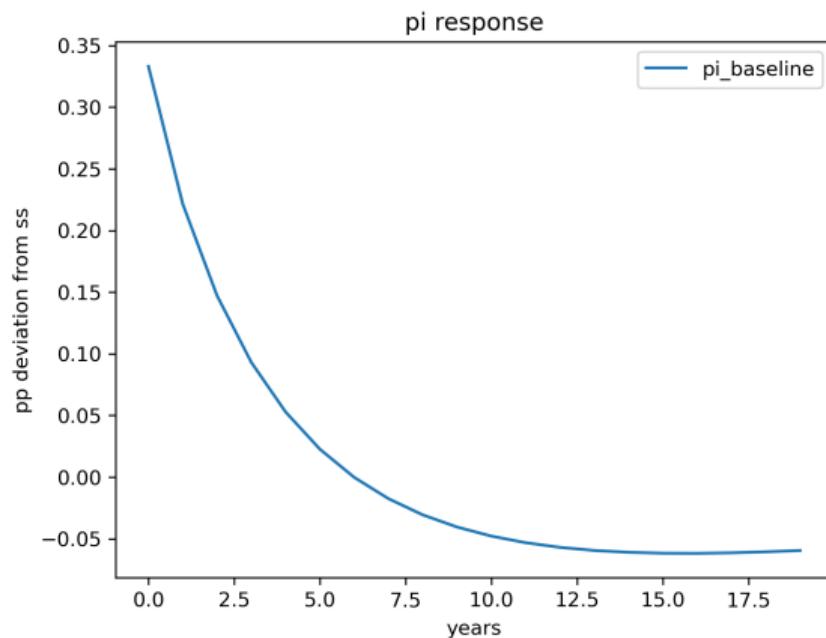
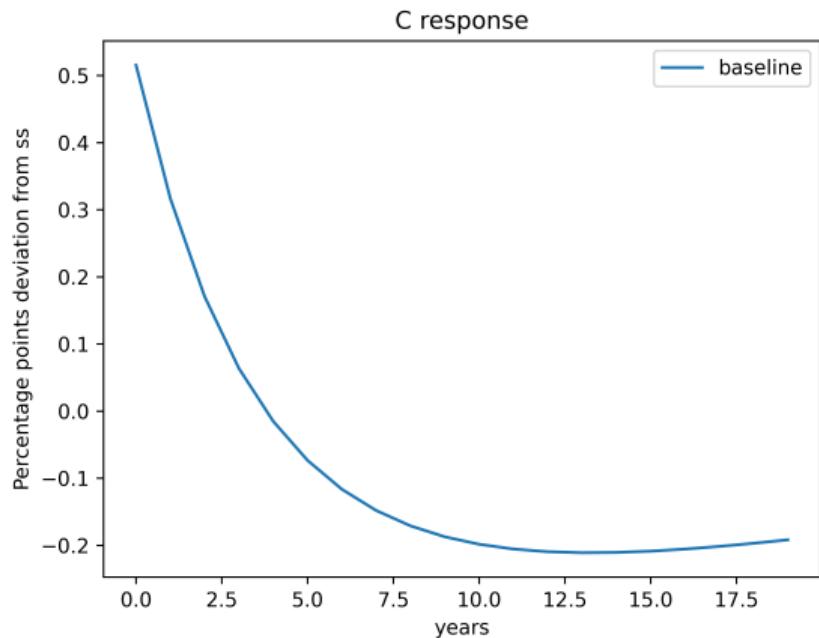
NNP distribution			Consumption
Pct	Data	Model	Model
0.01	-6.8	-7.2	0.0%
0.05	-3.6	-4.9	0.8%
0.1	-2.5	-3.6	2.3%
0.25	-1.1	-2.3	8.7%
0.5	-0.1	-0.9	25.3%
0.75	0.4	0.5	51.3%
0.9	2.2	2.0	74.3%
0.95	4.1	2.9	84.7%
0.99	10	4.6	95.7%

- Cov(MPC, NNP) at -0.072, perfectly matching the most precise estimate in Auclert (2019) [table](#)

The response of consumption to the wealth redistribution from unexpected inflation

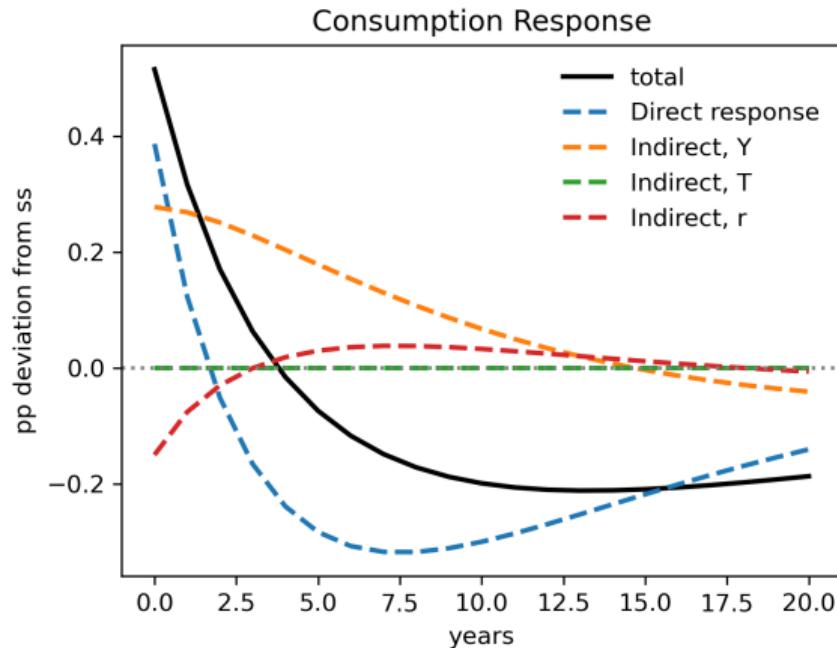
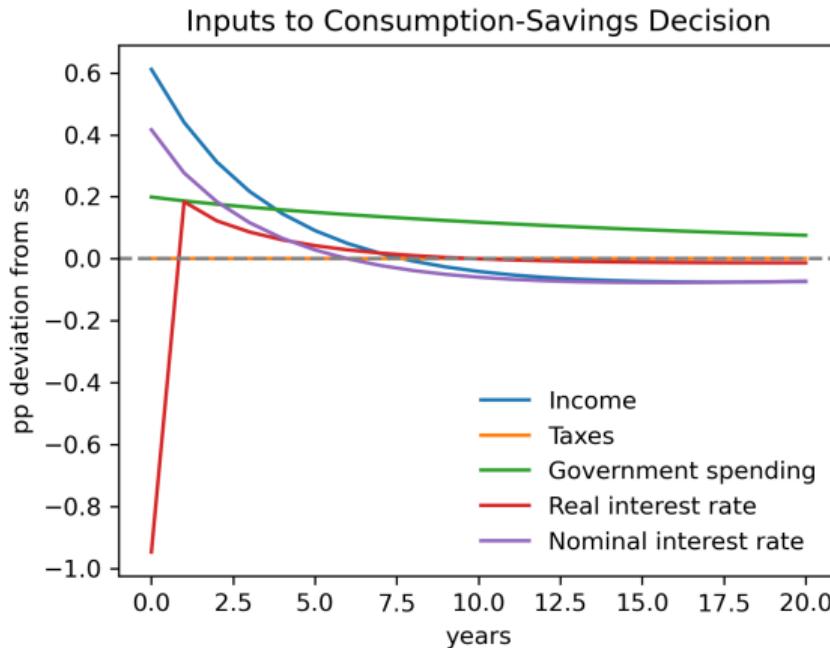
- Of course, inflation is an endogenous variable in the model
- Difficult to pin down the exact structural shocks behind the 2021 inflation episode
 - Also, not necessary for the question at hand
- Simulate a "unit of account" MIT shock that devalues nominal positions in t_0
 - Size calibrated to the 2021-2022 inflation surprise shock
- Look at the IRFs of C and π in response to the wealth redistribution
 - Possible interpretation: compare a *real-asset* economy hit by structural shocks that generated the 2021-22 inflation spike (no redistribution) to a *nominal-asset* economy.

A strong and persistent tailwind to aggregate demand and inflation



- After the initial spike, consumption and inflation converge to the steady state from below

Decomposition of the effects on aggregate consumption



- The Intertemporal Keynesian Cross amplifies the direct effect of the shock, monetary policy reacts by raising the policy rate, government spends its gains on its nominal debt.

Cognitive discounting

- Schnorpfeil et al. (2023) show that households are only partially aware of the Fisher channel
- Simulate the redistribution shock as a sequence of wealth taxes over time $\hat{\theta}_{\pi t}$ where

$$\theta_{\pi,t} = \begin{cases} \frac{\gamma_\pi}{d} & \text{for } 0 < t < d \\ 0 & \text{for } t \geq d \end{cases}$$

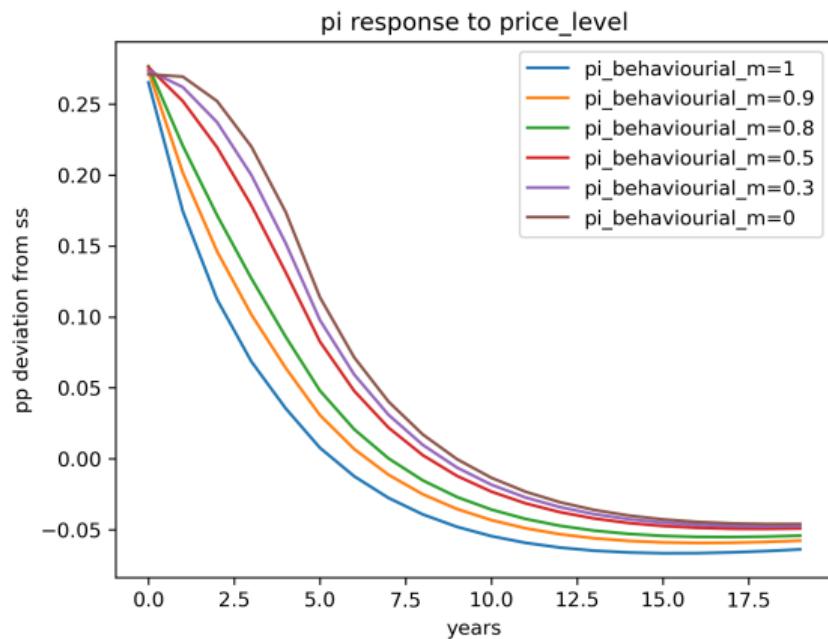
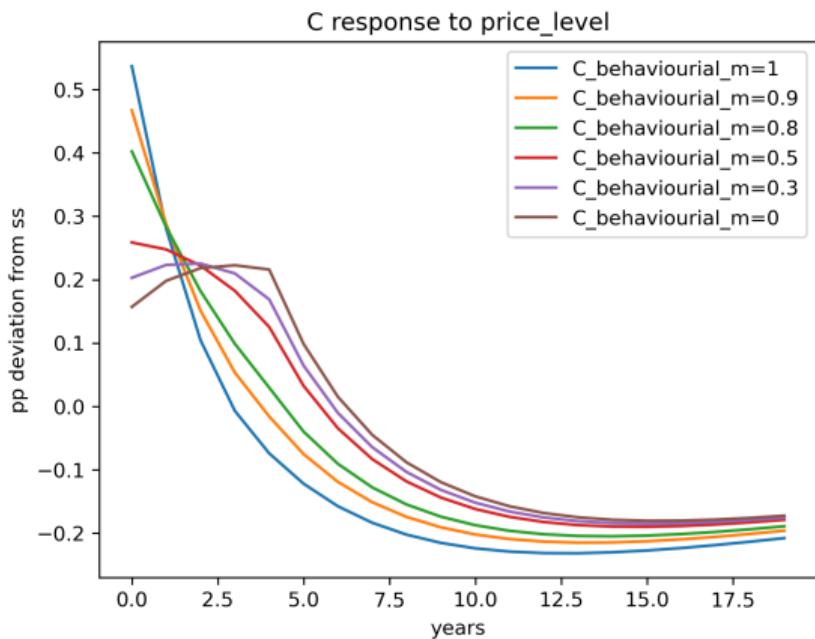
And d is NNP duration, mimicking e.g. the reduction in real value of mortgage payments.

- Introduce behavioural friction where the expectations of the taxes $\hat{\theta}_{\pi t}$ are defined as

$$E_t^B[\theta_{\pi,t+1}] = \theta_{\pi,ss} + \tilde{m} E_t[\theta_{\pi,t+1}] \quad (2)$$

- Can be microfounded from a noisy signal extraction problem (Gabaix (2020))

Response of consumption and inflation under cognitive discounting

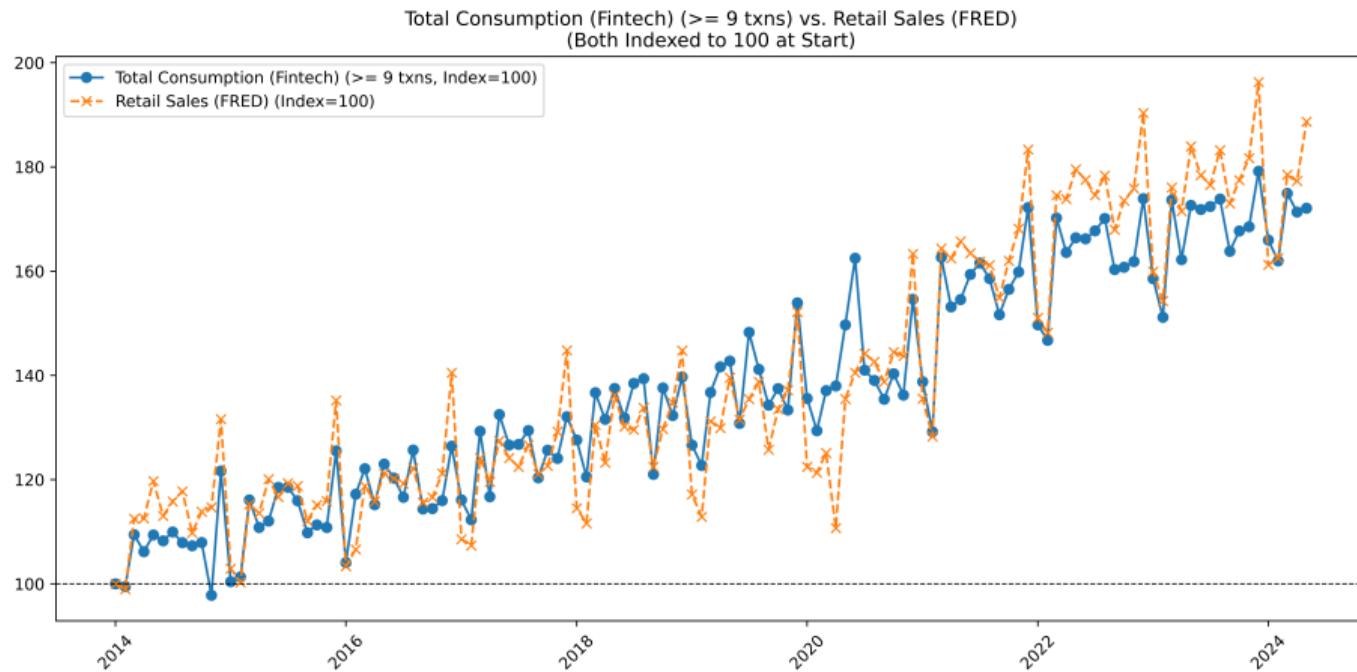


- Smaller initial spike of consumption, but more persistent tailwind to aggregate demand going forward

Empirical evidence: fintech data

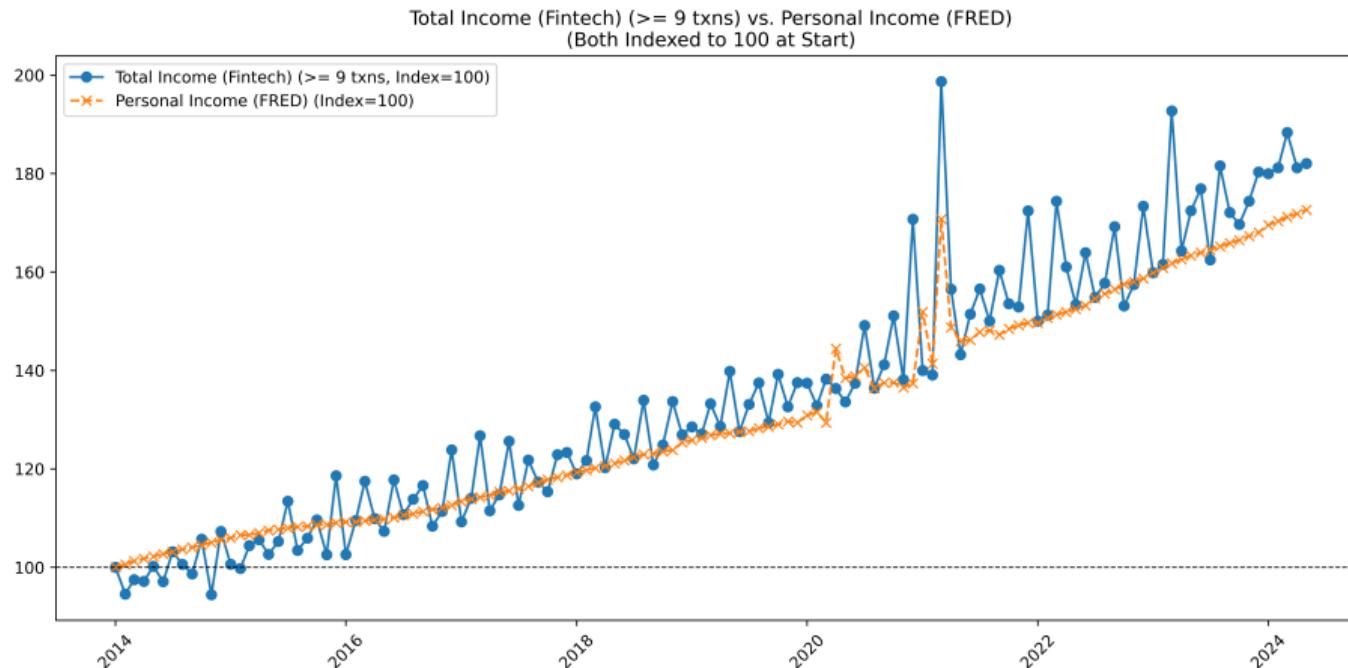
- Data on 100 billions of US transactions for 45 millions unique U.S. users
 - Typically a user is an household, can track multiple banks/cards accounts for each user
- Information on *all* flows in and out of each account tracked by the fintech
 - Can identify mortgage payments and interest income flowing into/out of the accounts
- Construct a panel of 430,760 users who remain continuously active in 2014-2024
 - Each user required to make at least nine relevant transactions each month in 2014-2024
 - Sufficient history to impute nominal positions at the onset of the inflationary period
 - Active filters for SMEs, remove outliers, include transactions only in USD...

Consumption outflows from the accounts - remarkable track of US retail sales



- Correlation greater than 0.95, similar for Personal Consumption Expenditures on Goods

Income inflows in the accounts - same trend of Personal Income from BEA



- The official series for Personal Income (BEA) is seasonally adjusted, unlike the fintech

Distributional statistics for income track the Survey of Consumer Finances

Income group	Fintech		SCF	
	Median	Mean	Median	Mean
Bottom 20	24.78	22.73	20.54	19.39
20-39.9	56.70	56.53	43.24	43.17
40-59.9	80.60	80.90	70.26	71.46
60-79.9	111.62	112.50	115.66	117.28
80-89.9	149.86	150.90	189.16	193.37
90-95	188.52	189.76	299.41	307.19
95-99	246.35	254.26	546.94	636.49
Top 1	410.34	461.94	1848.36	3191.79

- Data for 2021: total income in levels in the fintech aligns well for the bulk of the distribution, missing only people at the very top. SCF reports income before taxes, explaining some underestimation of the fintech data.

Impute stock of nominal positions from flows (vs. SCF)

- Mortgage debt:** match SCF well (share with debt $\approx 40\%$, quantiles close). Construction
- Liquid balances:** matches SCF in the bulk; upper tail noisier (non-deposit interest). Construction
- Other loans/assets exist in the data but are excluded due to noisier classification/stock imputation.

MORTGAGE/HELOC PRINCIPAL BALANCES

Statistic	2018		2021	
	Fintech	SCF	Fintech	SCF
Share with balance > 0	0.39	0.42	0.40	0.42
Mean balance	77,503	88,064	86,932	89,643
P10	0	0	0	0
P25	0	0	0	0
Median	0	0	0	0
P75	111,229	125,194	139,564	129,000
P90	256,703	278,209	299,146	268,400
P99	640,173	725,663	707,584	780,266

Notes: Fintech balances imputed from payment streams; SCF includes mortgages+HELOC (weighted).

LIQUID BALANCES (PROXY) vs. SCF DEPOSITS

Group	Fintech		SCF	
	Median	Mean	Median	Mean
Bottom 20	0.33	0.37	0.05	0.12
20–39.9	1.73	1.80	1.70	1.70
40–59.9	5.03	5.27	6.00	6.39
60–79.9	14.20	15.16	20.00	20.78
80–89.9	37.53	39.22	52.00	54.54
90–95	82.80	87.63	110.00	111.05
95–99	235.77	280.53	220.00	262.86
Top 1	1154.73	4971.78	810.00	1189.77

Notes: Proxy uses interest-income inflows capitalized at FDIC checking rates; units USD 000.

Design 1: Pre/Post cross-section (Mian–Sufi style)

- Baseline window: $T_0 = \text{Jan–Mar 2021}$; late window: $T_1 = \text{Jan–Mar 2022/2023/2024}$.

$$\Delta C_i = \alpha + \beta_{NNP} (NNP_{i,T_0} \cdot \Pi_{\Delta T}^s) + X'_{i,T_0} \theta + \varepsilon_i,$$

$$\Delta C_i = \alpha + \beta_L (NL_{i,T_0} \cdot \Pi_{\Delta T}^s) + \beta_A (NA_{i,T_0} \cdot \Pi_{\Delta T}^s) + X'_{i,T_0} \theta + \varepsilon_i.$$

- Outcome: average monthly spending change $\Delta C_i \equiv \bar{C}_{i,T_1} - \bar{C}_{i,T_0}$.
- Cumulative price-level surprise between T_0 and T_1 : $\Pi_{\Delta T}^s \equiv \sum_{t \in (T_0, T_1)} (\pi_t - \pi_t^e)$
- Net nominal positions, $NNP_{i,T_0} = NA_{i,T_0} - NL_{i,T_0}$
 - I use imputed liquid balances for NA_{i,T_0} and imputed principal balance outstanding on fixed-rate mortgages for NL_{i,T_0} , as payments for FRM do not change over the episode
- Controls X'_{i,T_0} : state fixed effects; winsorize 1%; SEs clustered by state.

Main results (Pre/Post in levels)

- Liabilities load strongly and robustly: $\hat{\beta}_L \approx 0.004\text{--}0.005$ across late windows.
- Asset slope is near zero and the univariate NNP slope is flat.

	$T_1 = 2022$	$T_1 = 2023$	$T_1 = 2024$
$\hat{\beta}_L$	0.005*** (0.001)	0.004*** (0.001)	0.005*** (0.001)
$\hat{\beta}_A$	0.000*** (0.000)	0.000** (0.000)	0.000 (0.000)
State FE	✓	✓	✓
Winsor (1%)	✓	✓	✓

- Interpretation: dollars of ΔC per $(NL \times \Pi^s)$ and $(NA \times \Pi^s)$.
- Placebo test show no effect pre-inflation shock Details

Back-of-envelope magnitude (debtor-side Fisher channel)

- Using $\hat{\beta}_L \simeq 0.004$, cumulative surprise Π^s in 2021-2023, and average FRM balance \bar{L} :

$$\Delta C_{\text{mortgagor}} \approx \hat{\beta}_L \times \Pi^s \times \bar{L} \approx 0.004 \times 0.10 \times 210,000 \approx \$85 \text{ per month.}$$

- With $\approx 40\%$ mortgagors, this maps to $\sim \$52\text{bn/year}$, about $\approx 0.3\%$ of 2023 PCE.
- Persistence (slightly larger in 2024) is qualitatively closer to the behavioral extension.
- Local projections of monthly inflation surprises with calendar and hh FE deliver similar implications [Details](#)
- External validation through county-level variation in NNP [Details](#)

Q3: Implications for monetary policy

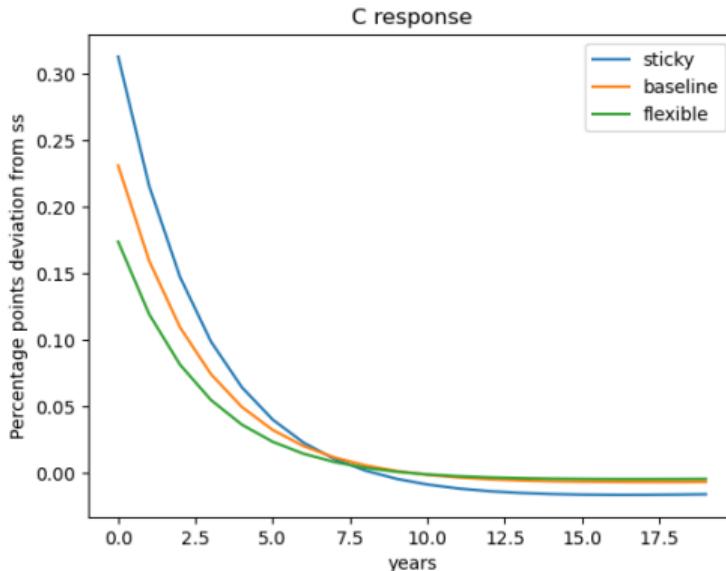
What are the implications for monetary policy?

- ① Monetary policy is up to 50% more powerful in the HANK model with RE
 - In a model with nominal assets, the unexpected inflation generated by an expansionary monetary policy shock redistributes wealth towards high MPC hh, increasing aggregate demand (and viceversa)
- ② The extent of nominal rigidities in the economy matters less for policy effectiveness:
 - As prices become more elastic, the real interest rates responds less to a monetary policy shock, but inflation responds more on impact, redistributing towards/from high MPC hh
 - Quantitatively, the real-rate still channel dominates, but the Fisher channel significantly attenuates the role of nominal rigidity as a determinant of monetary policy effectiveness.

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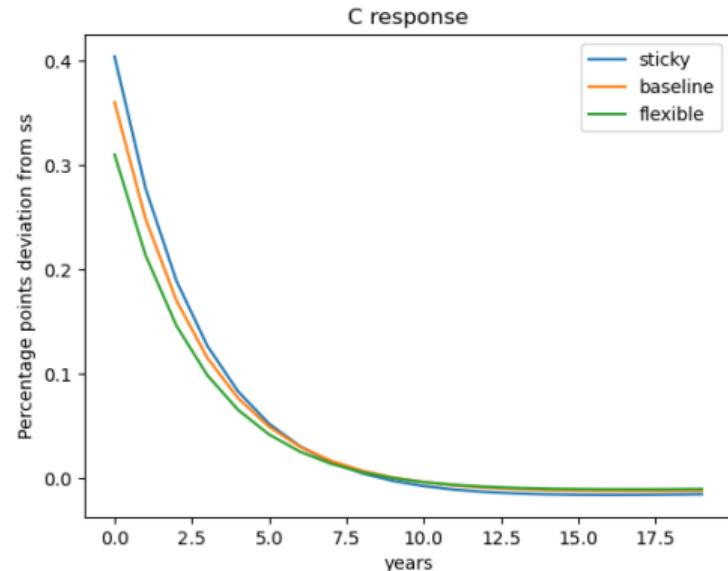
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Impacts of an expansionary monetary shock with and without an active Fisher channel



Model without the Fisher Channel

- Slope of the NKWPC: sticky: $\kappa_w = 0.05$; baseline: $\kappa_w = 0.10$; flexible: $\kappa_w = 0.15$
- When the Fisher channel is active, higher impacts on consumption of monetary policy shocks and smaller differences across the degrees of nominal rigidities



Model with the Fisher Channel

Conclusions

Conclusions

Q1 Sizable wealth redistribution generated by the 2021 inflation shock in the US

- From rich middle-aged and elderly to the rest of hhs groups, especially young mortgagors.

Q2 In a US HANK model with nominal assets C increased by 0.3-0.5% after the redistribution

- Supported by empirical evidence from admin data, leaning to the behavioural extension.

Q3 More powerful monetary policy and also less dependent on nominal rigidities

- The Fisher channel amplifies the real-rate channel and works even with flexible prices

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Net Nominal Positions (NNP) at the macro level

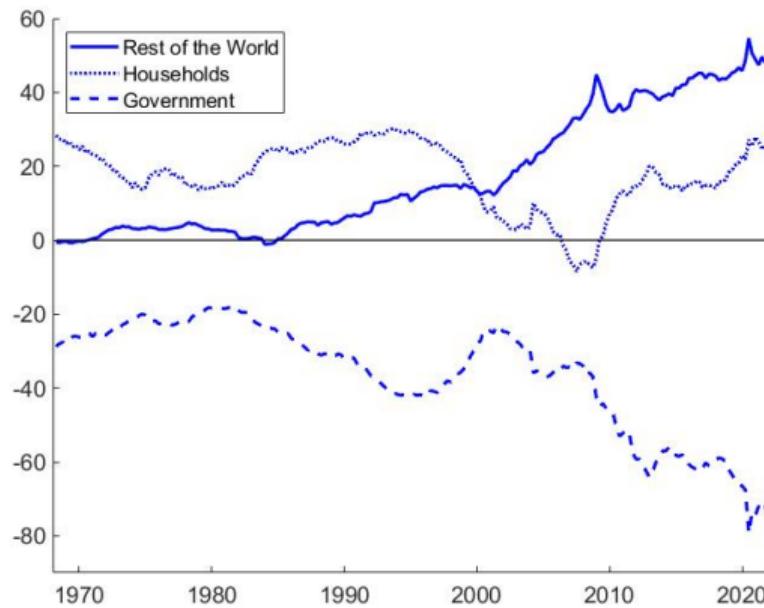


Figure 2: NNP as percentage of GDP for 1968-2021 for the three ultimate users of any claim in the US.

[DS](#) [Details](#) [Back](#)

Sources of data

① NNP at the sector level:

- Financial Accounts of the United States (FA):
 - ★ Quarterly balance sheets for 30 sectors that compose the US economy Sectors
 - ★ Financial assets and liabilities according to 24 instruments Instruments

② NNP at the household level:

- Distributed Financial Accounts
- Survey of Consumer Finance

③ Maturity structure of nominal payments:

- CRSP, FHFA

Back

Aggregation process (continued)

② Unveil investment intermediaries

- ▶ Each claim attributed to their shareholders

③ Calculate Direct Net Nominal Position (DNP):

$$DNP = NA - NL \quad (3)$$

④ Consolidate the business sector

- ▶ Letting $\theta = \frac{\text{DNP of the business sector}}{\text{total outside equity}}$
- ▶ The net nominal position (NNP) of sector i is defined as

$$NNP_i = DNP_i + \theta equity_i \quad (4)$$

- ▶ Sufficient statistic for redistribution after a shock to the price level

Sectors

Macro-Sector	Sector	Macro-Sector	Sector
Households Government	Households and nonprofit Federal, state, and local Monetary authority DB federal ret. funds DB state ret. funds Rest of the world Foreign banks in U.S. Foreign fund. corp.	Business	Corporate business Non-corp. business Commercial banks Saving institutions Credit unions Life insurance (general) Other insurance Closed-end funds GSEs Issuers of ABS Finance companies Mortgage companies REITs Security brokers and dealers Funding corporations
Rest of the World			
Intermediaries	Money market funds Mutual funds DC private pension DC federal ret. funds DC state ret. funds Life insurance (separate) Federal mortgage pools		

Measurement

Aggregation

Households		
	Assets	Liabilities
Pension entitlement	30	Total mortgages 11
Corporate equities	26	Consumer credit 4
Proprietors' equity in noncorporate business	13	Other loans 1
Mutual fund shares	11	
Savings deposits	10	
Checkable deposits	3	
MMMF shares	3	
Treasury securities	2	
Municipal securities	2	
Life insurance reserves	2	
Other loans	1	
Corporate and foreign bonds	1	
Trade credit	1	

Commercial banks		
	Assets	Liabilities
Mortgages	3	Savings deposits 12
Agency- and GSE-securities	3	Checkable deposits 5
Other institutional loans	3	
Consumer credit	2	
Commercial mortgages	2	
Treasuries	1	
Federal funds and repo	1	
Net interbank transactions	1	

Mutual funds		
	Assets	Liabilities
Corporate equities	13	Mutual fund shares 20
Corporate and foreign bonds	3	
Agency- and GSE securities	1	
Treasury securities	1	
Municipal securities	1	

Measurement

Aggregation

Instruments

Class	Instrument	Class	Instrument
Short	Checking deposits Fed funds Deposits abroad Net interbank trans. Savings deposit Open market p. Trade credit Taxes payables Consumer credit Oth. loans and adv. Dep. institutional loans Tbills	Long	Treasuries Corporate bonds Agency and GSE sec. Municipal securities Pension entitlements Life insurance res. Home mortgages Commercial mortg.
		Intermed.	Money market sh. Mutual funds sh.
		Equity	Corporate equities Non-corp equity

Measurement

Total nominal claims relative to US GDP

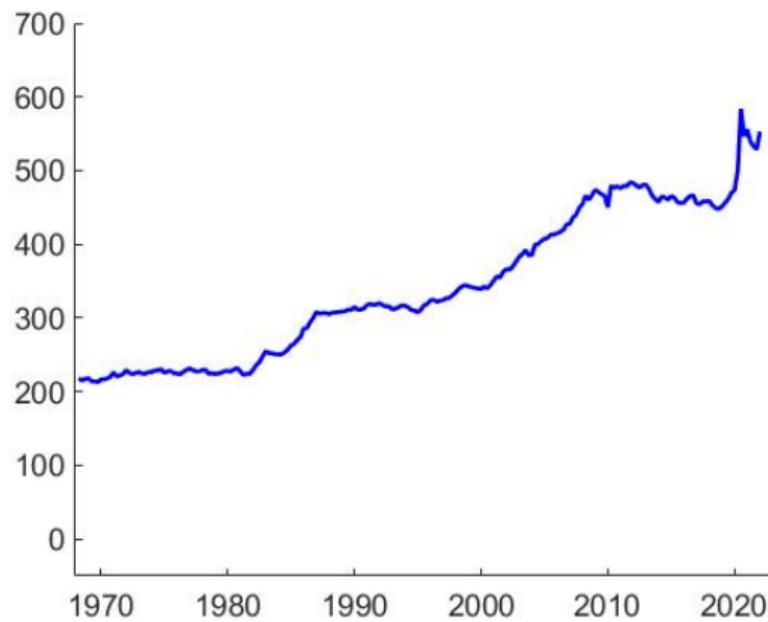


Figure 3: Market value of all outstanding nominal claims between different sectors of the US economy as a percentage of GDP, 1968-2021.

NNP as a % of GDP, detail

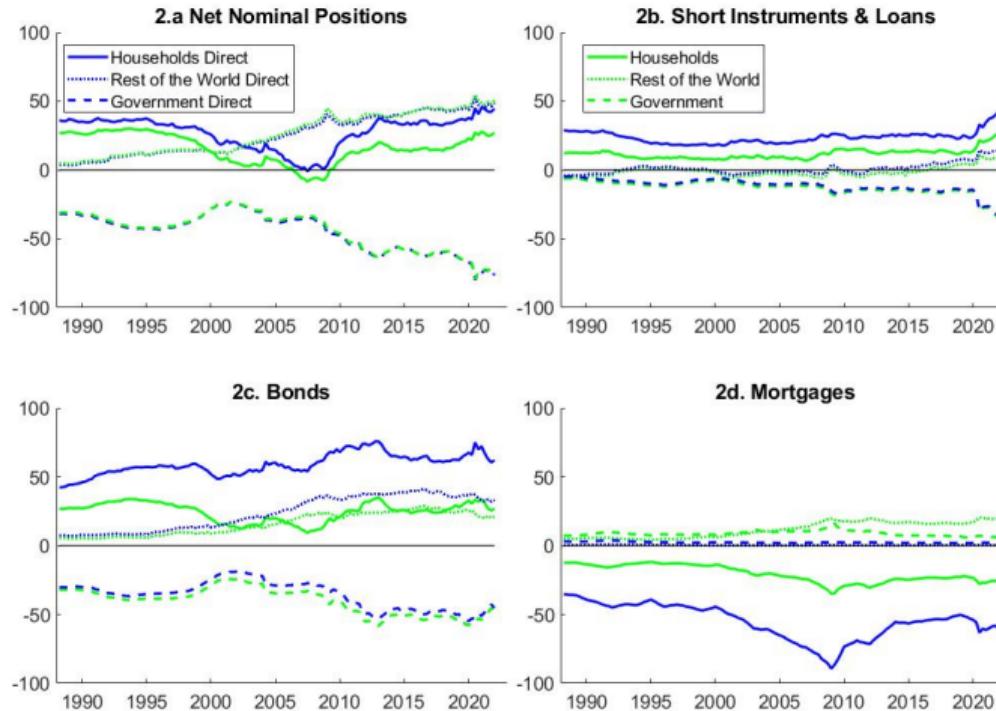


Figure 4: Net nominal positions as a percentage of US GDP, 1988-2022, by sector and class of instrument. [Back](#)

Doepeke and Schneider (2006) replication with minor adjustments

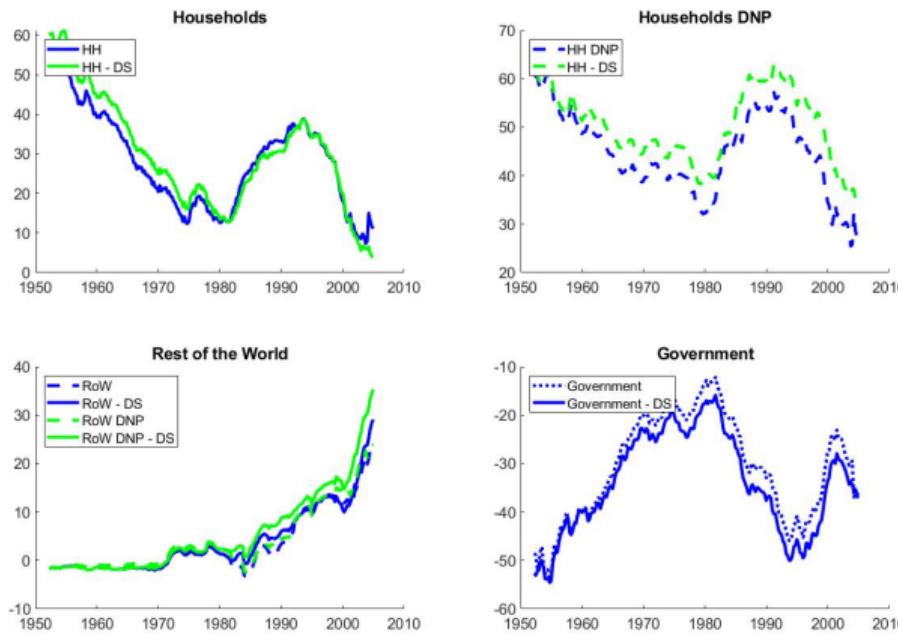


Figure 5: Net nominal positions by sector - my results (blue) versus DS (green). Minor differences are due to revision in FA data and slightly different treatment of sectors and instruments.

Back

My results vs DS

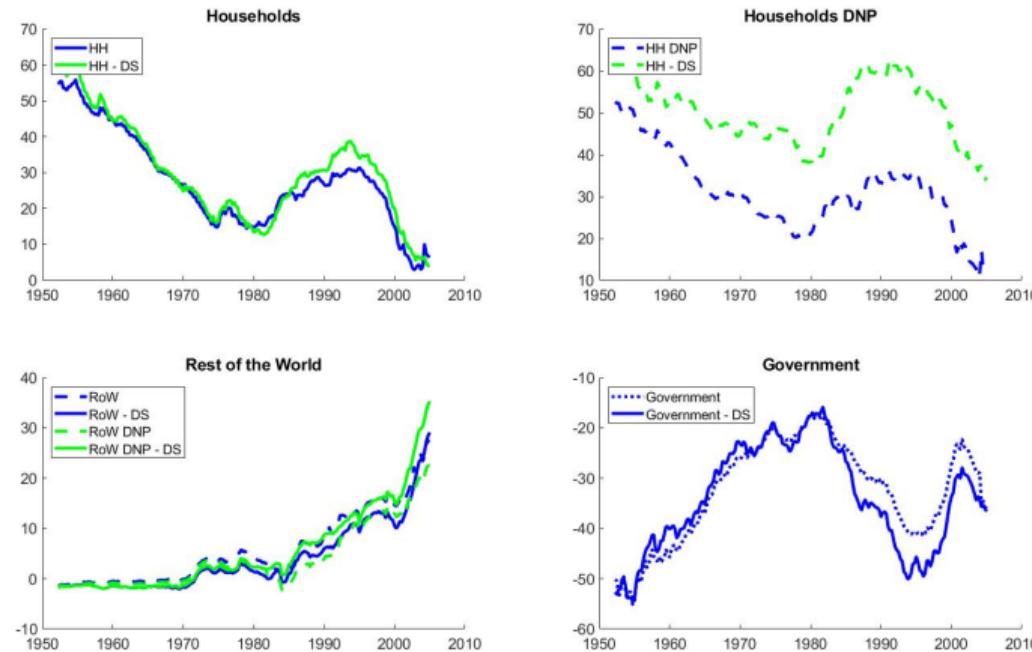


Figure 6: Net nominal positions by sector - my results (blue) versus DS (green). Differences now reflect also market value data reported by the FA and adjustment to SCF aggregates. [Back](#)

Duration of nominal positions

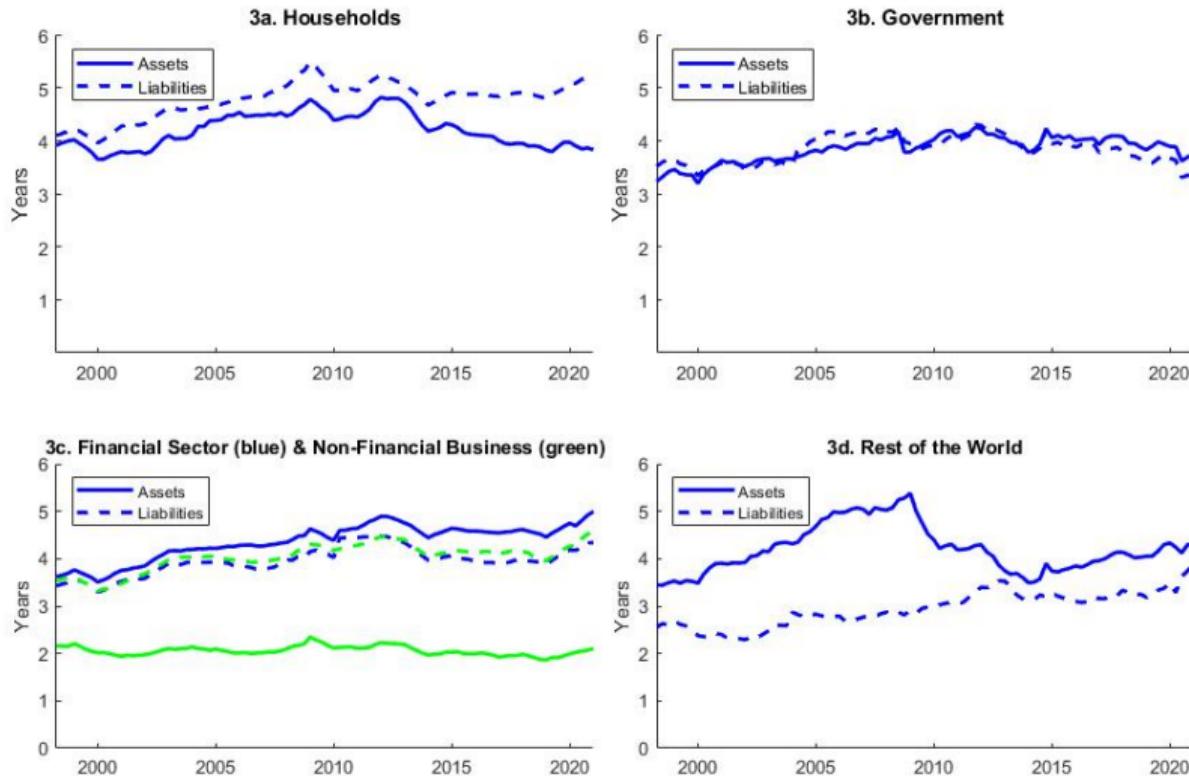


Figure 7: Duration in years of nominal positions for households (panel a), government (b), business (c) and the rest of the world (d)

Back

Shock to inflation expectations in 2021

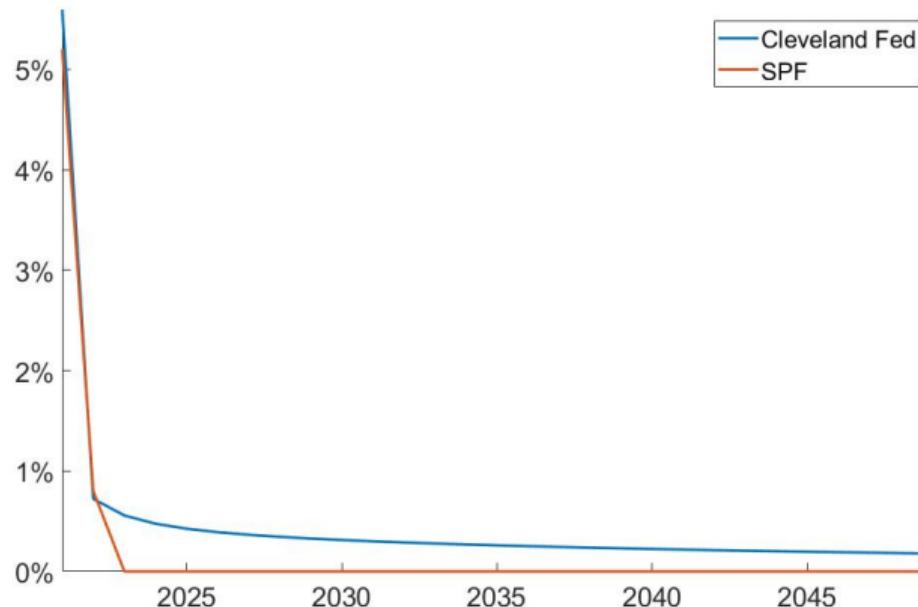


Figure 8: Revision in the term structure of inflation expectations between December 2021 and December 2020 according to the Cleveland Fed model (blue line) and to the Survey of Professional Forecasters (red line).

Redistributive effects

- Inflation expectations adjusted gradually during 2021: upper and lower bound on the revaluations for nominal positions maturing within 2021.

① Full anticipation:

$$w_t^p = \sum_{s=0}^S d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_s)} - \sum_{s=0}^S d_{t+s} e^{-i_t^{t+s}} \quad (5)$$

② Full surprise:

$$w_t^p = \begin{cases} \sum_{s=0}^S d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_4)} - \sum_{s=0}^S d_{t+s} e^{-i_t^{t+s}} & \text{if } S \leq 4 \\ \sum_{s=0}^S d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_s)} - \sum_{s=0}^S d_{t+s} e^{-i_t^{t+s}} & \text{if } S > 4 \end{cases} \quad (6)$$

Back

Redistributive effects

- Inflation expectations adjusted gradually during 2021: upper and lower bound on the revaluations for nominal positions maturing within 2021.

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$$w_t^p = \sum_{s=0}^S d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_s)} - \sum_{s=0}^S d_{t+s} e^{-i_t^{t+s}} \quad (5)$$

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Back

Redistributive effects

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- Full surprise may overstate if agents were able to intertemporally substitute.
- Baseline:

$$w_t^p = \begin{cases} \sum_{s=0}^S d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_2)} - \sum_{s=0}^S d_{t+s} e^{-i_t^{t+s}} & \text{if } S \leq 2 \\ \sum_{s=0}^S d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_s)} - \sum_{s=0}^S d_{t+s} e^{-i_t^{t+s}} & \text{if } S > 2 \end{cases} \quad (7)$$

- No clear evidence of nominal risk being transferred significantly during 2021 at the sector/group level.

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Gain and losses for macro sectors from the 2021 inflation shock, % GDP

	Full anticipation	Baseline	Full Surprise
Government	3.88	4.28	5.05
Rest of the World	-3.68	-3.55	-3.67
Households	-0.23	-0.83	-1.56

Present value gain or loss from the 2021 surge in inflation expectations, measured by the Cleveland FED model, for government, rest of the world and households.

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Gain and losses within the business sector, % GDP

	Full anticipation	Baseline	Full Surprise
Non-corporate business	2.13	2.15	2.16
Nonfinancial corporate business	2.90	2.92	2.89
Financial business	-4.34	-3.70	-3.16

Present value gain or loss from the 2021 surge in inflation expectations, measured by the Cleveland FED model for non-corporate business, non-financial corporate business and financial business.

Within the household sector

- Latest wave of the Survey of Consumer Finance (2019)
- Scale the value of each single nominal positions of a household according to the evolution for the household sector as a whole.
 - Substantial adjustment only of deposits

Average nominal positions as a percentage of net worth - 2019

Instrument	Age cohort					
	≤ 35	36-45	46-55	56-65	66-75	>75
A. All households						
Short-term	17	8	9	9	10	11
Bonds	10	9	12	13	14	12
Mortgages	-98	-33	-16	-8	-6	-4
Equity	-2	-2	-1	-1	0	0
Total NNP	-73	-18	3	13	18	19
B. Low income						
Short-term	92	-17	4	3	10	21
Bonds	10	7	6	6	5	2
Mortgages	-251	-117	-34	-9	-8	-15
Equity	-2	0	0	-1	-1	-1
Total NNP	-151	-126	-25	-1	6	7

Breakdown of NNP by type of instrument held for different groups of U.S. households in 2019. Value for each group as a percentage of average net worth in the group. In each group, components sum to 100%.

Average nominal positions as a percentage of net worth - 2019 (2)

Instrument	Age cohort					
	≤ 35	36-45	46-55	56-65	66-75	>75
C. Middle class						
Short-term	32	15	11	12	13	15
Bonds	16	13	14	14	13	10
Mortgages	-281	-86	-41	-21	-14	-10
Equity	1	1	1	1	1	1
Total NNP	-232	-57	-15	6	13	17
D. Rich						
Short-term	10	7	8	8	8	9
Bonds	8	8	11	13	15	14
Mortgages	-29	-14	-7	-4	-2	-2
Equity	-3	-3	-2	-2	0	0
Total NNP	-14	-3	10	15	20	21

Breakdown of NNP by type of instrument held for different groups of U.S. households in 2019. Value for each group as a percentage of average net worth in the group. In each group, components sum to 100%.

Nominal positions in bonds, market value

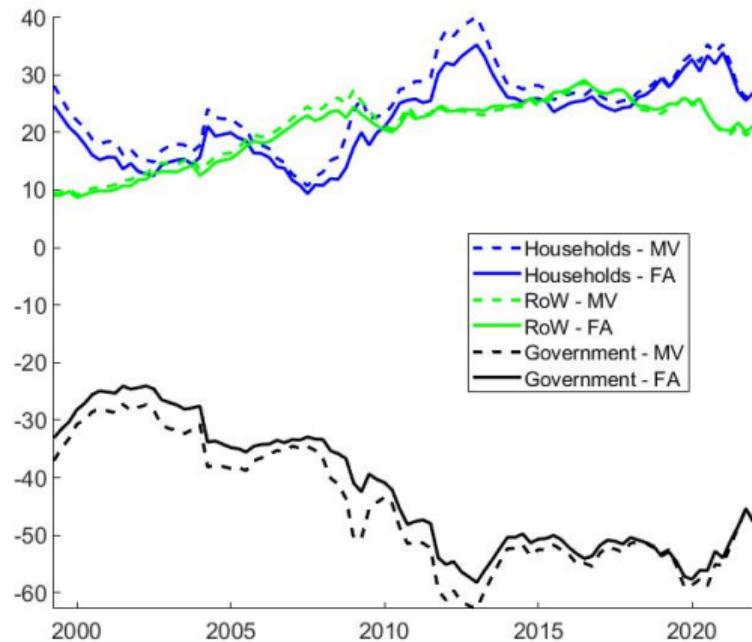


Figure 9: Nominal positions in bonds as a percentage of GDP for Households, Rest of the World, and Government. Dotted lines discount the stream of payments constructed above with the zero coupon yield curve, while solid lines use the market value reported by the Financial Accounts.

Results using the SPF

	Full anticipation	Baseline	Full Surprise
Government	3.2	3.58	4.36
Rest of the World	-2.45	-2.47	-2.72
Households	-0.77	-1.19	-1.76

Present value gain or loss as a percentage of GDP at the sector level from the 2021 surge in inflation expectations, measured by the SPF, based on nominal positions at the end of 2020.

Evolution of nominal positions - 2021

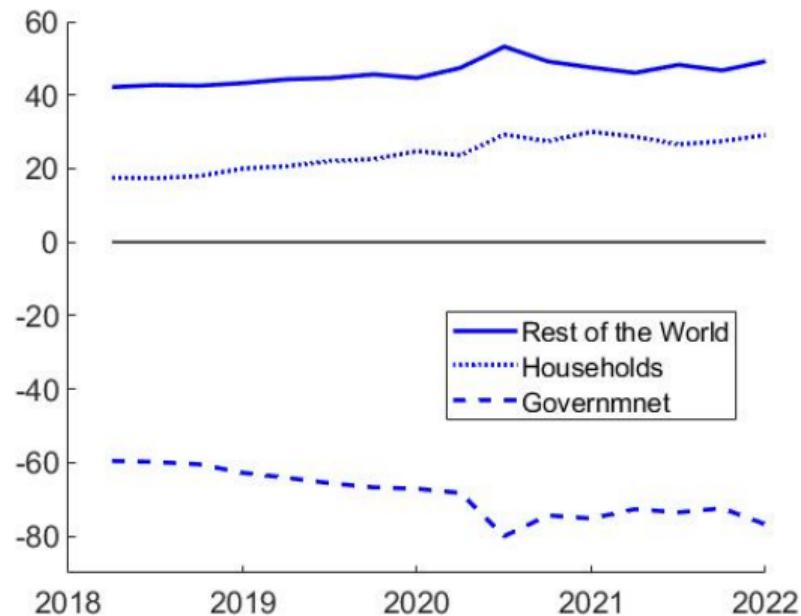


Figure 10: Evolution of net nominal positions relative to GDP for macro-sectors of the US economy, 2018-2021.

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Evolution of nominal positions - 2021

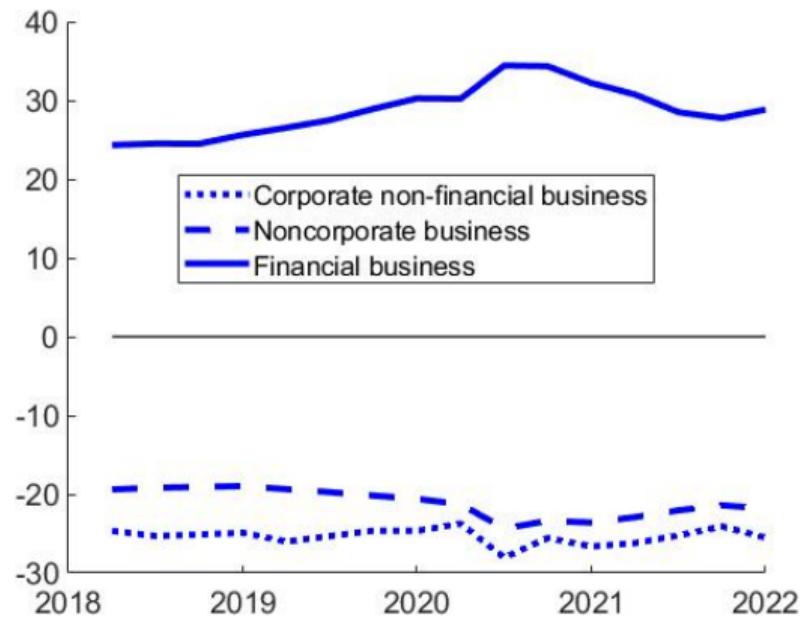


Figure 11: Evolution of net nominal positions relative to GDP for the business sector in the US economy, 2018-2021.

Evolution of nominal positions - 2021

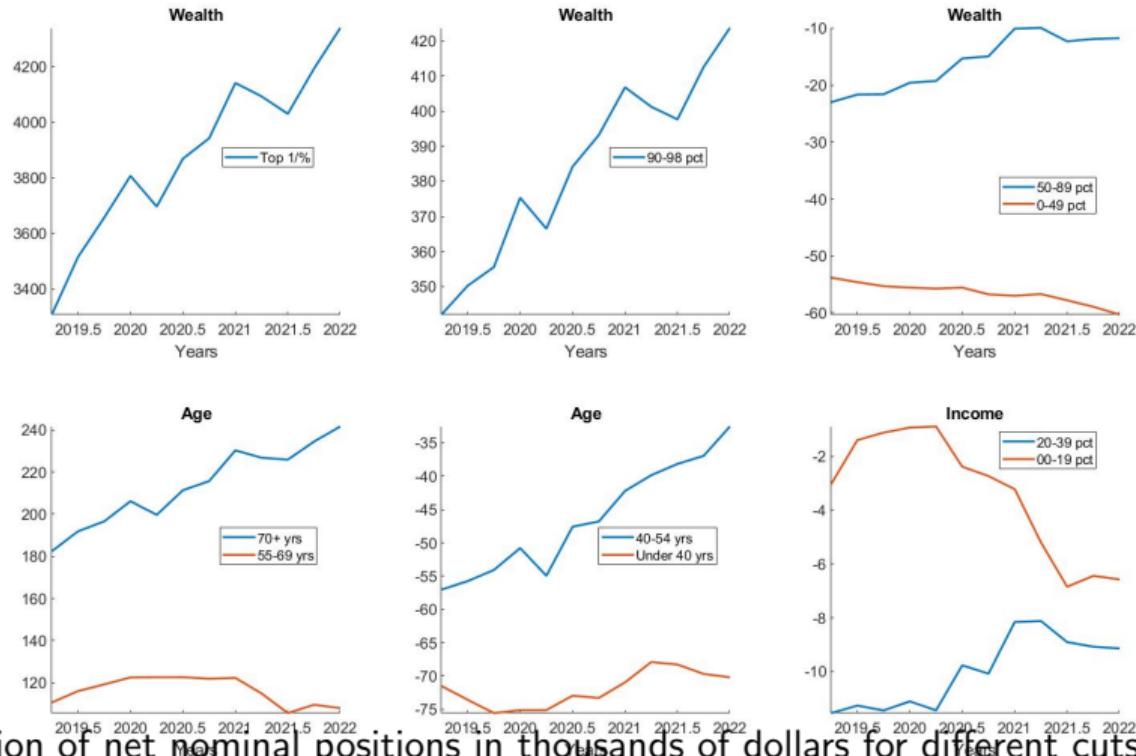


Figure 12: Evolution of net nominal positions in thousands of dollars for different cuts of the household sector according to the DFA - 2019-2021.

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Average gain or loss for groups of households - mortgage holders

	Age cohort					
	≤ 35	36-45	46-55	56-65	66-75	>75
A. Low income						
\$ '000	16	15	10	5	8	4
% Income	80	31	26	12	49	33
B. Middle class						
\$ '000	17	16	10	6	3	5
% Income	21	13	8	6	4	7
C. Rich						
\$ '000	17	22	-14	-54	-71	-43
% Income	12	7	-3	-11	-16	-15

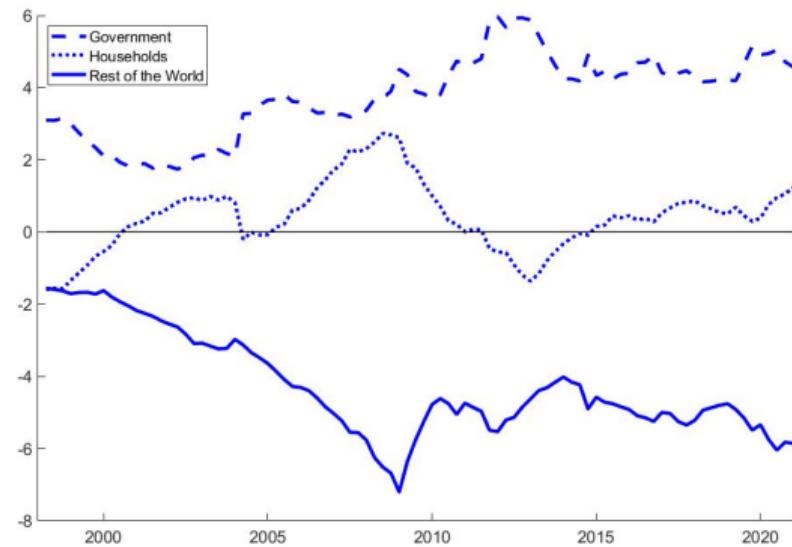
Present value gain or loss in thousands of dollars and as a percentage of household income from the 2021 surge in inflation expectations, measured by the Cleveland FED model. Gain or losses are conditional on having a mortgage for primary residence.

Percentage of mortgage holders in each cohort

	Age cohort					
	≤ 35	36-45	46-55	56-65	66-75	>75
Low income	2%	15%	16%	8%	8%	23%
Middle class	35%	58%	61%	52%	44%	27%
Rich	69%	83%	76%	55%	37%	20%

Fraction of households in each group having a mortgage.

Figure 13: Gains and losses from increasing the inflation target by 2 percentage points



Wealth gains or losses for government (dashed), households (dotted), rest of the world (solid) in present-value terms as percentages of GDP after a surprising announcement that future inflation will permanently increase by 2 percentage points per year. The announcement is simulated at every quarter, with gains and losses reflecting nominal positions and their term structure at the moment of the announcement.

Gain and losses for macro sectors under AIT, % GDP

	3 Years	5 Years	10 Years
Government	-2.63	-1.85	-1.05
Rest of the World	2.42	1.79	1.22
Households	0.25	0.07	-0.16

Present value gain or loss from a revision in inflation expectations due to a credible announcement by the FED of a three, five or ten year window for Average Inflation Targeting. I assume that the announcement by the FED of a window for AIT would entail keeping inflation at 2% in 2022 and setting a uniform inflation target for 2023 onward that will compensate for 2021 inflation spike in a window of three, five or ten years.

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Wages stickiness

- Wages for workers are set by unions subject to a quadratic costs in the utility function, following Erceg et al. (2000) and Auclert et al. (2024)
- In equilibrium, this leads to the New Keynesian Wage Phillips Curve: Unions

$$\log(1 + \pi_t^w) = \kappa_w \left(\phi N_t^{1+\nu} - \frac{(1 - \tau_t) w_t N_t}{\mu_w} \int e_{it} c_{it}^{-\sigma} di \right) + \beta \log(1 + \pi_{t+1}^w)$$

- Representative firms produces output

$$Y_t = Z_t N_t$$

- With flexible prices:

$$P_t = \frac{W_t}{Z_t} \implies \pi_t = \pi_t^w$$

Back

Closing the model

- Policy:

$$\begin{aligned}P_t G_t + Q_t \Lambda_t^g &= (1 + \delta Q_t) \Lambda_{t-1}^g + P_t T_t \\G_t &= G_{ss} - \gamma_G (B_t - B_{ss}) \\i_t &= r_t^* + \phi \mathbb{E} \pi_{t+1} + \epsilon_t\end{aligned}$$

- Market clearing:

$$\begin{aligned}Y_t &= \int c_{it} di + G_t \\B_t &= \int Q_t \Lambda_{it} di\end{aligned}$$

Back

- Sensitive to the Taylor rule coefficient
 - ▶ For $\phi_\pi = 1$, indeterminacy
 - ▶ For $\phi_\pi = 1.25$ the effects are very large
 - ▶ For $\phi_\pi = 2$, the effects are small but still meaningful (will report graphs for all).
- Sensitive to average maturity of nominal positions
- Robust to all other parameters (for reasonable parametrization)

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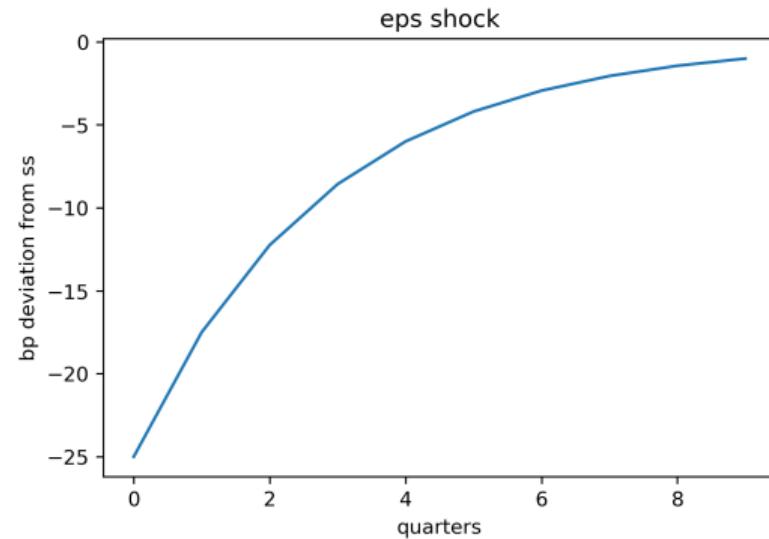
Further policy implications

- The insight about monetary policy is more general: any type of demand shock has larger effects the more flexible prices are for standard parameters
 - Discount factor shock [Results](#)
 - Government spending shock [Results](#)
- The redistributive role of inflation also calls for a more active Taylor rule in HANK (in progress)
- Larger fiscal multipliers of deficit-financed spending (in progress)

[Back](#)

MP shock

- Monetary policy shock



Back

Unions

- Mass 1 of unions which set wages on behalf of workers, union k provides specific task made up from efficiency units of household labor, which is then aggregated into N_t

$$N_t = \left(\int \left(\int s_{it} n_{kit} di \right)^{\frac{\epsilon-1}{\epsilon}} dk \right)^{\frac{\epsilon}{\epsilon-1}}$$

- Changing wages incur utility costs

$$\int \left(\frac{W_{kt}}{W_{kt-1}} - 1 \right)^2 dk$$

- Which yields the non-linear wage Phillips curve

$$\pi_t^w (1 + \pi_t^w) = \frac{\epsilon}{\psi} \int N_t \left(v'(N_t) - \frac{\epsilon-1}{\epsilon} \frac{\partial z_{it}}{\partial n_{it}} u'(c_{it}) \right) di + \beta \pi_{t+1}^w (1 + \pi_{t+1}^w)$$

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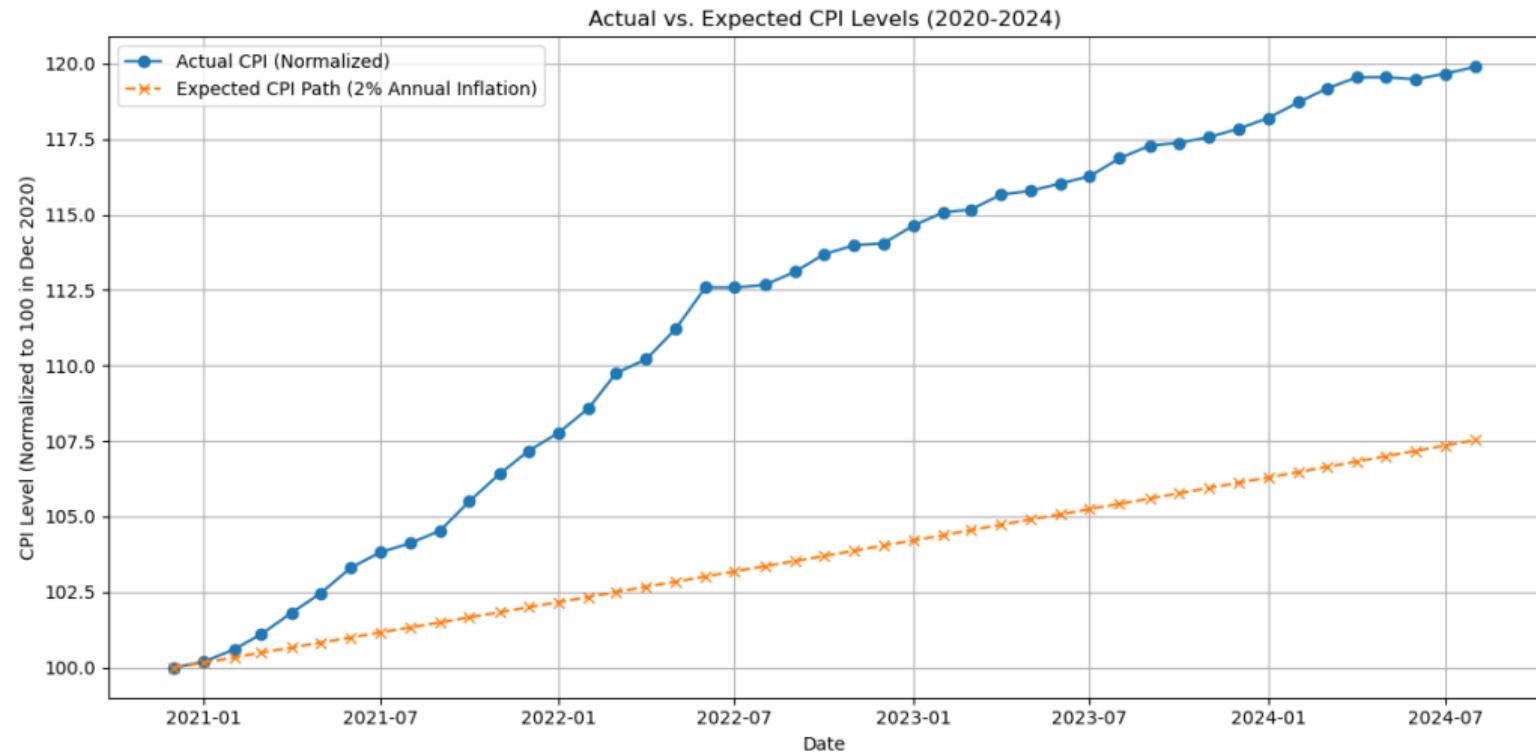
Calibration

Calibration parameters for the model.

Parameter	Description	Value	Parameter	Description	Value
σ	IES	0.5	κ_w	Slope of wage Phillips curve	0.05
ϕ	Frisch	0.5	μ_w	Wage markup	1.1
a	Borrowing constraint	-1	ψ	Taylor Rule coefficient	1.25
θ	Tax progressivity	0.18	B	Government Debt/GDP	0.2
ρ_e	Autocorrelation of earnings	0.91	G	Government spending	0.2
σ_e	Std of log earnings	0.92	γ_G	G response	0.1
β	Discount Factor	0.85	r^*	Eq. real rate	0.05
δ	Bond decay	0.80	π_{ss}	Steady-state inflation	0

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Inflation shock



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Robustness to the paradox of flexibility

- This paradox happens for any reasonable parametrization of wage stickiness $\kappa \in [0.001, 0.7]$ ¹
- But is very sensitive to the coefficient on expected inflation of the Taylor rule. The closer the coefficient is to 1.5, less this paradox is true. For $\phi > 1.5$, the sign flips.

¹For $\kappa > 0.7$, the model is indeterminate

Response of households at different percentiles of the distribution

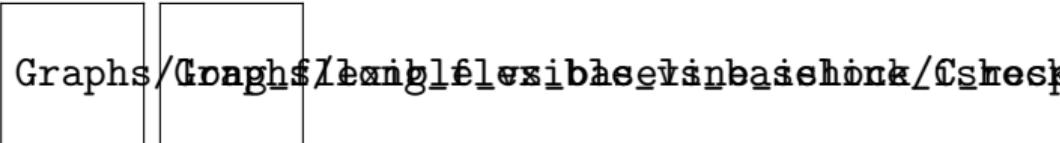


Figure 14: Response of households at different percentiles of the wealth and income distribution

- Debtors increase their consumption substantially [Back](#)

Response of households at different percentiles of the distribution

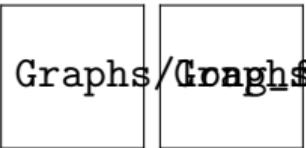


Figure 15: Response of households at different percentiles of the wealth and income distribution.

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A discount factor shock and its inflation response

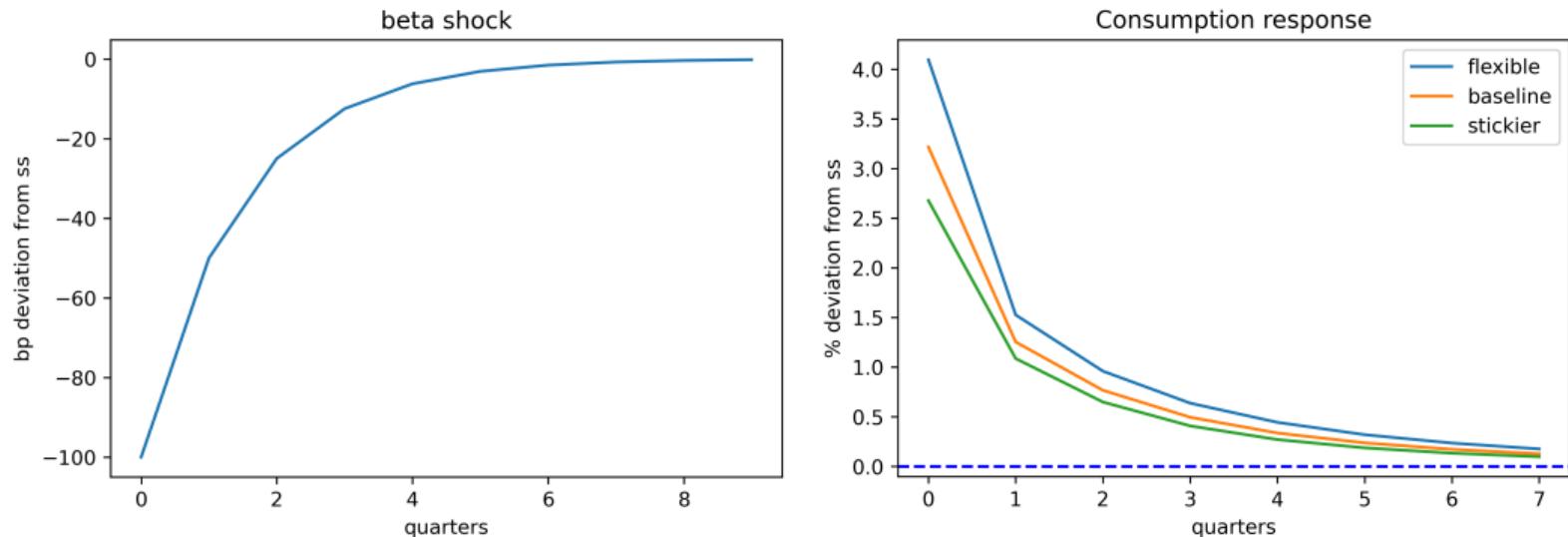


Figure 16: Discount factor shock and the response of consumption in the model. Flexible: $\kappa = 0.09$, baseline: $\kappa = 0.01$, stickier: $\kappa = 0.011$.

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A government spending shock and its inflation response

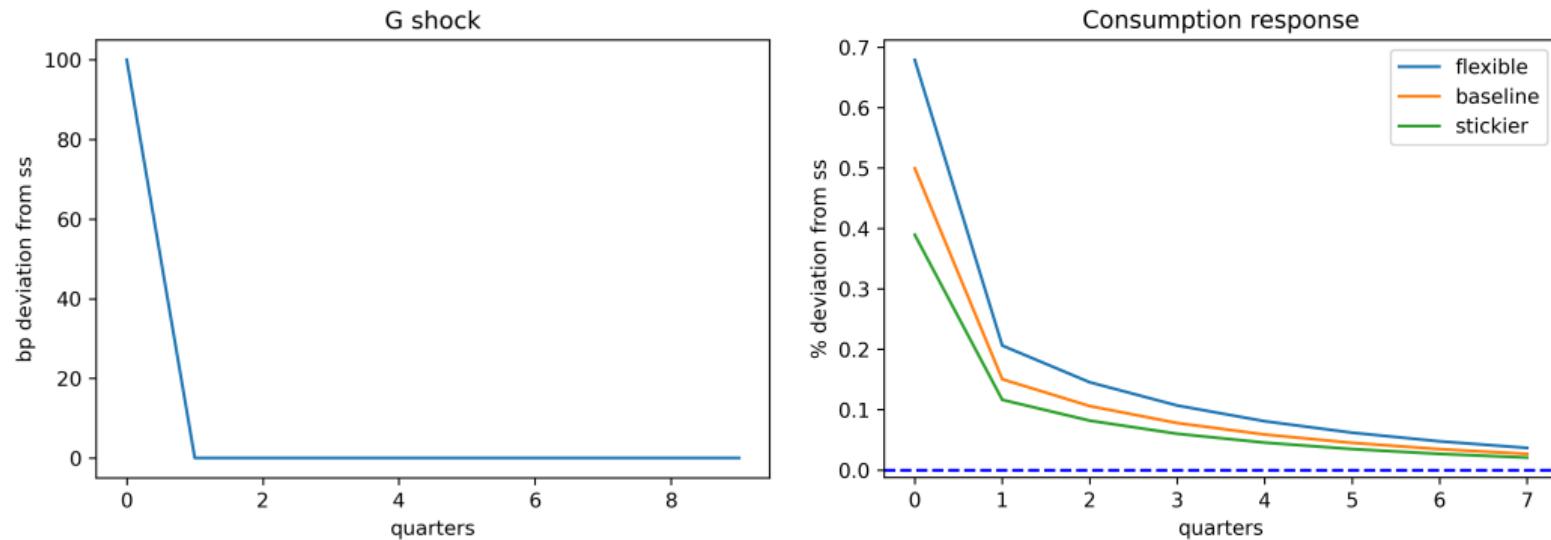


Figure 17: Government spending shock and the response of consumption in the model. Flexible: $\kappa = 0.09$, baseline: $\kappa = 0.01$, stickier: $\kappa = 0.011$.

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Quantitative model with two assets

- Household problem

$$V_t(e, \Lambda_-, a_-) = \max_{c, \Lambda, a} \left\{ \frac{c^{1-\sigma}}{1-\sigma} + \beta \mathbb{E}_t V_{t+1}(e', \Lambda, a) \right\} \quad (1)$$

$$c + a + Q_t \Lambda = z_t(e) + (1 + r_t^a) a_- + (1 + \delta Q_t) \Lambda_- - \Psi(a, a_-) \quad (8)$$

$$a \geq \underline{a}, \quad Q_t \Lambda \geq \underline{b} P_t, \quad (9)$$

where $z_t(e)$ is net labor income and the adjustment cost function is specified as

$$\Psi(a, a_-) = \frac{\chi_1}{\chi_2} \left| \frac{a - (1 + r_t^a) a_-}{(1 + r_t^a) a_- + \chi_0} \right|^{\chi_2} [(1 + r_t^a) a_- + \chi_0],$$

with $\chi_0, \chi_1 > 0$ and $\chi_2 > 1$.

Back

Production

$$Y_t = Z_t K_{t-1}^\alpha N_t^{1-\alpha}$$

$$Q_t = 1 + \frac{1}{\delta \epsilon_I} \left(\frac{K_t - K_{t-1}}{K_{t-1}} \right)$$

$$(1+r_t)Q_t = \alpha Z_{t+1} \left(\frac{N_{t+1}}{K_t} \right)^{1-\alpha} mc_{t+1} - \left[\frac{K_{t+1}}{K_t} - (1-\delta) + \frac{1}{2\delta \epsilon_I} \left(\frac{K_{t+1} - K_t}{K_t} \right)^2 \right] + \frac{K_{t+1}}{K_t} Q_{t+1}$$

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Introducing prices stickiness

- Competitive final good sector aggregates a continuum of intermediate goods produced by monopolistically competitive firms, facing quadratic adjustment costs Firms
- In equilibrium, we have:

$$\log(1 + \pi_t) = \kappa_\pi \left(\frac{w_t}{Z_t} - \frac{1}{\mu} \right) + \frac{1}{1 + r_{t+1}} \frac{Y_{t+1}}{Y_t} \log(1 + \pi_{t+1}) \quad (10)$$

- κ_π and κ_w will govern different degrees of price and wage stickiness

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Paradox of flexibility

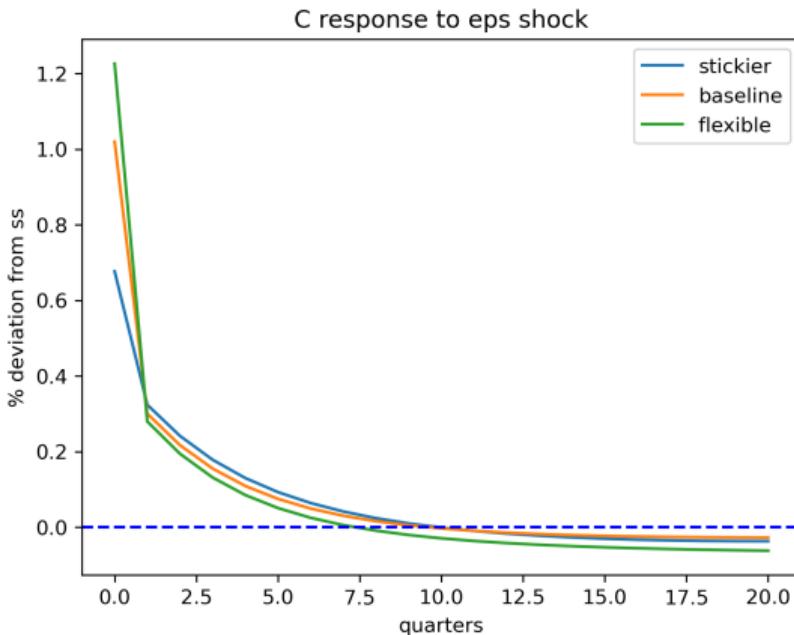
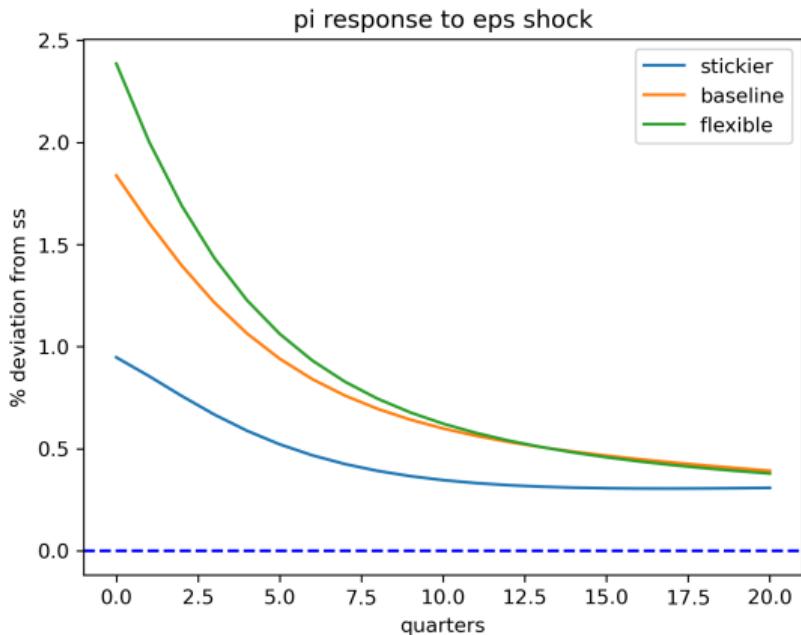


Figure 18: Monetary policy shock and the response of inflation and aggregate consumption in the model. Stickier: $\kappa_p = 0.05$, baseline: $\kappa_p = 0.10$, flexible: $\kappa_p = 0.15$.

- Competitive final good firm aggregates a continuum of intermediate goods with constant elasticity of substitution $\frac{\mu}{1-\mu} > 1$
- Intermediate goods are produced by monopolistically competitive firms with production function $y_{jt} = Z_t n_{jt}$ which employ a representative workforce
- Each firm sets prices p_{jt} subject to quadratic adjustment costs
$$\phi_t(p_{jt}, p_{jt-1}) = \frac{\mu}{\mu-1} \frac{1}{2\kappa} \log(1 + \pi_t)^2 Y_t$$

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Constructing nominal liabilities: fixed-rate mortgage balances

- Identify mortgage debits using the provider's transaction classifier; keep payments $> \$200$.
- Convert raw debits into **mortgage payment streams**:
 - bucket payments by size \rightarrow persistent runs (allow gaps ≤ 3 months)
 - strip escrow (default factor 0.92) and smooth (rolling median, 3 months)
 - flag large jumps ($> 50\%$) as refinancing/new stream; smaller “steps” as rate/refi events
- Classify **ARM vs FRM** using cadence of steps and sign consistency with 1Y CMT changes; treat the rest as FRM.
- Use piecewise-constant rates (Freddie Mac 30 yr for FRM, CMT-1Y + 2% for ARM), assume a benchmark maturity of 26 years and impute principal balance by inverting annuity formula.

[Details](#)

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Constructing nominal assets: liquid deposit balances

- Fintech data contain **interest income inflows** at the user level.
- For each user-year y , proxy liquid balances by **capitalizing** interest income:

$$NA_{i,y} \approx \frac{\text{InterestIncome}_{i,y}}{r_y^{\text{chk}}},$$

where r_y^{chk} is the average checking-account interest rate (FDIC).

- Interpretation/caveats:
 - Heavy right tail and measurement error can attenuate asset coefficients toward zero.

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Imputing principal balance outstanding (per mortgage stream)

Let A_t be the estimated P&I payment in month t , r_t the (loan-specific) monthly rate, and n_0 the term.

- Benchmark maturity: $n_0 = 312$ months (26 years); for left-censored streams set $n_0 = 156$.
- Rates:
 - FRM: piecewise-constant r_t pinned to Freddie Mac 30Y mortgage rate at origination/steps
 - ARM: piecewise-constant r_t pinned to CMT-1Y +2% at origination/steps

$$B_0 = \frac{A_0(1 - (1 + r_0)^{-n_0})}{r_0},$$

$$B_{t+1} = \max\{B_t(1 + r_t) - A_t, 0\}.$$

- If $A_t = 0$ for 3 consecutive months, set $B_t = 0$ (paid off).

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Design 2: Local projections (dynamics)

- Horizon- h spending change:

$$\Delta_h C_{i,t} \equiv C_{i,t+h} - C_{i,t}.$$

- Monthly inflation surprise: $\pi_t^s = \pi_t - \pi_t^e$ (expectations fixed at T_0).
- Two-way fixed effects: household FE γ_i and calendar-month FE τ_t .

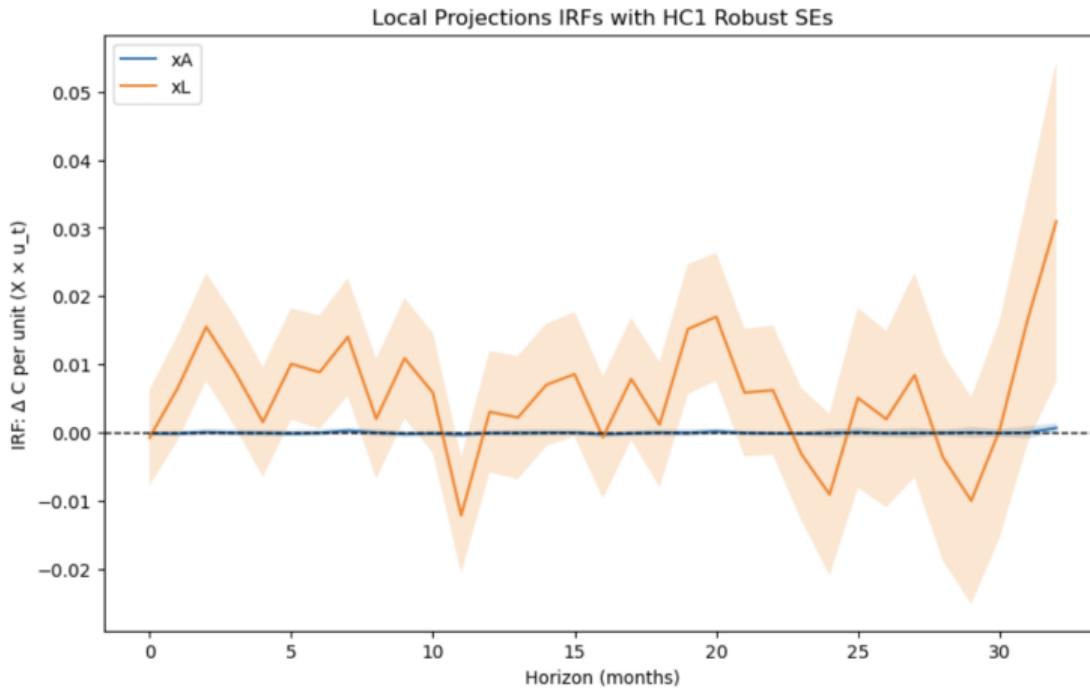
$$\Delta_h C_{i,t} = \alpha + \beta_{NNP}(h) (NNP_{i,T_0} \cdot \pi_t^s) + \gamma_i + \tau_t + \varepsilon_{i,t+h},$$

$$\Delta_h C_{i,t} = \alpha + \beta_L(h) (NL_{i,T_0} \cdot \pi_t^s) + \beta_A(h) (NA_{i,T_0} \cdot \pi_t^s) + \gamma_i + \tau_t + \varepsilon_{i,t+h}.$$

- Identification: cross-sectional exposure \times common inflation surprises.

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Local projections: spending response to inflation surprises



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Appendix (Empirics): robustness, diagnostics, placebo, counties

- **Fintech pre/post robustness:** shift baseline window T_0
- **Why $\hat{\beta}_{NNP} \approx 0$:** mapping from $(\hat{\beta}_L, \hat{\beta}_A)$ to implied $\hat{\beta}_{NNP}$
- **Placebo tests:** run the same design on pre-inflation windows (2018–2021)
- **County-level cross-check:** construction + regression + results

Pre/post robustness to baseline window T_0

PRE/POST SPENDING RESPONSE TO NET NOMINAL POSITION, BY BASELINE WINDOW T_0

	Jan–Mar	Feb–Apr	Mar–May
$\hat{\beta}_{NNP}$	-0.000 (0.000)	0.000** (0.000)	0.000* (0.000)
State FE	✓	✓	✓
Winsor (1%)	✓	✓	✓
N	85,976	85,976	85,976
R^2	0.000	0.000	0.000

Outcome: ΔC_i . Regressor: $(NNP_{i,T_0} \times \Pi_{\Delta T}^s)$. Columns vary T_0 within 2021; T_1 fixed in 2024. Robust SEs clustered by state; state FE; 1% winsor.

Pre/post robustness to baseline window T_0

PRE/POST SPENDING RESPONSE TO NOMINAL LIABILITIES AND ASSETS, BY BASELINE WINDOW T_0

	Jan–Mar	Feb–Apr	Mar–May
$\hat{\beta}_L$	0.005*** (0.001)	0.004*** (0.001)	0.003** (0.001)
$\hat{\beta}_A$	0.000 (0.000)	0.000** (0.000)	0.000** (0.000)
State FE	✓	✓	✓
Winsor (1%)	✓	✓	✓
N	85,976	85,976	85,976
R^2	0.001	0.001	0.000

Estimates of eq. (??). Outcome: ΔC_i . Regressors: $(NL_{i,T_0} \times \Pi_{\Delta T}^s)$ and $(NA_{i,T_0} \times \Pi_{\Delta T}^s)$. Columns vary T_0 within 2021; T_1 fixed in 2024. Robust SEs clustered by state; state FE; 1% winsor.

Why the NNP slope is attenuated (mapping diagnostic)

FROM LIABILITY AND ASSET SLOPES TO THE IMPLIED NET NOMINAL POSITION SLOPE

	Estimate (per log-pt)	s.e.
β_L/Π^s	0.0491	(0.0084)
β_A/Π^s	0.0000	(0.0001)
<i>Second moments (scaled by $(\Pi^s)^2$; units \$²)</i>		
Var(A)	3.29×10^{11}	
Var(L)	2.32×10^8	
Cov(A, L)	-2.84×10^7	
(A, L)	-0.003	
Var($A - L$)	3.30×10^{11}	
$\hat{\beta}_{NNP}^{LA \Rightarrow NNP}/\Pi^s$	-0.0000	(0.0001)
Direct $\hat{\beta}_{NNP}/\Pi^s$	-0.0000	(0.0001)

Notes: $N = 85,976$; state FE; winsor 1%; $\Pi^s = 0.098$ log-pt.

Numerator shares: $b_A[\text{Var}(A) - \text{Cov}] = -122\%$; $b_L[\text{Cov} - \text{Var}(L)] = +222\%$.

Placebo (pre-inflation baseline $T_0 = \text{Jan–Mar 2018}$; vary T_1)

PLACEBO: NNP SPECIFICATION

T_1	2019	2020	2021
$\hat{\beta}_{NNP}$	-0.000*** (0.000)	-0.000*** (0.000)	0.000 (0.000)
N	85,976	85,976	85,976
R^2	0.000	0.000	0.000

PLACEBO: (L, A) SPECIFICATION

T_1	2019	2020	2021
$\hat{\beta}_L$	0.000 (0.000)	0.001 (0.001)	0.001 (0.001)
$\hat{\beta}_A$	-0.000*** (0.000)	-0.000*** (0.000)	0.000 (0.000)
N	85,976	85,976	85,976
R^2	0.000	0.000	0.000

Notes: same pre/post design but entirely pre-inflation; robust SEs clustered by state; 1% winsor; no additional controls beyond the intercept.

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Placebo (pre-inflation baseline within 2018; late window T_1 matched in 2024)

PLACEBO: NNP SPECIFICATION

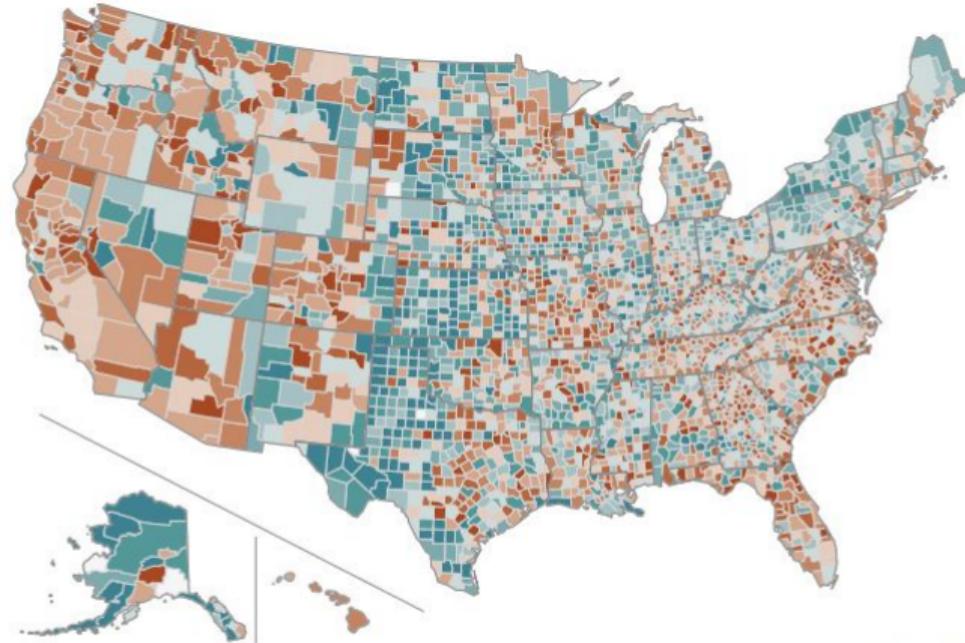
T_0	Jan–Mar	Feb–Apr	Mar–May
$\hat{\beta}_{NNP}$	-0.000*** (0.000)	0.000 (0.000)	-0.000 (0.000)
N	85,976	85,976	85,976
R^2	0.000	0.000	0.000

PLACEBO: (L, A) SPECIFICATION

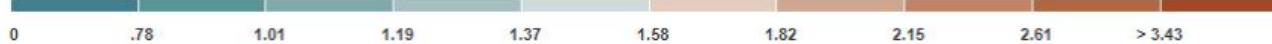
T_0	Jan–Mar	Feb–Apr	Mar–May
$\hat{\beta}_L$	0.001 (0.001)	-0.001 (0.001)	-0.003*** (0.001)
$\hat{\beta}_A$	-0.000*** (0.000)	0.000 (0.000)	-0.000 (0.000)
N	85,976	85,976	85,976
R^2	0.000	0.000	0.000

Notes: baseline windows are pre-inflation (2018). Robust SEs clustered by state; 1% winsor; no additional controls beyond the intercept.

Large variation in debt-to-income (DTI) ratios at the county level - 2021



Source: FRBNY Consumer Credit Panel/Equifax,



Constructing relevant measures at the county level (j)

- For nominal liabilities, use county debt-to-income ratio (DTI_j) from the NY FED
- For nominal assets, assign those proportionally on yearly interest income (I_j), scaled by county income Y_j (both from IRS SOI)

$$\frac{NNP_j}{Y_j} = \frac{I_j}{I} \times \frac{NA}{Y_j} - DTI_j \quad (11)$$

- For consumption C_j , use credit/debit card spending at the county level from Chetty et al. (2020)
[Data](#) [Comparison with BEA](#)

County-level regression

- Same identification strategy
- Regress county j spending growth from the start of inflation episode on its 2021Q1 NNP, normalized by county income

$$\Delta \log(C)_j = \alpha + \beta_1 \times \frac{\text{NNP}_j}{Y_j} + \boldsymbol{\beta_2} \times \mathbf{X}_j + \epsilon_j \quad (12)$$

- Weighting each county by population

Results (1)

NNP AND SPENDING GROWTH

	(1)	(2)	(3)	(4)
NNP/Y	-0.2866 (0.459)	-0.1018 (0.385)	0.1476 (0.295)	0.6640 (0.300)
State FE	✓	✓	✓	
Industry Comp.	✓	✓		
Employment	✓			
N	952	1607	1607	1607
R ²	0.447	0.394	0.371	0.007

Results (2)

SEPARATING NOMINAL ASSETS AND NOMINAL LIABILITIES

	(1)	(2)	(3)	(4)
NL/Y	0.7193 (0.691)	0.4640 (0.574)	0.0683 (0.351)	-0.1168 (0.678)
NA/Y	0.1300 (0.736)	0.277 (0.679)	0.4600 (0.795)	-1.2669 (0.525)
State FE	✓	✓	✓	
Industry Comp.	✓	✓		
Employment	✓			
N	952	1607	1607	1607
R ²	0.448	0.394	0.372	0.011

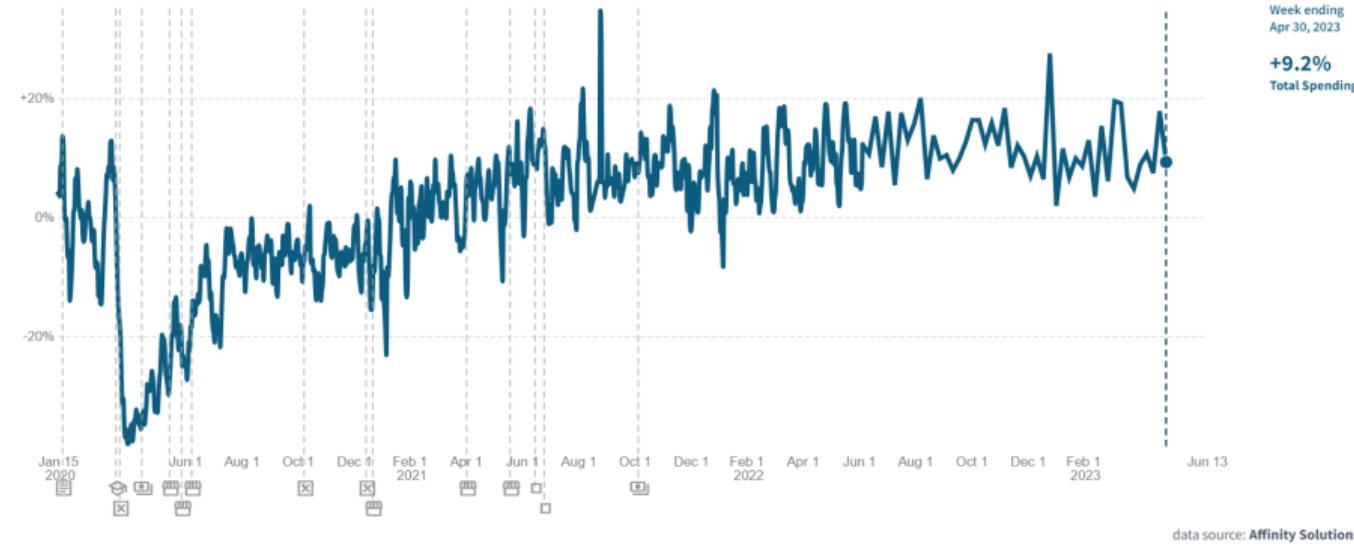
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Credit/debit card spending



Percent Change in All Consumer Spending*

In Dutchess, as of April 30 2023, total spending by all consumers increased by 9.2% compared to January 2020.



*Change in average consumer credit and debit card spending, indexed to January 4-31, 2020 and seasonally adjusted. The dashed segment of the line is provisional data, which may be subject to non-negligible revisions as newer data is posted. This series is based on data from Affinity Solutions.

last updated: May 10, 2023 next update expected: June 13, 2023

visit trackthereccovery.org to explore

Comparison with BEA

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Relatively good track of aggregate expenditures [\(Back\)](#)

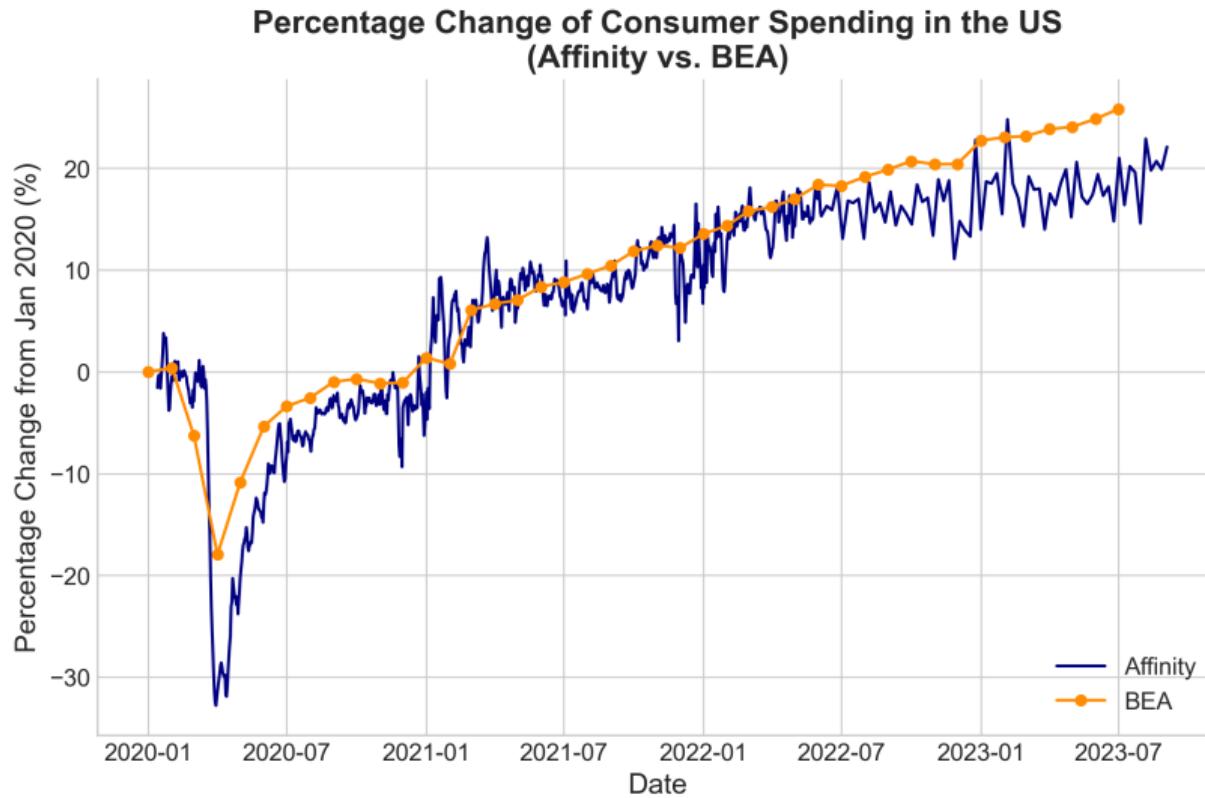


Figure 19: Total consumer spending in the US - Affinity versus BEA Personal Consumption Expenditures

US CPI YoY



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Covid-19 cases in the US

OPPORTUNITY INSIGHTS
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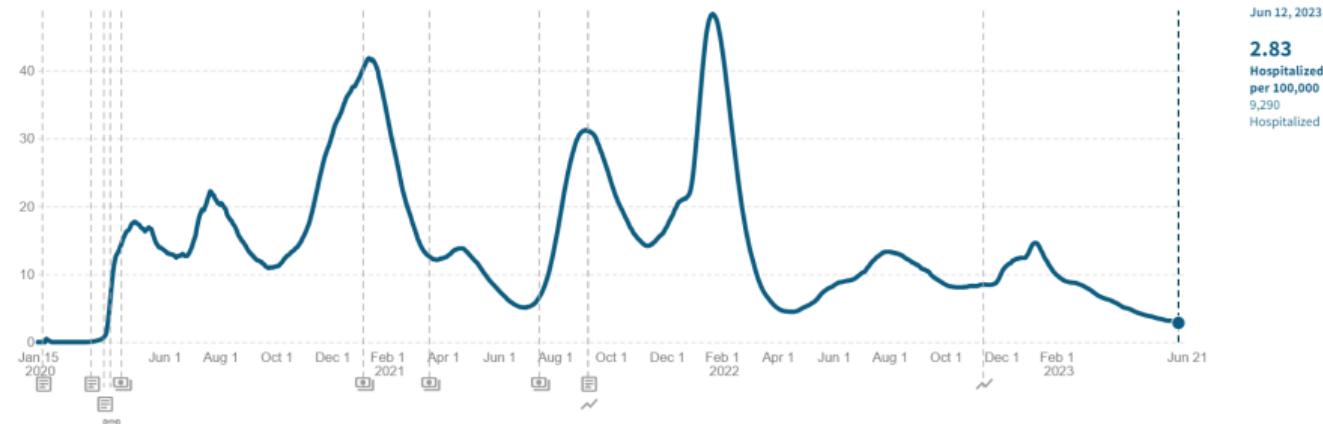
HARVARD
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GATES FOUNDATION

Weekly Reported COVID-19 Cases, Deaths, Tests, and Hospitalizations*

In the United States, on June 12, 2023, there were **2.83** newly reported patients currently hospitalized in an inpatient bed who have suspected or confirmed COVID-19 per 100,000 people



data sources: New York Times, Johns Hopkins Coronavirus Resource Center, Centers for Disease Control and Prevention (CDC), U.S. Department of Health & Human Services

*Confirmed COVID-19 cases and deaths as a 7-day rolling sum and confirmed COVID-19 tests and hospitalizations as a 7-day moving average. This series uses the data published by the New York Times, the Johns Hopkins Coronavirus Resource Center, the Centers for Disease Control and Prevention (CDC), and the U.S. Department of Health & Human Services. Negative numbers may appear if corrections to official statistics are made that, on net, reduce the daily count relative to new events.

last updated: June 14, 2023 next update expected: June 21, 2023

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Robustness - timing

- Results are robust to:
 - Measuring debt-to-income and asset-to-income ratios in 2019 (though not significant)
 - Measuring growth within the last 12 months (though magnitude smaller)
 - Controlling for cumulative Covid-19 cases at the beginning of the period (March 2021) and Covid-19 cases during the period
 - Measuring nominal debt per hh and nominal asset per hh (though not significant)

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