Essays in Macroeconomics

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

PhD Viva

Link to the latest version - Very preliminary, should be final on Saturday Dec 13th evening

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Introduction

- Inflation creates winners and losers through many channels - see paper 2 for the Euro-Area
  - Heterogeneity in consumption baskets, degree of wage stickiness ...
- Focus of paper 1 and 3: "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 addressed in this presentation:
  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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  3. How does accounting for the Fisher channel change our understanding of monetary policy in HANK?

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.

A: Strong and persistent tailwind to aggregate demand ($\approx$ 0.5% of US GDP in the model).

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: Unexpected inflation and wealth redistribution - Paper 3

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:

$$NNP_i = NA_i - NL_i \tag{1}$$

Net Nominal Positions (NNP) at the macro level

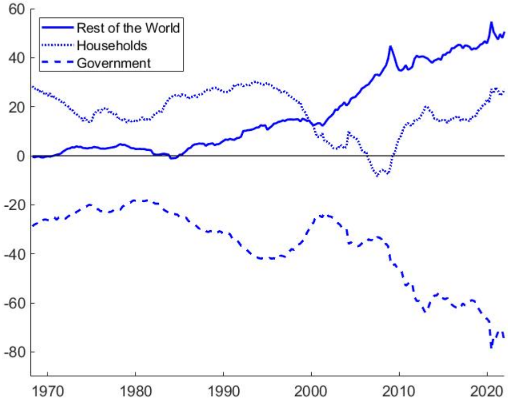

Figure 1: NNP as percentage of GDP for 1968-2021 for the three ultimate users of any claim in the US.

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Net Nominal Positions - within the US household sector

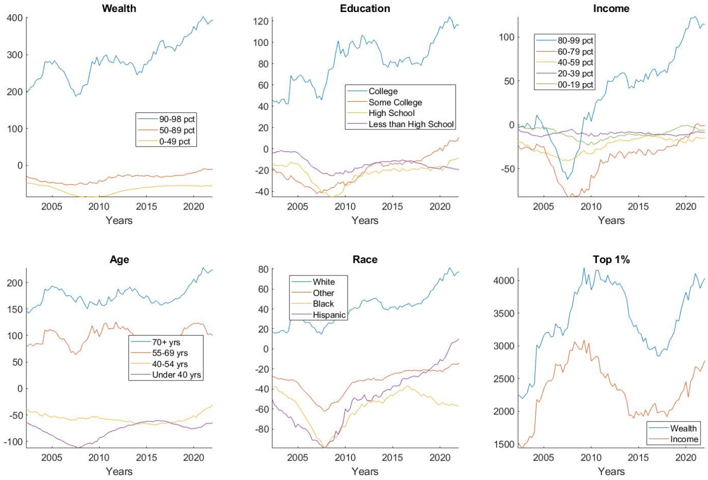

Figure 2: Average net nominal positions per hh, 2020 $ '000. Source: Distributional Financial Accounts

NNP @ macro level

Redistributive effects

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

1. Full anticipation:

$$w_t^p = \sum_{s=0}^{S} d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_s)} - \sum_{s=0}^{S} d_{t+s} e^{-i_t^{t+s}} \tag{2}$$

2. Full surprise:

$$w_t^p = \begin{cases} \sum_{s=0}^{S} d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_4)} - \sum_{s=0}^{S} d_{t+s} e^{-i_t^{t+s}} & \text{if } S \leqslant 4 \\ \sum_{s=0}^{S} d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_s)} - \sum_{s=0}^{S} d_{t+s} e^{-i_t^{t+s}} & \text{if } S > 4 \end{cases} \tag{3}$$

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Baseline

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

$$w_t^p = \begin{cases} \sum_{s=0}^{S} d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_2)} - \sum_{s=0}^{S} d_{t+s} e^{-i_t^{t+s}} & \text{if } S \leqslant 2 \\ \sum_{s=0}^{S} d_{t+s} e^{-(i_t^{t+s} + \hat{\Pi}_s)} - \sum_{s=0}^{S} d_{t+s} e^{-i_t^{t+s}} & \text{if } S > 2 \end{cases} \quad (4)$$

- 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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Average gain or loss for groups of households from the 2021-22 inflation shock

	Age cohort					
	$\leqslant 35$	36-45	46-55	56-65	66-75	>75
			A. Low income			
$ '000	1.5	6.1	3.1	0.35	-0.35	0.35
% Income	4	10	6	1	-1	1
			B. Middle class			
$ '000	13.6	19.5	11.8	0.35	-4.7	-6
% Income	10	10	5	0	-3	-6
			C. Rich			
$ '000	20.1	34	-66.1	-170.5	-220.7	-175.1
% 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 - Paper 1

One-account HANK model

- Households subject to idiosyncratic risk borrow and save facing a borrowing constraint
- Government issues debt held by households, set taxes to finance spending, monetary policy follows a standard Taylor rule
- Sticky wages, flexible prices that generates a New Keynesian Wage Phillips Curve
  - No profits and constant real wage - consistent with post-pandemic labor market (Autor et al. (2023))

Key deviation from 'canonical' HANK:

- Hhs save and borrow in a *long-term nominal* asset
  - At price Q_t gives the stream of nominal payments $1, \delta, \delta^2$...

Household problem

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

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

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

- No arbitrage:

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

Calibration matching distribution of NNPs and their covariance with MPC table

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)

The response of consumption to the wealth redistribution

- 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 (how the redistribution of wealth transmitted to consumption)
- Simulate a "unit of account" shock that devalues nominal positions as in the 2021-22 episode shock
- Look at the IRFs of C and π in response to the wealth redistribution generated by the "unit of account" shock
  - 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

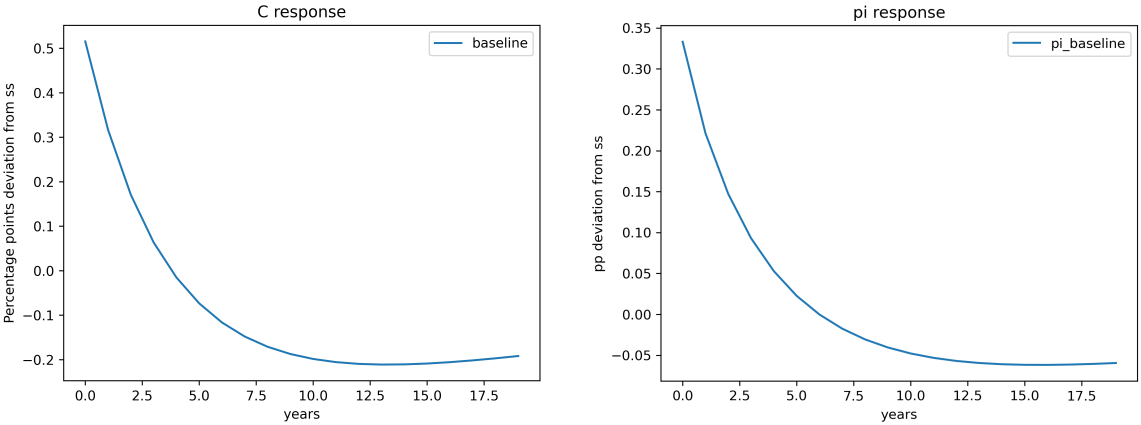

Figure 3: Impulse response functions (IRFs) of consumption and inflation to the wealth redistribution.

Decomposition of the effects on aggregate consumption

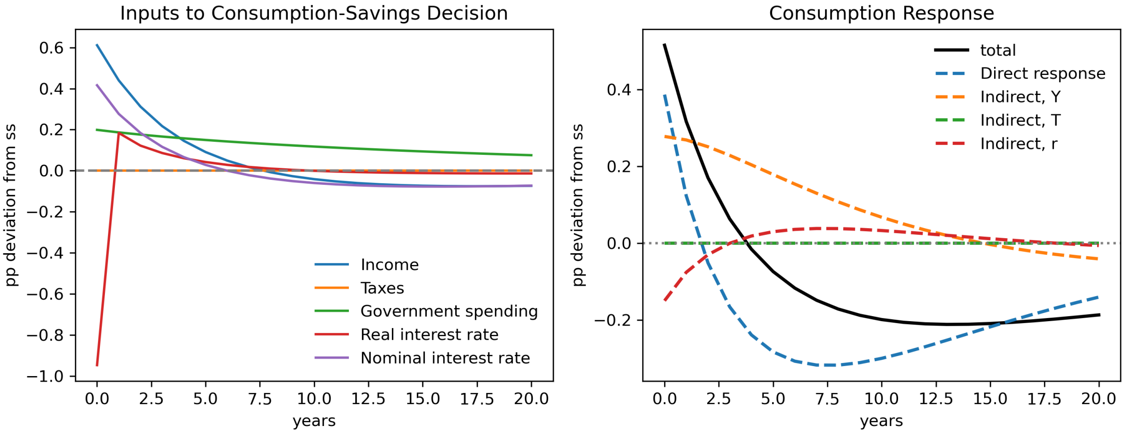

Figure 4: Decomposition of the effect on C in the shock itself, keynesian cross Y and policy reactions.

Extension with behaviourial friction

Cognitive discounting

- Schnorpfeil et al. (2023) show that households are often only partially aware of the Fisher channel

- Simulate the redistribution shock as a sequence of wealth taxes over time $\hat{\theta}_{\pi t}$ where

$$\hat{\theta}_{\pi t} = \frac{\theta_\pi}{d}$$

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

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

$$E_t^{BR}[\hat{\theta}_{\pi t+1}] = \hat{\theta}_{\pi ss} + \tilde{m} E_t[\hat{\theta}_{\pi t+1}]$$

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

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Smaller initial response, but more persistent tailwind to aggregate demand

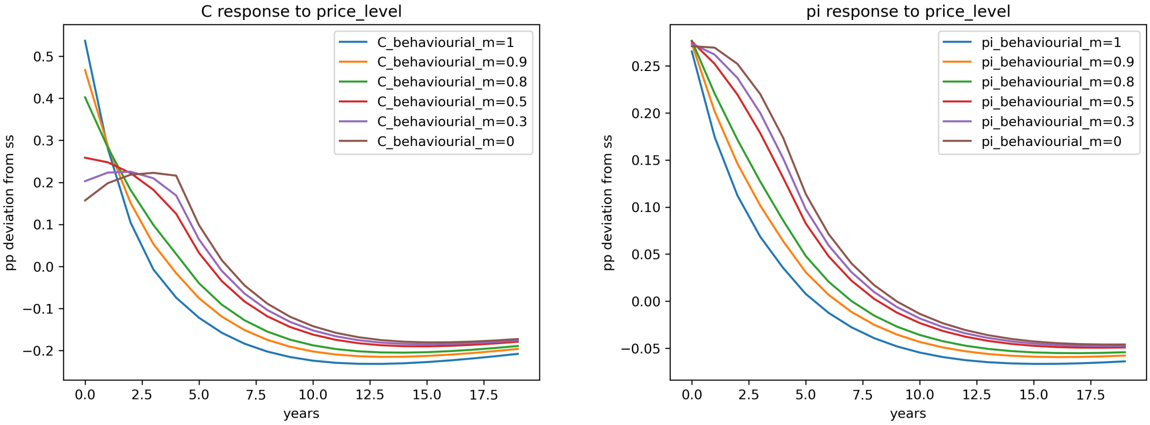


Figure 5: Impulse response functions (IRFs) of consumption and inflation to the wealth redistribution generated by the 2021-22 inflation shock varying the degree of cognitive discounting.

Empirical evidence: hh-level and county-level regressions

- **Prediction (Fisher channel):** after an inflation *surprise*, households with **more nominal debt** (more negative NNP) should raise consumption more; households with **more nominal assets** should raise consumption less (or cut).

- **Household evidence (fintech panel, 2014–2024):** construct baseline exposures (fixed-rate mortgage balances and liquid deposits) and relate them to spending changes during 2021–2024.
  - Two designs: **pre/post cross-section** and **local projections** (dynamics).

- **External validation:** county-level regressions à la Mian et al. (2013) using public spending data and county proxies for nominal assets/liabilities.

Empirical evidence: fintech data

- Data on 100 billions of US transactions for 45 millions unique US account owners
  - Typically an account owner is an household
- Information on all flows in and out of the account
  - Can identify whether the account holder is paying down a mortgage or not
- Restrict the sample to a cohort of users present in each month from 2014 to 2024
  - Also remove outliers, include transactions only in USD ..

Remarkable track of some US aggregates - US retail sales

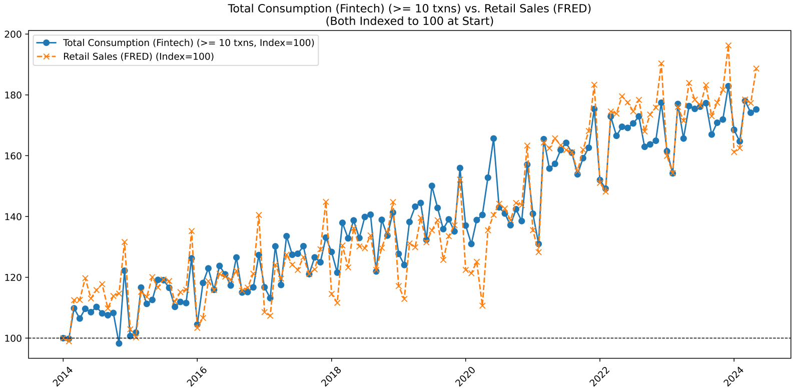


Figure 6: Comparison of our consumption measure in the fintech data with U.S. Retail Sales from January 2014 to May 2024. The fintech data are restricted to a sample of users who performed at least 9 relevant transaction per month during this period, resulting in a panel of 430,760 users. Both values are indexes starting at 100 in January 2014.

Income

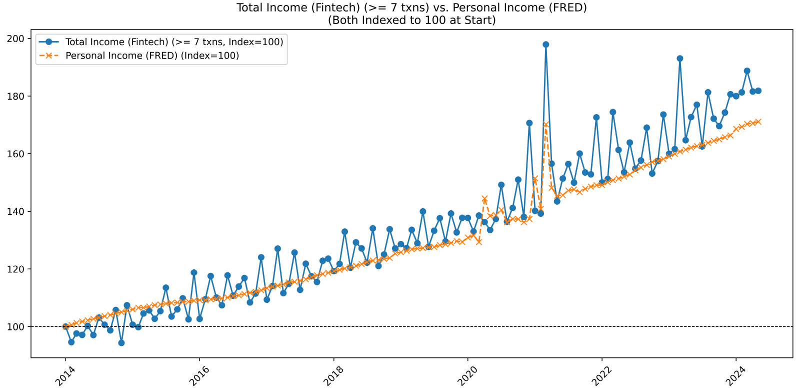


Figure 7: Comparison of total income inflows in the fintech data (not seasonally adjusted) with official U.S. Personal Income (BEA) (seasonally adjusted) from January 2014 to May 2024. The fintech data are restricted to a sample of users who performed at least at least 9 relevant transaction per month during this period, resulting in a panel of 430,760 users. Both values are indexes starting at 100 in January 2014.

Income distribution

	Fintech		SCF	
Income group	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

Total Income by percentile: Fintech vs. SCF, 2021 (USD 000)

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 (default \$400) $\rightarrow$ persistent runs (allow gaps $\leqslant 3$ 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 (baseline exposure for Fisher channel).

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

$$B_0 = \frac{A_0\left(1-(1+r_0)^{-n_0}\right)}{r_0},$$
$$B_{t+1} = \max\{B_t(1+r_t) - A_t,\ 0\}.$$

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

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.

Household net nominal position (NNP) proxy

- Baseline net nominal position at T_0:

$$NNP_{i,T_0} = NA_{i,T_0} - NL^{FRM}_{i,T_0},$$

where NL^{FRM}_{i,T_0} is the imputed **fixed-rate** mortgage principal balance.

- Focus on FRM to isolate the Fisher channel:
  - FRM nominal payments are contractually fixed (clean devaluation under inflation surprise)
  - ARMs adjust with rates over the episode (nominal payments move), complicating interpretation
- Other loans/assets exist in the raw data but are excluded due to noisier classification/stock imputation.

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

- Baseline window: T_0 = Jan–Mar 2021; late window: T_1 = Jan–Mar 2022/2023/2024.
- Outcome: average monthly spending change

$$\Delta C_i \equiv C_{i,T_1} - C_{i,T_0}.$$

- Cumulative **price-level surprise** between T_0 and T_1:

$$\Pi^s_{\Delta T} \equiv \sum_{t \in (T_0,T_1)} (\pi_t - \pi^e_t),$$

with expectations π^e_t from the Survey of Professional Forecasters as of T_0.

$$\Delta C_i = \alpha + \beta_{NNP} \left(NNP_{i,T_0} \cdot \Pi^s_{\Delta T}\right) + X'_{i,T_0}\theta + \varepsilon_i,$$
$$\Delta C_i = \alpha + \beta_L \left(NL_{i,T_0} \cdot \Pi^s_{\Delta T}\right) + \beta_A \left(NA_{i,T_0} \cdot \Pi^s_{\Delta T}\right) + X'_{i,T_0}\theta + \varepsilon_i.$$

- Controls: state fixed effects (measured at T_0); winsorize 1%; SEs clustered by state.

Main results (Pre/Post in levels)

- Regressions run on a random 20% of the balanced panel: $N = 85{,}976$.
- **Liabilities load strongly and robustly:** $\hat{\beta}_L \approx 0.004$–$0.005$ 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***	0.004***	0.005***
	(0.001)	(0.001)	(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 $(NA \times \Pi^s)$.

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

- Using $\hat{\beta}_L \simeq 0.004$ (units: \$ of ΔC per \$ of L per log-pt of surprise), cumulative surprise $\Pi^s \simeq 0.10$ between 2021Q1 and 2023Q1, and average FRM balance $\bar{L} \simeq \$210{,}000$:

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

- With $\approx 40\%$ mortgagors, this maps to $\sim \$52$bn/year, about $\approx 0.3\%$ of 2023 PCE.
- Persistence (similar/slightly larger in 2024) is qualitatively closer to the behavioral extension.

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.

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

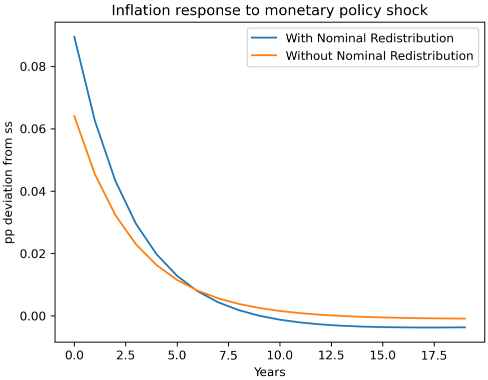
- Identification: cross-sectional exposure $\times$ common inflation surprises.

Part III: Implications for monetary/fiscal policy - Paper 1

Monetary policy when inflation redistributes wealth

- How does our understanding of monetary and fiscal policy change in a HANK model where inflation redistributes wealth as in the data?
- First, monetary policy is more powerful when the Fisher channel is taken into account:
  - Simulate a monetary policy shock with standard persistence shock
  - Compare the IRFs in the model where households have nominal assets to those where they have real assets.

A standard monetary policy shock with and without nominal redistribution

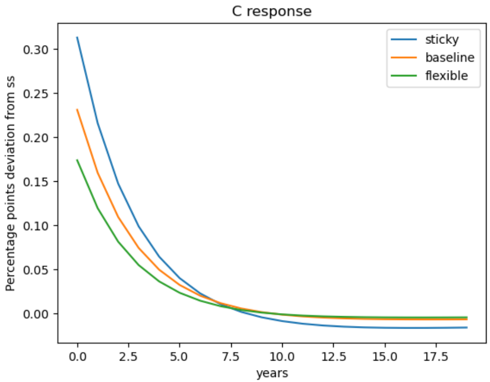


- Monetary policy is 50% more powerful when unexpected inflation redistribute wealth as in the data, and it also has larger effects on prices.

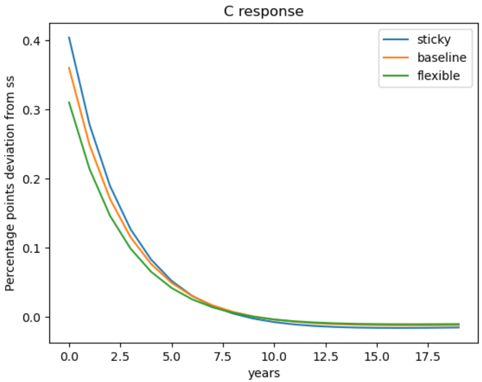
Monetary policy and nominal rigidities

- Second, decreasing the degrees of nominal rigidities generates now two competing effects:
  1. The real interest rate responds less to a monetary policy shock (conventional wisdom)
  2. There is more redistribution of wealth across households on impact (new)
- Quantitatively, the first channel dominates
  - Monetary policy is still more effective the higher the degree of nominal rigidities
- But the Fisher channel significanlty attenuates the role of nominal rigidity as a determinant of monetary policy effectivness

The Fisher channel, nominal rigidities and monetary policy effectiveness



Model without the Fisher Channel



Model with the Fisher Channel

- Smaller differences across degrees of nominal rigidities in the transmission to consumption.

Conclusions

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Q1 Sizable wealth redistribution generated by the 2021-22 inflation shock

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

Q2 In a HANK model with long-term nominal assets C and π increase despite MP tightening

- Consistent with the surprising resilience of the US economy in 2022-2023.
- Response of C supported by household-level and cross-county empirical evidence.

Q3 Fisher channel makes monetary policy more powerful and also less dependent on the degree of nominal rigidity in the economy

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Appendix I: Unexpected inflation and wealth redistribution

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):

$$DNP = NA - NL \tag{5}$$

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

$$NNP_i = DNP_i + \theta equity_i \tag{6}$$

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

Sectors

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

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		

Instruments

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

Measurement

Total nominal claims relative to US GDP

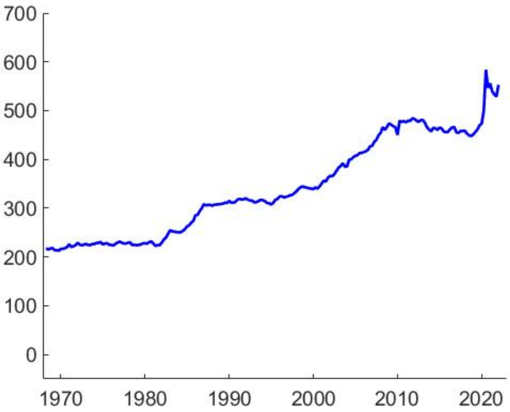


Figure 8: Market value of all outstanding nominal claims between different sectors of the US economy as a percentage of GDP, 1968-2021.

NNP as a % of GDP, detail

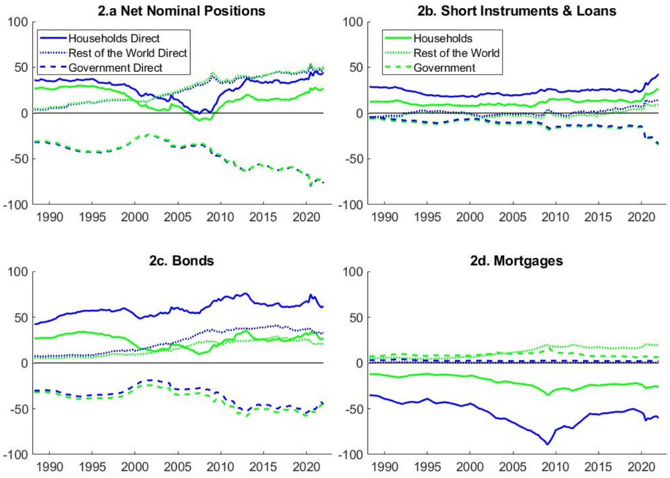


Figure 9: Net nominal positions as a percentage of US GDP, 1988-2022, by sector and class of instrument. Back

Doepke and Schneider (2006) replication with minor adjustments

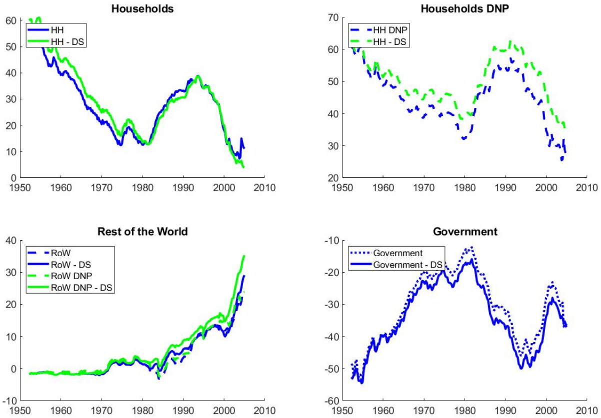


Figure 10: Net nominal positions by sector - my results (blue) versus DS (green). Minor differences are due to revision in FA data and slightly different treatment of sectors and instruments. Back

My results vs DS

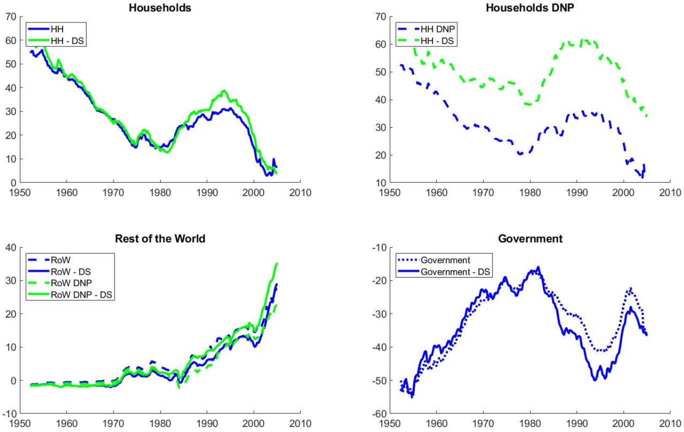


Figure 11: Net nominal positions by sector - my results (blue) versus DS (green). Differences now reflect also market value data reported by the FA and adjustment to SCF aggregates. Back

Duration of nominal positions

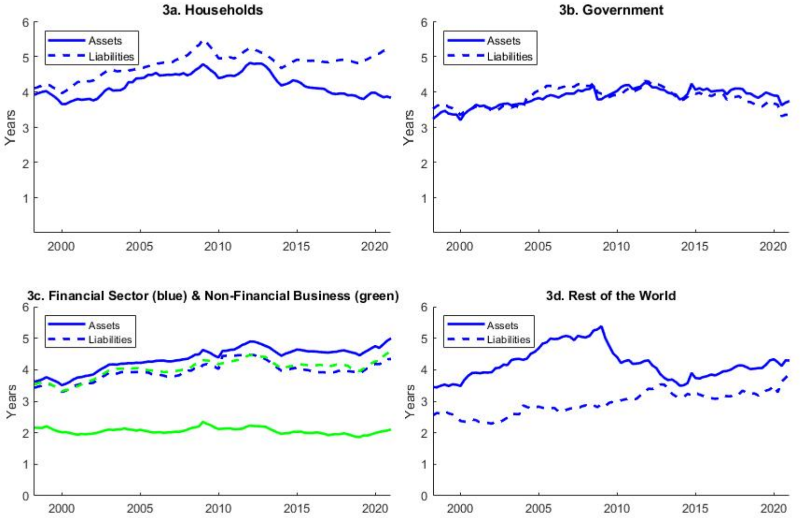


Figure 12: Duration in years of nominal positions for households (panel a), government (b), business (c) and the rest of the world (d). Back

Shock to inflation expectations in 2021

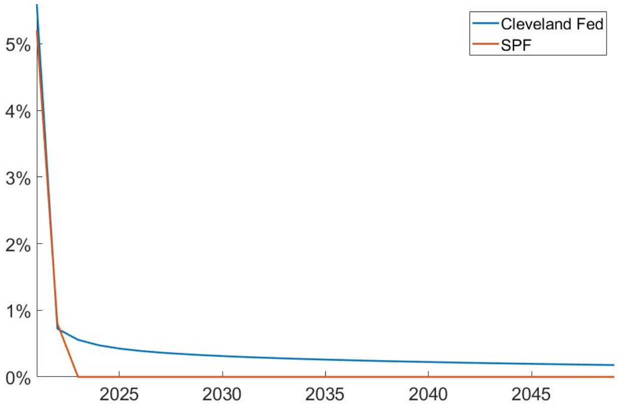


Figure 13: Revision in the term structure of inflation expectations between December 2021 and December 2020 according to the Cleveland Fed model (blue line) and to the Survey of Professional Forecasters (red line).

Back

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					
	$\leqslant 35$	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

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

Instrument	Age cohort					
	$\leqslant 35$	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

Nominal positions in bonds, market value

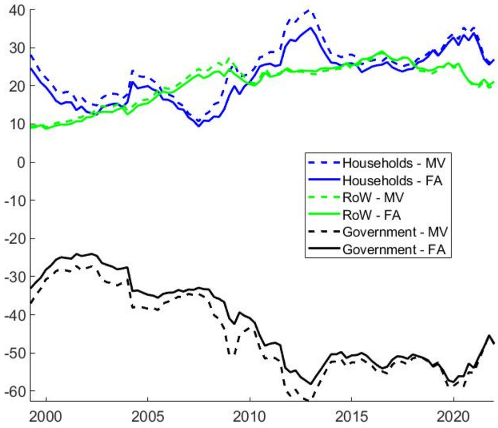


Figure 14: Nominal positions in bonds as a percentage of GDP for Households, Rest of the World, and Government. Dotted lines discount the stream of payments constructed above with the zero coupon yield curve, while solid lines use the market value reported by the Financial Accounts. Back

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

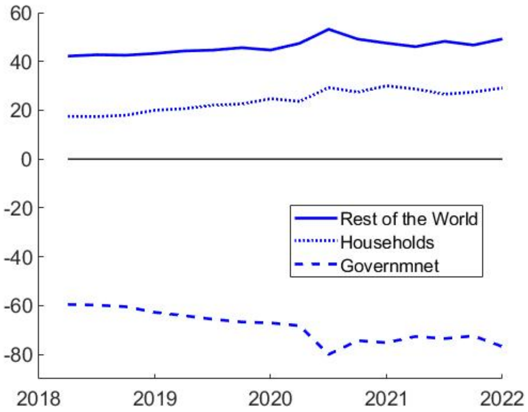


Figure 15: Evolution of net nominal positions relative to GDP for macro-sectors of the US economy, 2018-2021. Back

Evolution of nominal positions - 2021

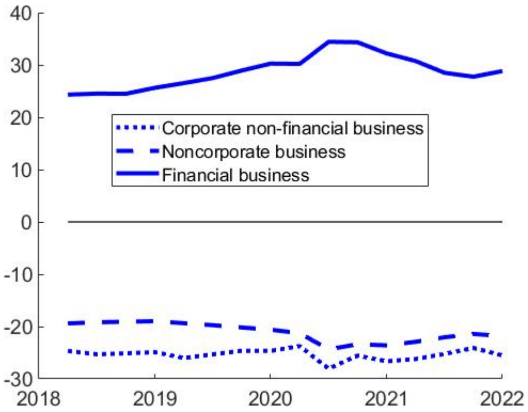


Figure 16: Evolution of net nominal positions relative to GDP for the business sector in the US economy, 2018-2021.

Evolution of nominal positions - 2021

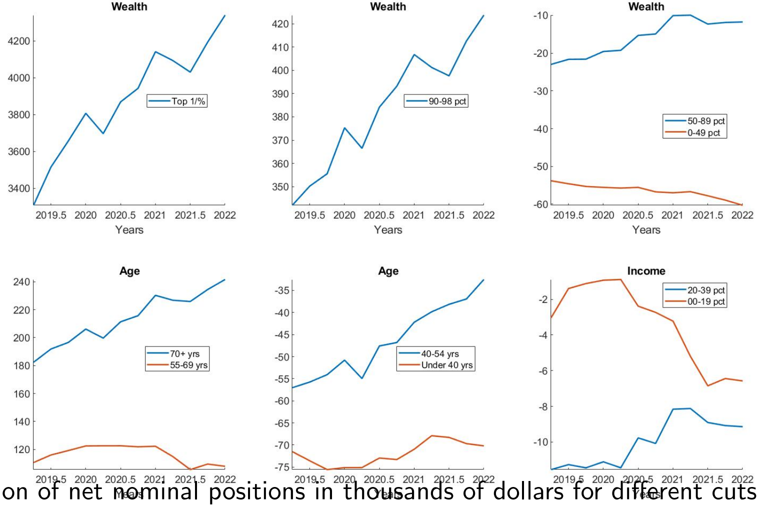


Figure 17: Evolution of net nominal positions in thousands of dollars for different cuts of the household sector according to the DFA - 2019-2021. Back

Average gain or loss for groups of households - mortgage holders

	Age cohort					
	$\leqslant 35$	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

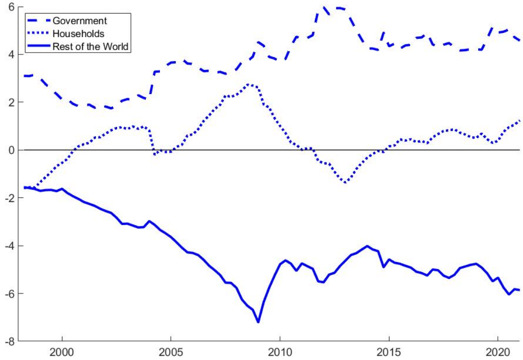
Present value gain or loss in thousands of dollars and as a percentage of household income from the 2021 surge in inflation expectations, measured by the Cleveland FED model. Gain or losses are conditional on having a mortgage for primary residence.

Percentage of mortgage holders in each cohort

	Age cohort					
	$\leqslant 35$	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 18: **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.

A credible announcment of AIT

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.

Back

Appendix II: The Fisher channel according to HANK

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 Phillipps Curve: Unions

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

- Representative firms produces output

$$Y_t = Z_t N_t$$

- With flexible prices:

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

Back

Closing the model

- Policy:

$$T_t + B_{t+1} = G_t + (1 + r_t)B_t$$
$$i_t = r_t^* + \phi\mathbb{E}\pi_{t+1} + \epsilon_t$$

- Market clearing:

$$Y_t = \int c_{it}di + G_t$$
$$B_t = \int Q_t\Lambda_{it}di$$

Back

Robustness

- Sensitive to the Taylor rule coefficient
  - For $\phi_\pi = 1$, indeterminancy
  - 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)

Back

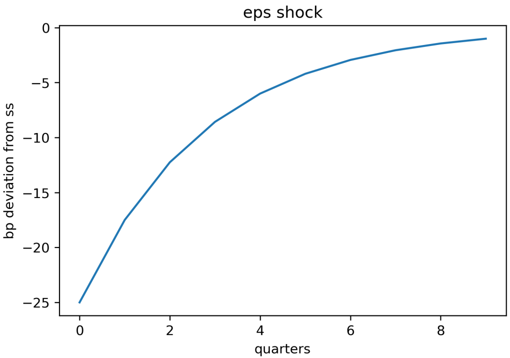
Further policy implications

- 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

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

- 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

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

'

- Back

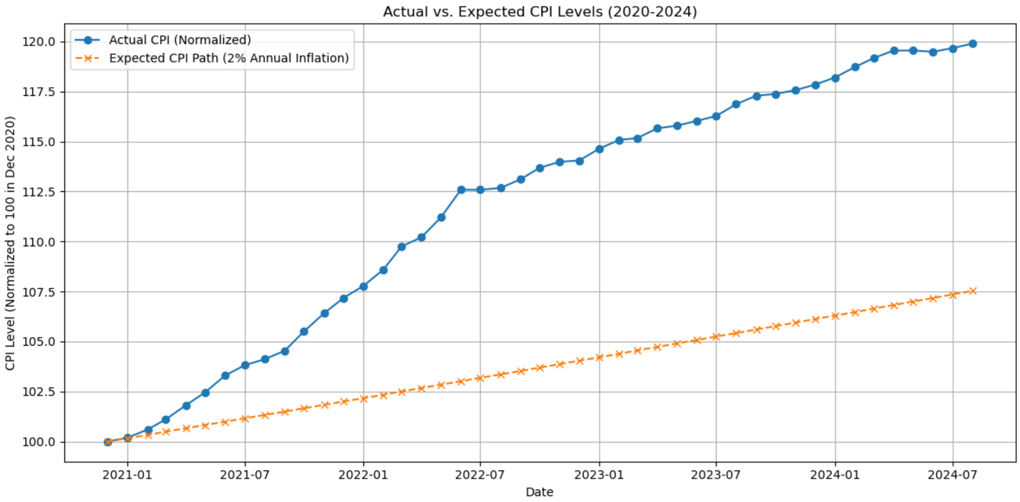
Calibration

Calibration parameters for the model.

Parameter	Description	Value	Parameter	Description	Value
σ	IES	0.5	κ_w	Slope of wage Phillips curve	0.1
υ	Frisch	0.5	μ_w	Wage markup	1.1
$\underline{a}$	Borrowing constraint	-1	ϕ	Taylor Rule coefficient	1.25
θ	Tax progressivity	0.18	B	B/Y	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	0.88	$r*$	Eq. real rate	0.05
δ	Bond decay	0.80	π_{ss}	Steady-state inflation	0

Back

Inflation shock



Back

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.

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

Response of households at different percentiles of the distribution

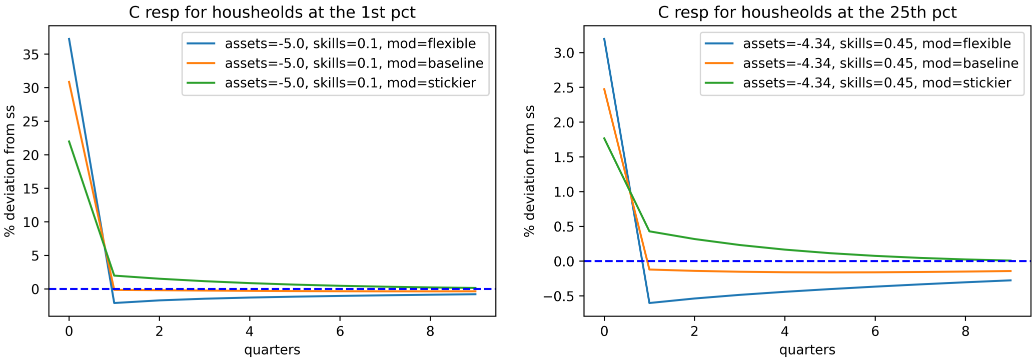


Figure 19: Response of households at different percentiles of the wealth and income distribution

- Debtors increase their consumption substantially Back

Response of households at different percentiles of the distribution

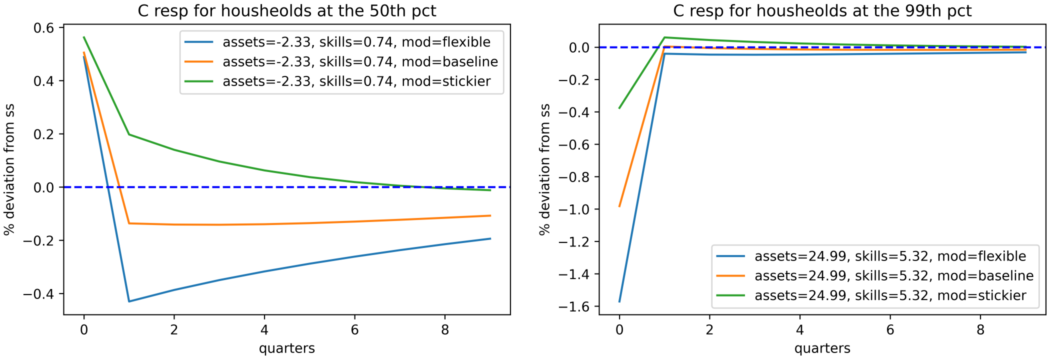


Figure 20: Response of households at different percentiles of the wealth and income distribution.

Back

A discount factor shock and its inflation response

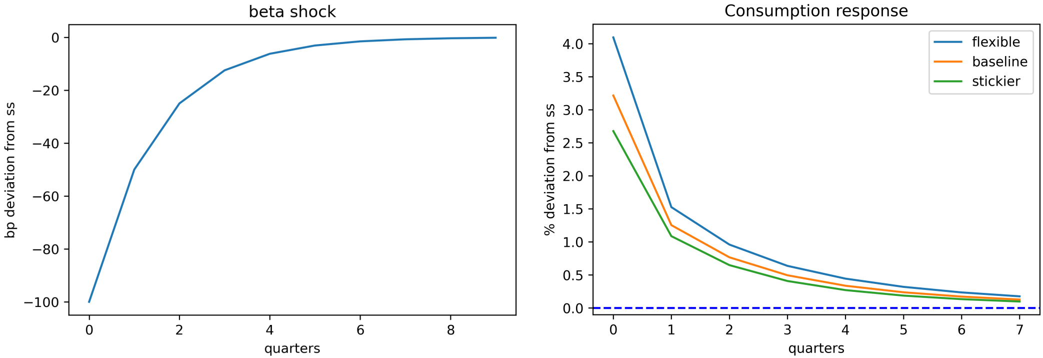


Figure 21: Discount factor shock and the response of consumption in the model. Flexible: $\kappa = 0.09$, baseline: $\kappa = 0.01$, stickier: $\kappa = 0.011$.

Back to discussion

A government spending shock and its inflation response

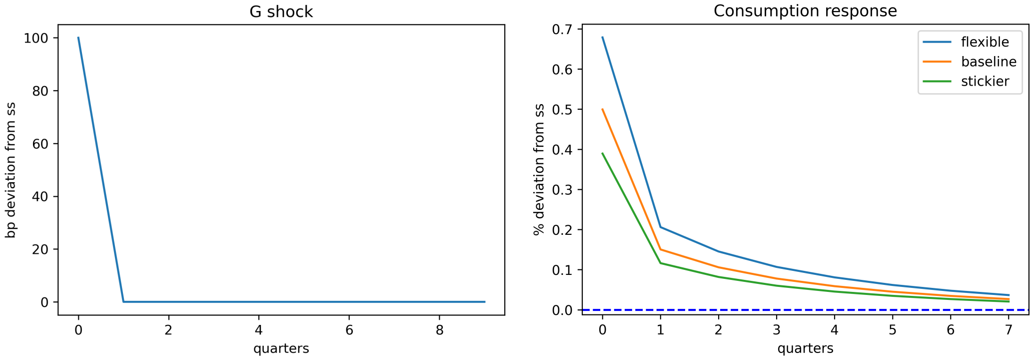


Figure 22: Government spending shock and the response of consumption in the model. Flexible: $\kappa = 0.09$, baseline: $\kappa = 0.01$, stickier: $\kappa = 0.011$.

Back to discussion

Quantitative model with two assets

- Household problem

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

$$c + a + Q_t\Lambda = z_t(e) + (1+r_t^a)a_- + (1+\delta Q_t)\Lambda_- - \Psi(a,a_-) \tag{7}$$

$$a \geqslant \underline{a}, \quad Q_t\Lambda \geqslant \underline{b}P_t, \tag{8}$$

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

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

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

Back

Production

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

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

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

Back

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:

$$\log(1+\pi_t) = \kappa_\pi \left(\frac{w_t}{Z_t} - \frac{1}{\mu} \right) + \frac{1}{1+r_{t+1}} \frac{Y_{t+1}}{Y_t} \log(1+\pi_{t+1}) \tag{9}$$

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

Back

Paradox of flexibility

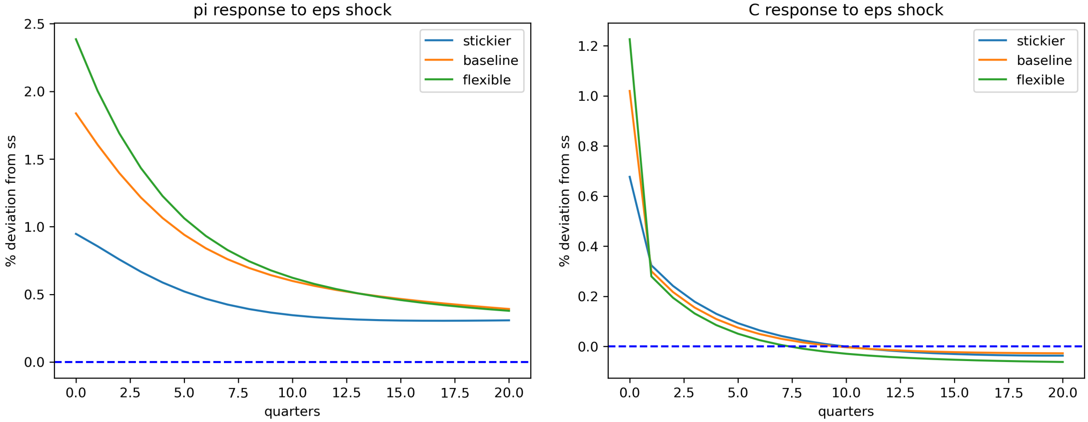


Figure 23: Monetary policy shock and the response of inflation and aggregate consumption in the model. Stickier: $\kappa_p = 0.05$, baseline: $\kappa_p = 0.10$, flexible: $\kappa_p = 0.15$.

Back

Firms

- 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 $\phi_t(p_{jt}, p_{jt-1}) = \frac{\mu}{\mu-1}\frac{1}{2\kappa}\log(1+\pi_t)^2 Y_t$
- Back

Appendix III: Empirical evidence

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

- **Fintech pre/post robustness:** shift baseline window T_0 (eqs. (**??**), (**??**))
- **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 (Appendix C)

Pre/post robustness to baseline window T_0 (NNP, eq. (??))

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

Estimates of eq. (**??**). Outcome: ΔC_i. Regressor: $(NNP_{i,T_0} \times \Pi^s_{\Delta T})$. 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 (L/A, eq. (??))

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***	0.004***	0.003**
	(0.001)	(0.001)	(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: $(NL_{i,T_0} \times \Pi^s_{\Delta T})$ and $(NA_{i,T_0} \times \Pi^s_{\Delta T})$. 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)
Second moments (scaled by $(\Pi^s)^2$*; units* $\$^2$		
$\mathrm{Var}(A)$	3.29×10^{11}	
$\mathrm{Var}(L)$	2.32×10^{8}	
$\mathrm{Cov}(A, L)$	-2.84×10^{7}	
(A, L)	-0.003	
$\mathrm{Var}(A - L)$	3.30×10^{11}	
$\hat{\beta}^{LA \Rightarrow NNP}_{NNP}/\Pi^s$	-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: $b_A[\mathrm{Var}(A) - \mathrm{Cov}] = -122\%$; $b_L[\mathrm{Cov} - \mathrm{Var}(L)] = +222\%$.

Diagnostic mapping from $(\hat{\beta}_L, \hat{\beta}_A)$ in eq. (**??**) to the implied $\hat{\beta}_{NNP}$ in eq. (**??**) on the same sample.

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

Placebo: NNP specification (eq. (**??**))

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 (eq. (**??**))

T_1	2019	2020	2021
$\hat{\beta}_L$	0.000	0.001	0.001
	(0.000)	(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.

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

PLACEBO: NNP SPECIFICATION (EQ. (??))

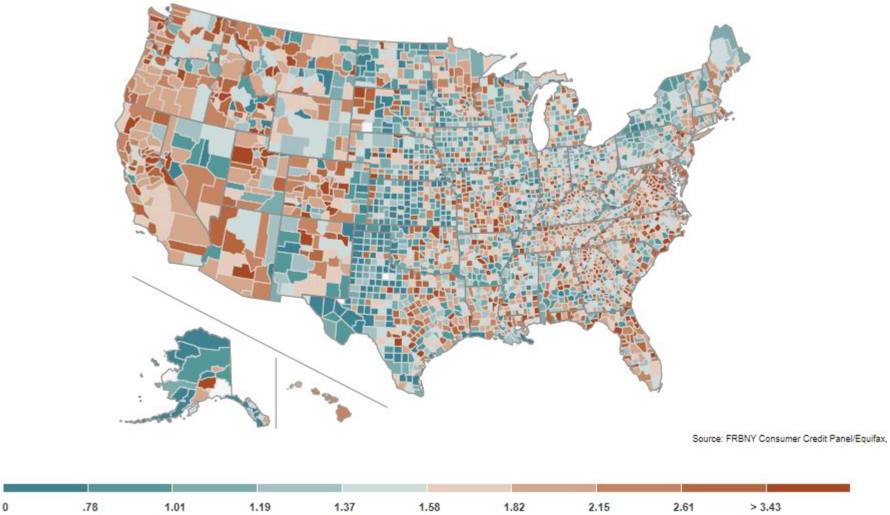
T_0	Jan–Mar	Feb–Apr	Mar–May
$\hat{\beta}_{NNP}$	-0.000***	0.000	-0.000
	(0.000)	(0.000)	(0.000)
N	85,976	85,976	85,976
R^2	0.000	0.000	0.000

PLACEBO: (L, A) SPECIFICATION (EQ. (??))

T_0	Jan–Mar	Feb–Apr	Mar–May
$\hat{\beta}_L$	0.001	-0.001	-0.003***
	(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: 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



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)

$$\frac{NNP_j}{Y_j} = \frac{I_j}{I} \times \frac{NA}{Y_j} - DTI_j \tag{10}$$

- 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

$$\Delta \log(C)_j = \alpha + \beta_1 \times \frac{\text{NNP}_j}{Y_j} + \boldsymbol{\beta_2} \times \mathbf{X}_j + \epsilon_j \tag{11}$$

- 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

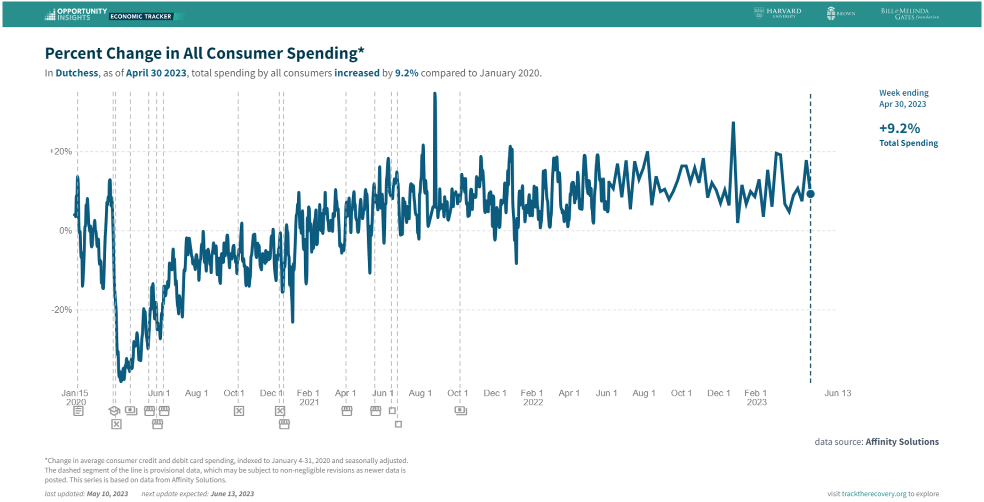
Results (2)

Separating nominal assets and nominal liabilities

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

Back to fintech results back

Credit/debit card spending



Comparison with BEA   Back

Relatively good track of aggregate expenditures (Back)

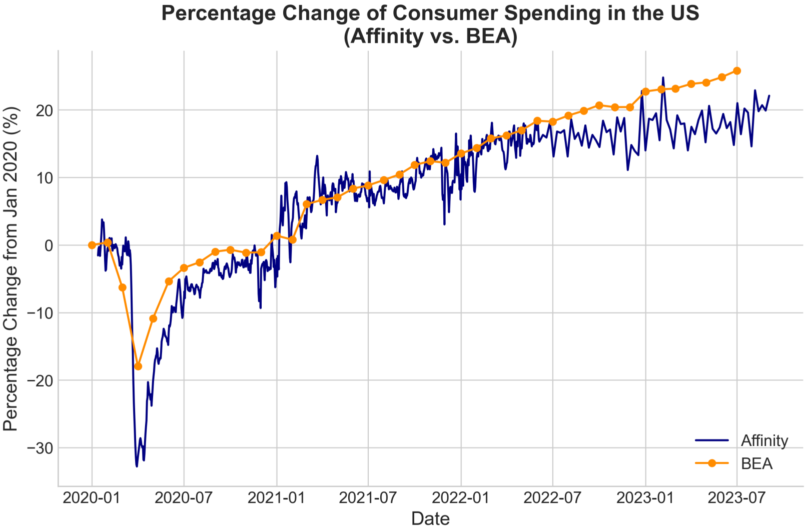
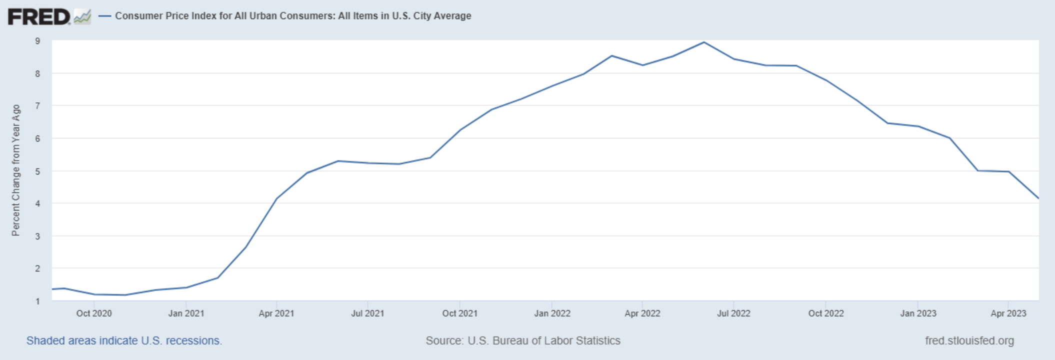


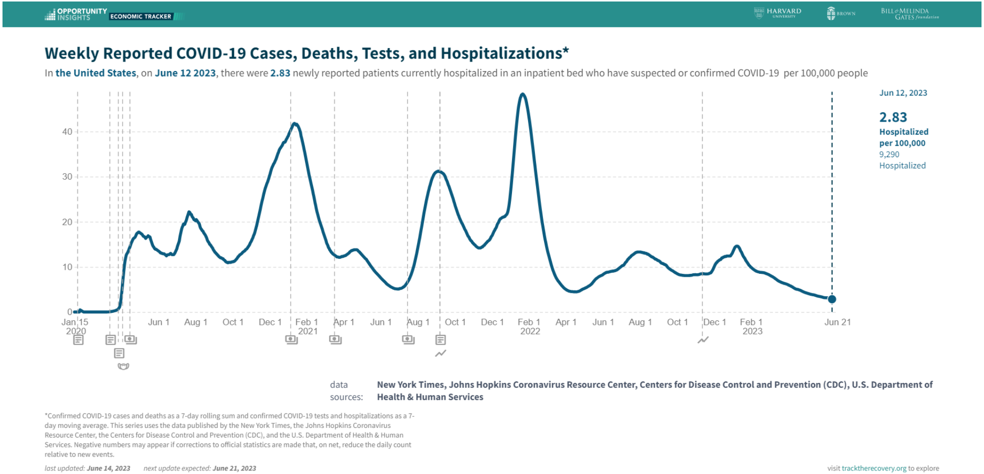
Figure 24: Total consumer spending in the US - Affinity versus BEA Personal Consumption Expenditures

US CPI YoY



Back

Covid-19 cases in the US



Back

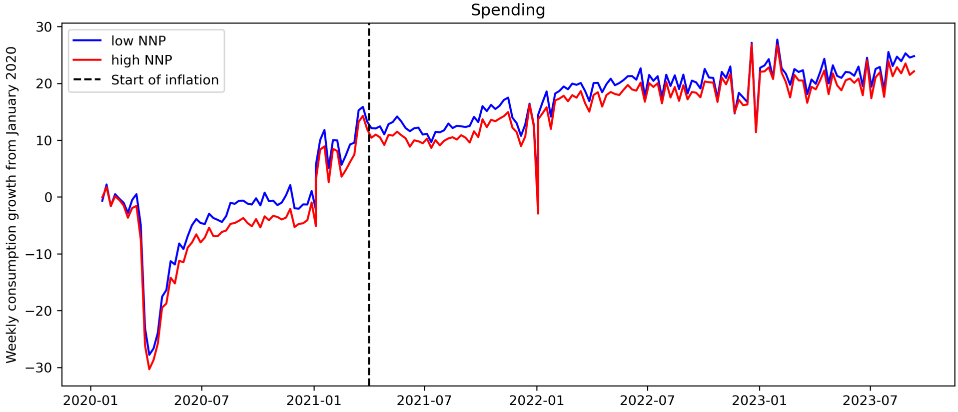
Robustness - timing

- 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)

back

Diff-in-diff design

- Look at counties' consumption growth for the top and bottom NNP quintiles.



- Without controls, low NNP counties seem to have been growing more (in contrast with the theory). Back