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 (some details may still change on Monday December 16th)

December 15, 2025

Overview of my PhD dissertation

1. "*Who Bears the Costs of Inflation? Euro Area Households and the 2021-2023 Inflation Shock*" jointly with Gonzalo Paz-Pardo, Jirka Slacalek, Oreste Tristani, Gianluca Violante
   - Comprehensive evaluation of the heterogeneous welfare costs across households. Core finding: inflation resembled an age-dependent tax, with the retirees losing but roughly half of the young winning, essentially thanks to the devaluation of their nominal debt (Fisher channel).
2. *"Winners and Losers from Unexpected Inflation"*
   - Quantifies the Fisher channel in the 2021 inflation shock in the US. Core finding: losses concentrated among rich middle-aged/elderly, gains for the rest, especially the middle-class.
3. *"The Fisher Channel According to HANK: Unexpected Inflation and the Missing Recession"*
   - Takes this wealth redistribution between low MPC creditors and high MPC debtors in a HANK model and in U.S. administrative data ($\approx$ 500,00 households) to test its implications for consumption. Core finding: wealth redistribution generated a strong and persistent tailwind to aggregate demand ($\approx$ 0.3-0.5% of US consumption).

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Q1: Heterogeneous welfare costs of inflation in the Euro Area - "*Who Bears the Costs of Inflation? Euro Area Households and the 2021-2023 Inflation Shock*"

What are the distributional effects of the recent inflation shock?

- Large shock in euro area in 2021–23: 18% cumulative price increase
- Key drivers: energy and food prices Data
- Public debate: contrasting arguments
  - Poorer and younger households spend more on energy and food
  - But wealthier and older households own more nominal wealth
- Our contribution:
  1. Conceptual: Simple framework that illustrates various channels of inflation shocks
  2. Empirical: Quantify size of various channels across households in four EA countries

Households

- Overlapping generations living for two periods $t = 0, 1$ (short-run & long-run)
- No uncertainty (aggregate or idiosyncratic), and no binding liquidity constraints
- Problem of individual i belonging to the cohort born at $t = 0$:

$$
\begin{aligned}
V_i &= \max_{c_{it}, a_{i,kt+1}, B_{St+1}, B_{Lt+1}} u_i(c_{i0}) + \beta_i u_i(c_{i1}) \\
&s.t. \\
c_{it} P_{it} &= W_{it} - T_{it} + B_{i,St} + (1 + Q_{Lt}\delta) B_{i,Lt} + \sum_k (Q_{kt} + D_{kt})\, a_{i,kt} \\
&\quad - Q_{St} B_{i,St+1} - Q_{Lt} B_{i,Lt+1} - \sum_k Q_{kt} a_{i,kt+1}.
\end{aligned}
$$

W nominal wages, T nominal gov't taxes net of transfers, B_S short-term bonds, B_L long-term bonds, a_k real assets, $Q_\cdot$ asset/bond prices, D_k dividends, δ coupon decay rate

- $P_{it} = P^*_{it}(1 - \mathcal{T}_{it})$, effective prices = raw (counterfactual) prices – government subsidy

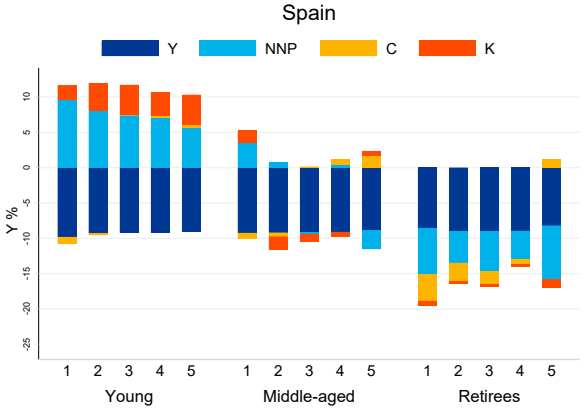
Money metric welfare

- Object of interest: impact of inflation shock dz_0 on welfare of each household
- Invoke the **envelope theorem** (dz_0 'small'), and ignore changes in choice variables
- Money metric welfare change:

$$dW_i = \frac{dV_i / u_i'\left(c_{i0}\right)}{dz_0} P_{i0}$$

'How much EUR would you be willing to give up to avoid the inflation shock?'

1. Breakdown of direct component: Spain

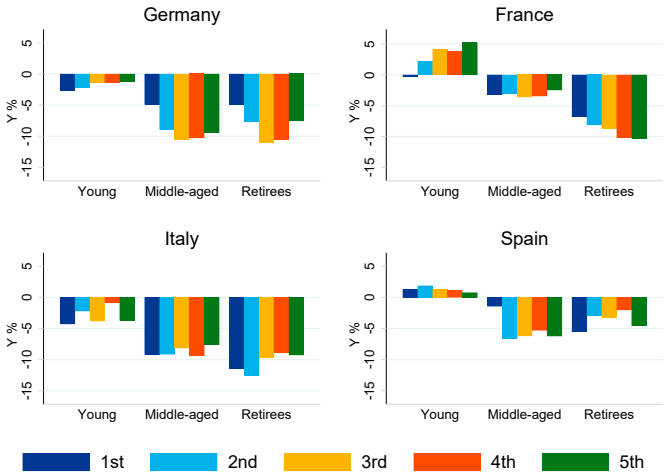


- **Net income:** loss of 9%, even across groups
- **Net nominal positions:** positive impact for the young, negative for the retirees
- π **differences:** in general, quite small
- **K gains:** gains for young (net asset buyers) Welfare only affected when trading

Overall:

Old lose 15%, young break even or gain slightly

Total welfare change



Average total effect (% of income):

- DE: –7.0%
- FR: –2.5%
- IT: –9.0%
- ES: –3.5%

Q2: Unexpected inflation and wealth redistribution - *"Winners and Losers from Unexpected Inflation"*

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

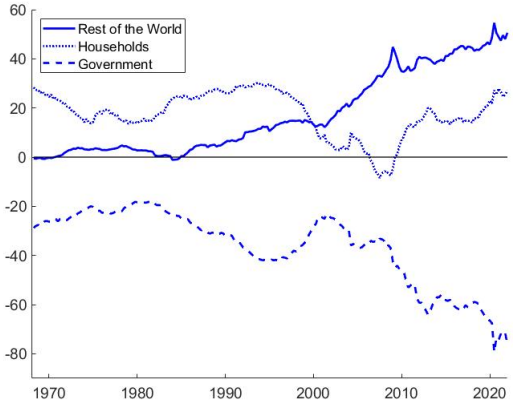


Figure 1: NNP as percentage of GDP for 1968-2021 for the three ultimate users of any claim in the US.

DS Details Back

Net Nominal Positions - within the US household sector

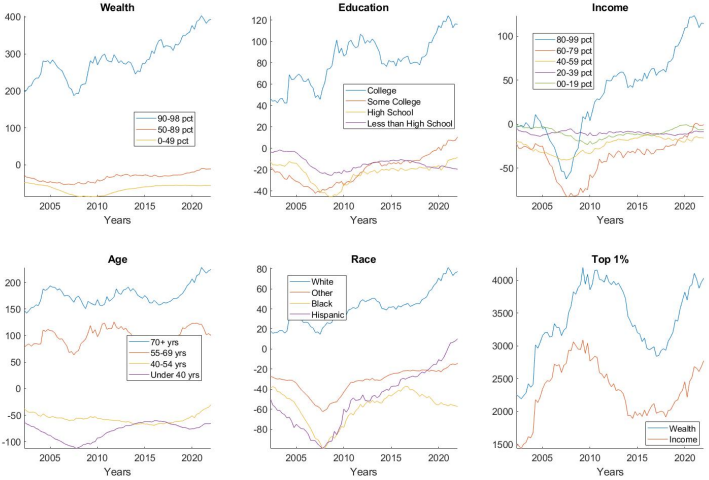


Figure 2: Average net nominal positions per hh, 2020 $ '000. Source: Distributional Financial Accounts

NNP @ macro level

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

	Age cohort					
	$\leqslant 35$	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

Q3: Transmission to consumption - *"The Fisher Channel According to HANK: Unexpected Inflation and the Missing Recession"*

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

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

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

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

- No arbitrage:

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

Supply side | Policy and Market Clearing | Extension with behaviourial friction

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

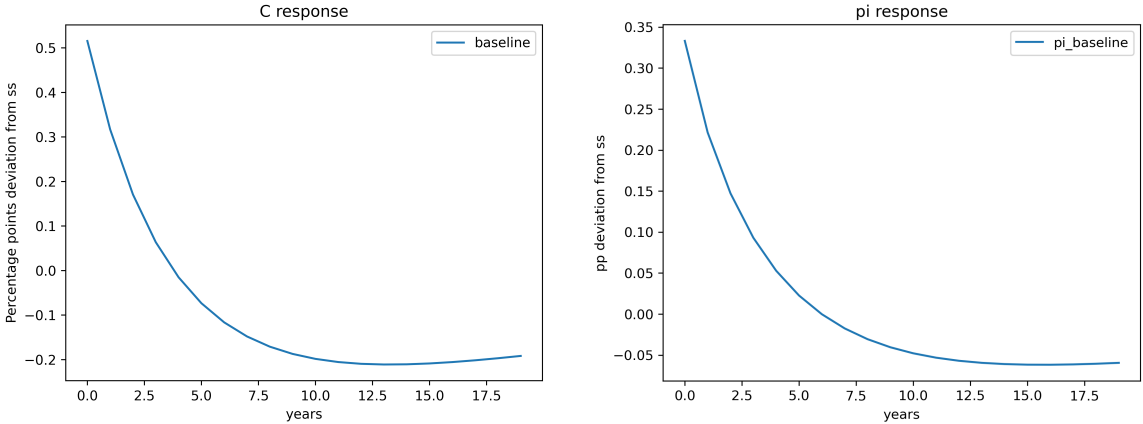


Figure 3: Impulse response functions (IRFs) of consumption and inflation to the wealth redistribution.

Decomposition of the effects on aggregate consumption

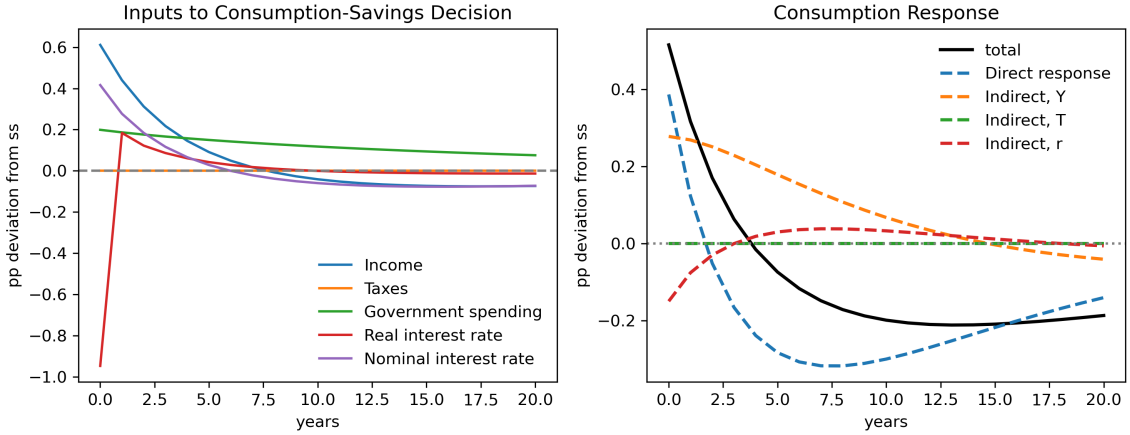


Figure 4: Decomposition of the effect on C in the shock itself, keynesian cross Y and policy reactions.

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

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

  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

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

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

Smaller initial response, but more persistent tailwind to aggregate demand

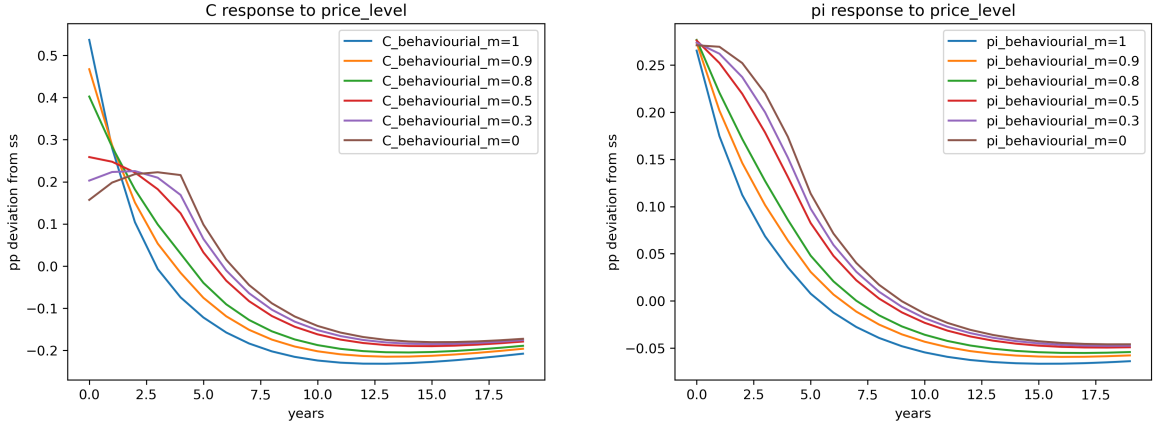


Figure 5: Impulse response functions (IRFs) of consumption and inflation to the wealth redistribution generated by the 2021-22 inflation shock varying the degree of cognitive discounting.

Empirical evidence: 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

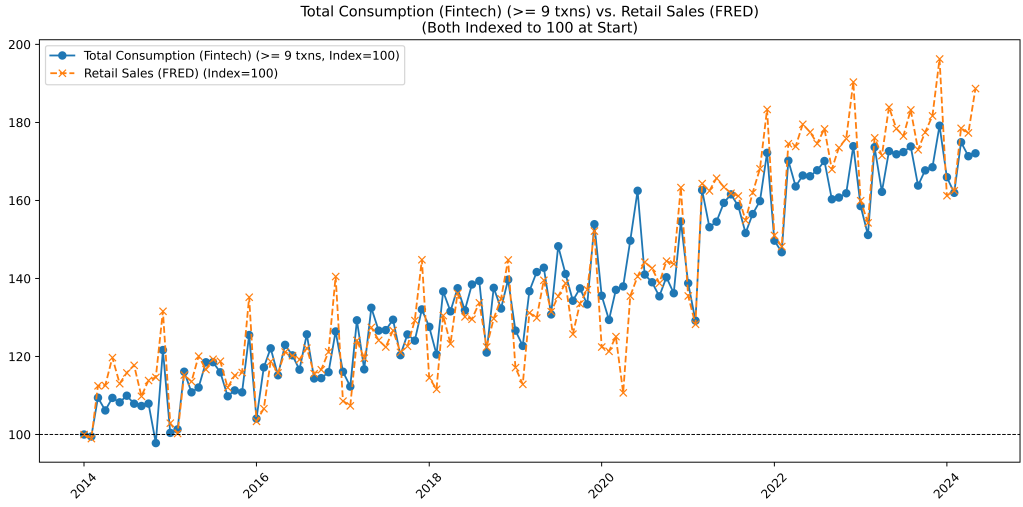


Figure 6: Comparison of aggregate consumption in my fintech panel with U.S. Retail Sales

Aggregate Income against the BEA

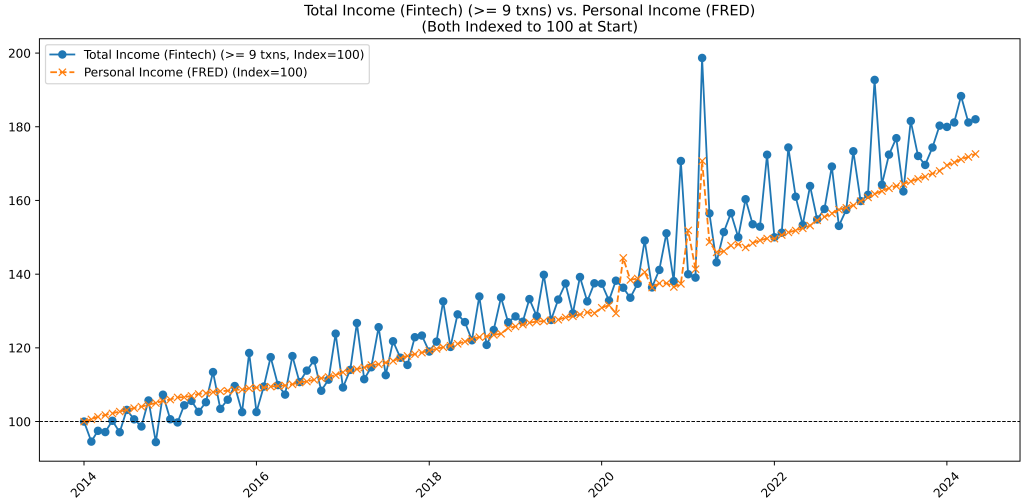


Figure 7: Comparison of total income in my fintech panel with Personal Income (BEA, seasonally adjusted)

Distribution of Total Income against the SCF

	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)

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

MORTGAGE/HELOC PRINCIPAL BALANCES

	2018		2021	
Statistic	**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

	Fintech		SCF	
Group	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 = 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)

- **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.

- Local projections of monthly inflation surprises with calendar and households fixed effects deliver similar implications Details

Q4: Implications for monetary policy - *"The Fisher Channel According to HANK: Unexpected Inflation and the Missing Recession"*

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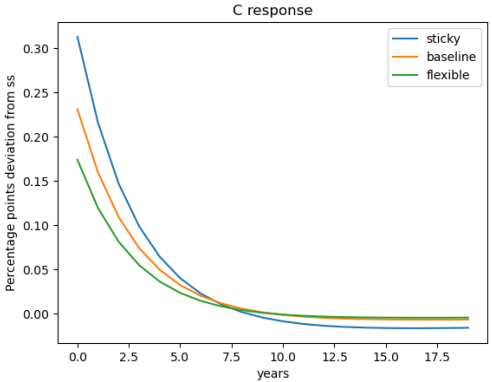
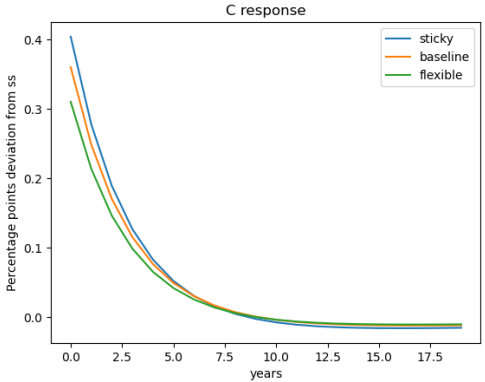
Impacts of an expansionary monetary shock with and without an active Fisher channel



Model without the Fisher Channel



Model with 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 shock

Conclusions

Conclusions

Q1 Substantial welfare costs of inflation in the Euro-Area after a comprehensive assessment
- Age-dependent tax with young households often winning thanks to the Fisher channel.

Q2 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.

Q3 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 behaviourial extension.

Q4 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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References

References I

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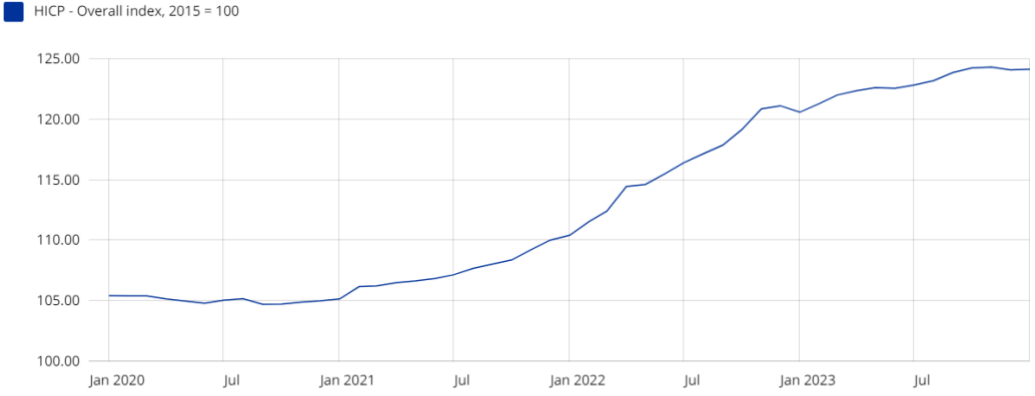
Appendix I: Who Bears the Costs of Inflation? Euro Area Households and the 2021-2023 Inflation Shock

Event study: recent euro area inflation episode, 2021–2023



Source: EUROSTAT

EUROPEAN CENTRAL BANK | EUROSYSTEM

https://data.ecb.europa.eu

What are the distributional effects of the recent inflation shock?

- Large shock in euro area in 2021–23: 18% cumulative price increase
- Key drivers: energy and food prices Data
- Public debate: contrasting arguments
  - Poorer and younger households spend more on energy and food
  - But wealthier and older households own more nominal wealth
- Our contribution:
  1. Conceptual: Simple framework that illustrates various channels of inflation shocks
  2. Empirical: Quantify size of various channels across households in four EA countries

What the paper does

- Develops a model to illustrate distributional effects of inflation through:
  1. Heterogeneous consumption bundles: different inflation rates across Hhs
  2. Heterogeneous nominal wage rigidity: workers vs pensioners
  3. Devaluation / revaluation of net nominal positions: borrowers vs savers
  4. 'Unconventional' fiscal policy through energy subsidies and direct transfers
  5. Response of real asset prices (housing, stocks) to the inflation shock
- Combines various data sources to measure each channel in four large euro area countries (DE, FR, IT, ES)
- Quantifies welfare cost of each component across the age/consumption distribution

Preview of empirical results

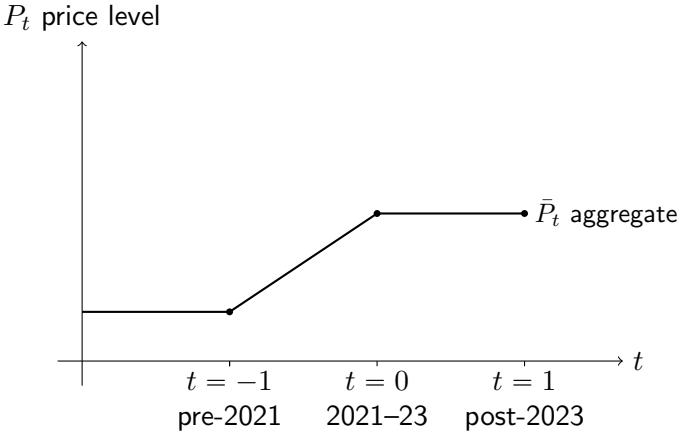
1. Low-consumption Hhs: a bit higher inflation rates, but hedged by low rent inflation
2. Real wages of most households declined (wage stickiness)
3. Net nominal positions: retirees lost, while indebted younger benefited
4. Unconventional fiscal policy: shielded vulnerable Hhs (especially in Spain)
5. Housing and stocks: not good inflation hedges in short run

- Overall:
  - losses are large: 70% of households lost about up to 15% of income;
  - older households lost the most as a fraction of income;
  - within age brackets, lower-consumption households often experienced larger losses;
  - 30% of households experienced gains, especially in France and Spain—indebted

Recent related contributions

- Fagereng, Gomez, Gouin-Bonenfant, Holm, Moll, Natvik (2022)
  - Framework to study impact of capital gain shocks on household welfare
- Del Canto, Grigsby, Qian, Walsh (2023)
  - Builds on Fagereng et al. (2022) to study IRFs to structural inflationary shocks
- Cardoso, Ferreira, Leiva, Nuño, Ortiz, Rodrigo, Vazquez (2022)
  - Distributional impact for Spain using BBVA data
- Many other empirical studies, mostly focusing on heterogeneous consumption baskets
  - Battistini, Di Nino, Dossche, Kolndrekaj (2022)
  - Charalampakis, Fagandini, Henkel, Osbat (2022)
  - Curci, Savegnago, Zevi, Zizza (2023)
  - Menyhert (2022)

Our experiment: one-off increase in infl 2021–23 (MIT shock)



Assumptions

Before $t = 0$ (pre-2021), aggr price level constant (zero infl in steady state)

[A1] At $t = 0$ (short run; years 2021–23), unanticipated inflation shock $dz_0 \Rightarrow$ permanent jump in aggr price level

Relative goods prices left unrestricted

[A2] At $t = 1$ (long run; after 2023), price stability restored

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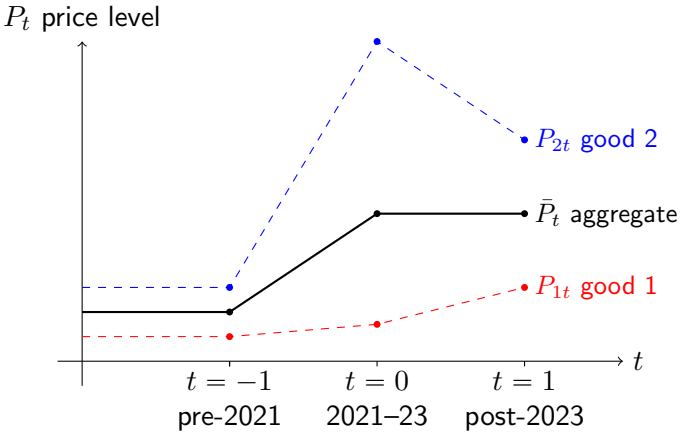

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Relative goods prices left unrestricted

[A2] At $t = 1$ (long run; after 2023), price stability restored

Relative prices back to pre-shock

[A3] The shock is neutral in the long run (real values of wages, asset prices, taxes, dividends do not change)

[A4] Long-run adjustment of the govt

Households

- Overlapping generations living for two periods $t = 0, 1$ (short-run & long-run)
- No uncertainty (aggregate or idiosyncratic), and no binding liquidity constraints
- Problem of individual i belonging to the cohort born at $t = 0$:

$$
\begin{aligned}
V_i &= \max_{c_{it}, a_{i,kt+1}, B_{St+1}, B_{Lt+1}} u_i(c_{i0}) + \beta_i u_i(c_{i1}) \\
&s.t. \\
c_{it} P_{it} &= W_{it} - T_{it} + B_{i,St} + (1 + Q_{Lt}\delta) B_{i,Lt} + \sum_k (Q_{kt} + D_{kt})\, a_{i,kt} \\
&\quad - Q_{St} B_{i,St+1} - Q_{Lt} B_{i,Lt+1} - \sum_k Q_{kt} a_{i,kt+1}.
\end{aligned}
$$

W nominal wages, T nominal gov't taxes net of transfers, B_S short-term bonds, B_L long-term bonds, a_k real assets, $Q_\cdot$ asset/bond prices, D_k dividends, δ coupon decay rate

- $P_{it} = P^*_{it}(1 - \mathcal{T}_{it})$, effective prices = raw (counterfactual) prices – government subsidy

Money metric welfare

- Object of interest: impact of inflation shock dz_0 on welfare of each household
- Invoke the **envelope theorem** (dz_0 'small'), and ignore changes in choice variables
- Money metric welfare change:

$$dW_i = \frac{dV_i / u_i'\left(c_{i0}\right)}{dz_0} P_{i0}$$

'How much EUR would you be willing to give up to avoid the inflation shock?'

Welfare decomposition: four components

- Differentiate Lagrangean with respect to (inflation) shock z_0
- Decompose welfare change as: $d\mathcal{W}_i = d\mathcal{W}_i^{DIR} + d\mathcal{W}_i^{UFP} + d\mathcal{W}_i^{IND} + d\mathcal{W}_i^{LR}$
  1. Direct: impact of the raw inflation shock, using Hh-level raw inflation shock P_{i0}^*
  2. 'Unconventional' fiscal policy: impact of govt interventions, gap between P_{i0}^* and P_{i0}
  3. Indirect: equilibrium response of labor and capital income, taxes, and asset prices to z_0
  4. Long-run: residual long-run effects (relative price re-alignment)
- These components consist of terms related to parts of budget constrnt (income, NNP, ...)

Measurement

Countries and demographic groups

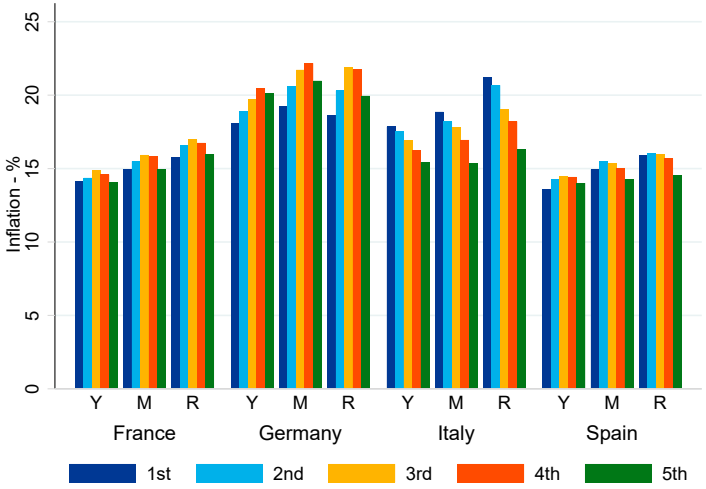
- Big-4 economies in euro area: Germany, France, Italy, Spain
- Breakdown of households by age (25–44, 45–64, 65+) and consumption quintiles

Data sources

- Direct component
  - Prices and consumption baskets: Household Budget Survey (2015), Harmonized Index of Consumer Prices (HICP), expected inflation (Consensus Economics)
  - Income, wealth and portfolios: Household Finance and Consumption Survey (2017)
- Unconventional fiscal pol: Bruegel data, counterfactual energy prices (Dao et al 2023)
- Indirect component
  - Wages from collective agreements and official minimum wage data; pension data
  - House prices, REIT returns, stock market data

Details

2021–23 cumulative household-level inflation: 13–23 percent

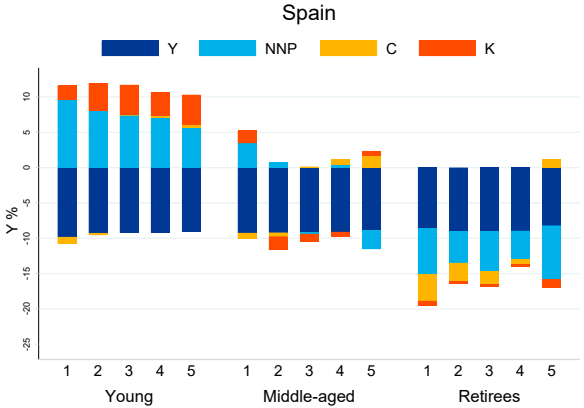


Cumulative inflation shock

- FR: 15%
- DE: 20%
- IT: 17%
- ES: 14%

Inflation decomposition

1. Breakdown of direct component: Spain



- **Net income:** loss of 9%, even across groups
- **Net nominal positions:** positive impact for the young, negative for the retirees
- π **differences:** in general, quite small
- **K gains:** gains for young (net asset buyers) Welfare only affected when trading

Overall:
Old lose 15%, young break even or gain slightly

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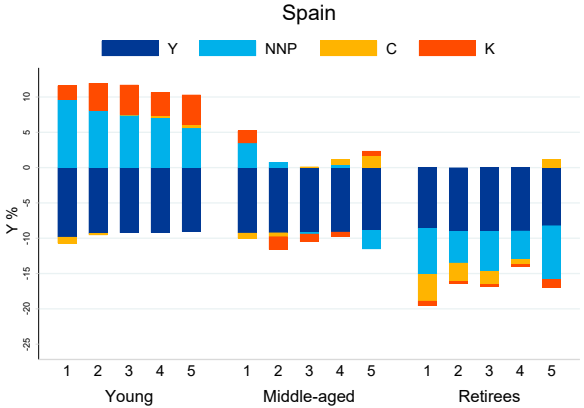

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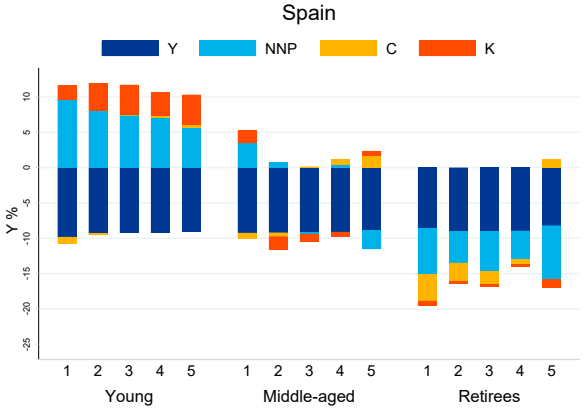

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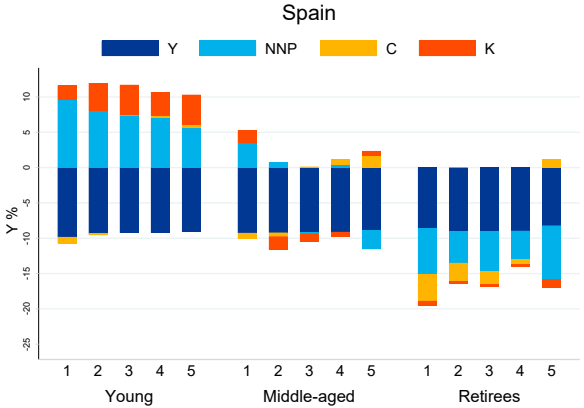

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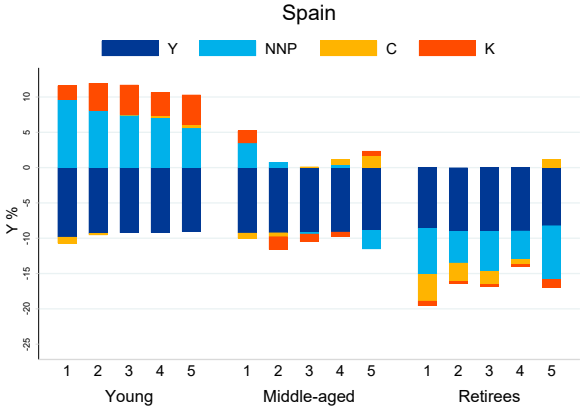

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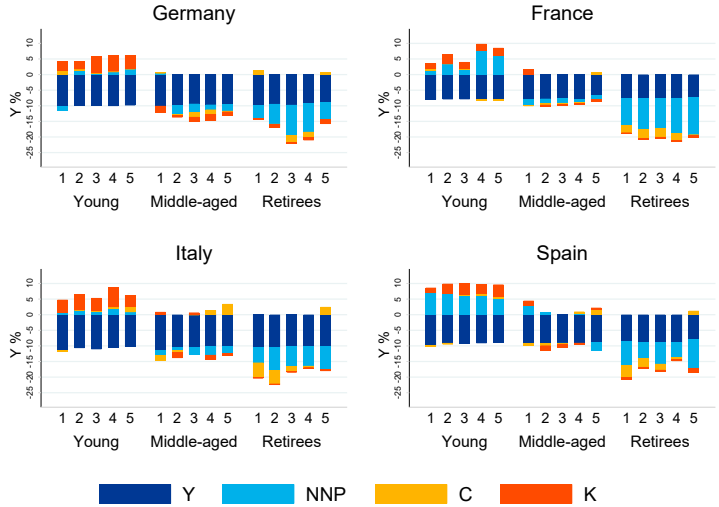
Overall:

Old lose 15%, young break even or gain slightly

1. Direct component, cross-country comparison: ~ 0 to -15%



Y: Net income

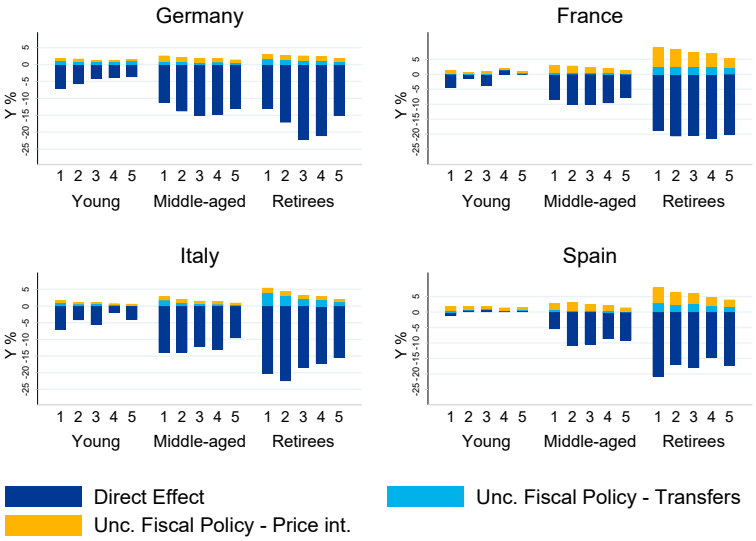
NNP: Net nominal positions

C: π differences

K: Capital gains

More heterogeneity in France and Spain, despite lower inflation, because of larger NNPs

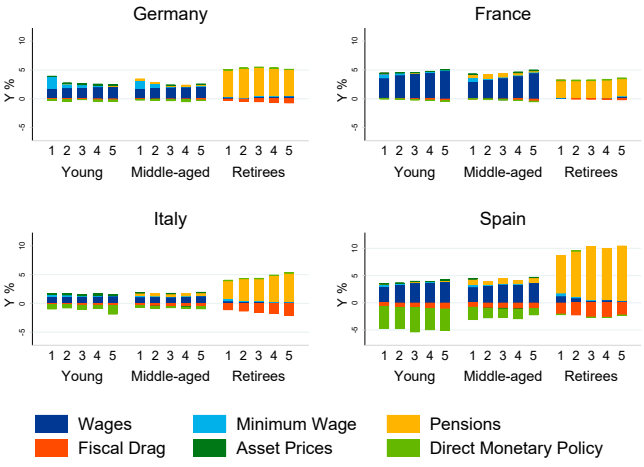
2. Unconventional fiscal policy reduced impact by 1 to 5%



Mitigation of welfare loss, particularly through energy price interventions

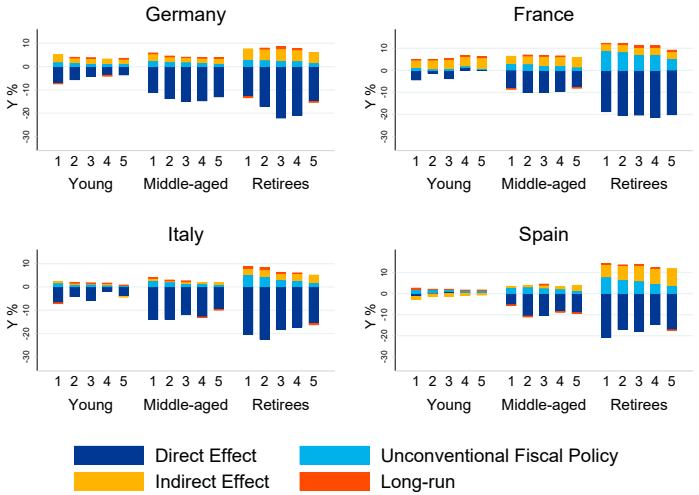
Reduction in inflation

3. Indirect component: ¡ 5%



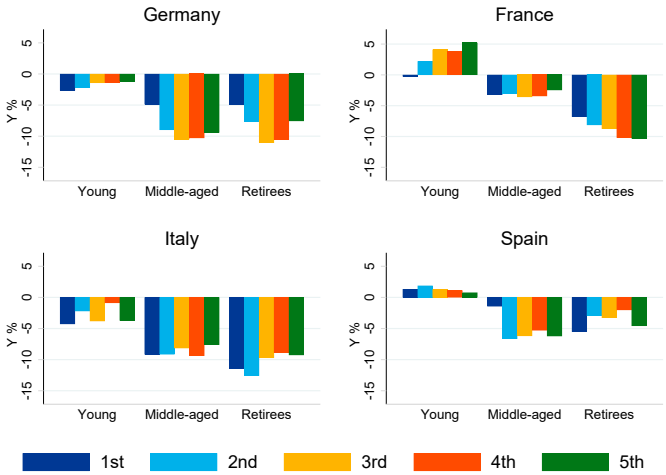
- **Y: Net labor income**: large real purchasing power loss, sizeable recovery only in France
- **Minimum wage**: partially compensates low-income workers in Germany/France
- **Pensions**: mostly indexed, large adjustments, particularly in Spain
- **Monetary policy**: affects negatively ES young (adjustable-rate mortgages)

Putting together the four components of the effect on welfare



- **Direct component** dominates
- **Fiscal response** is nontrivial
- **Indirect** relevant for some
- **Long-run** limited effect

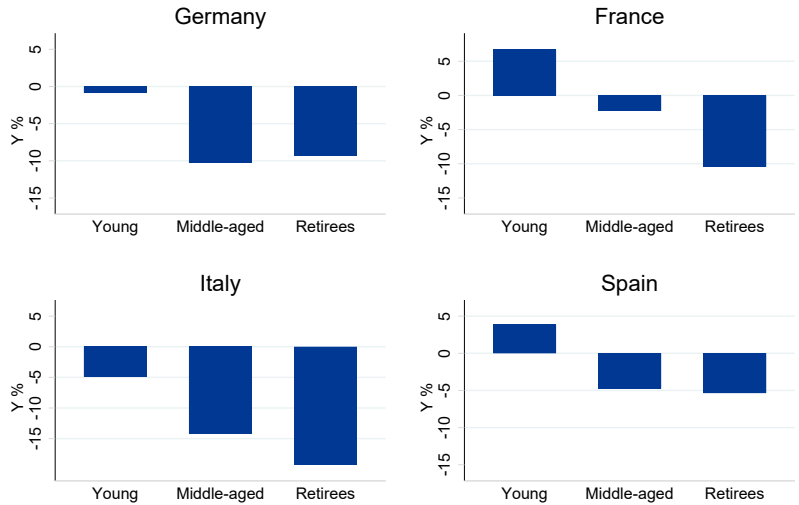
Total welfare change



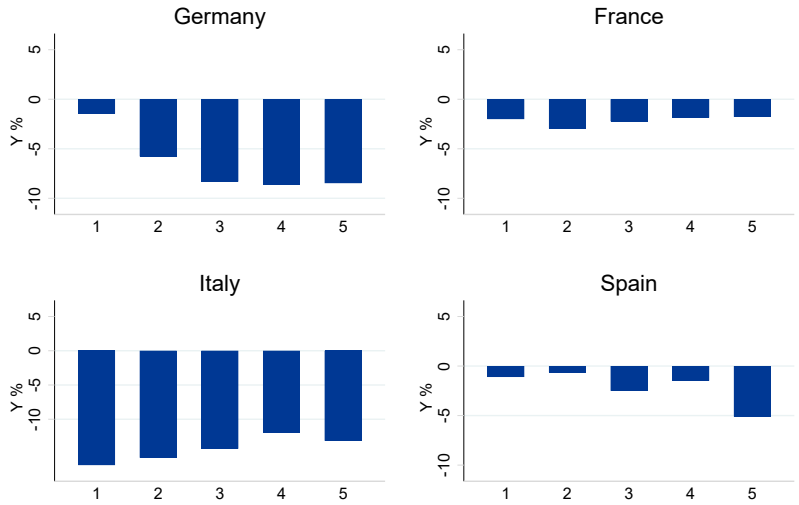
Average total effect (% of income):

- DE: –7.0%
- FR: –2.5%
- IT: –9.0%
- ES: –3.5%

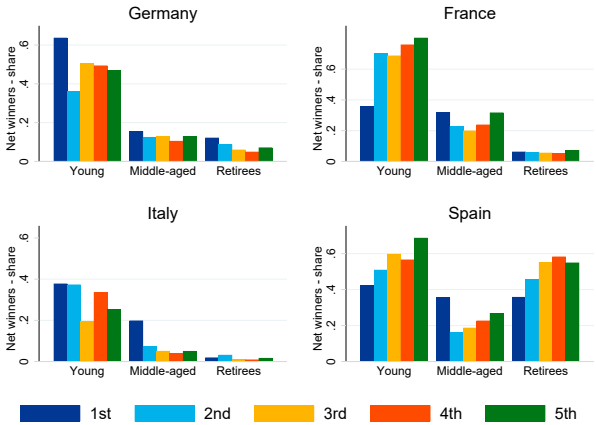
Total welfare change: clear gradient by age



Total welfare change: no clear gradient by consumption



Share of winners



- On average, 30% of net winners
- But there are many young that lose, even in ES/FR
- Most retirees are net losers, except for ES

Summary: who bore the costs of inflation in euro area?

- Inflation shock was an age-dependent tax that hit hard older households
- Uniform incidence within age: higher inflation rate for poor offsets higher NNP for rich
- Nominal wages are quite rigid in the short run
- Unconventional fiscal policy played a significant role, especially in Spain
- Housing and stocks are not good inflation hedges in the short run
- Most households lost, but around 30% (debtors) gained
- (Governments were mostly net winners)

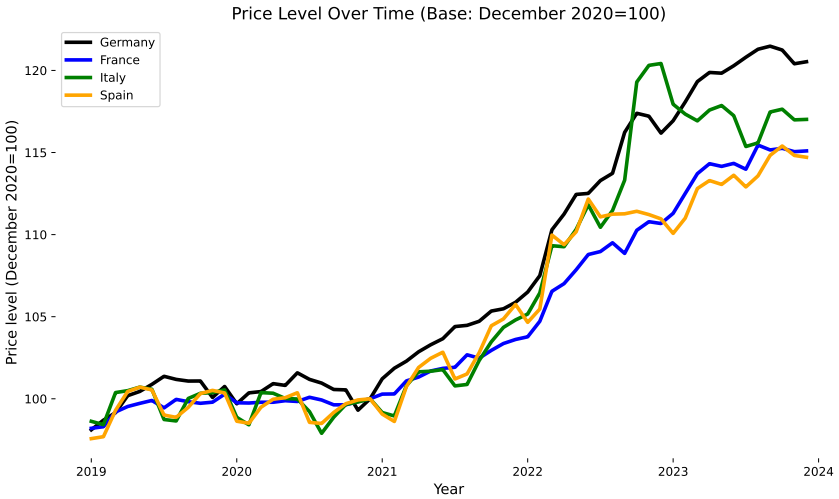
Thanks!

Beyond the household sector: Government

- Household sector is a net loser. But who is on the other side of NNP losses?
- Compute aggregate gains by broad sector (households, government, foreign)
  - Attributing firm holdings to their owners
- Government gains: net borrower + fiscal drag
- But it loses: financing of ad-hoc fiscal measures + higher costs of its purchases.

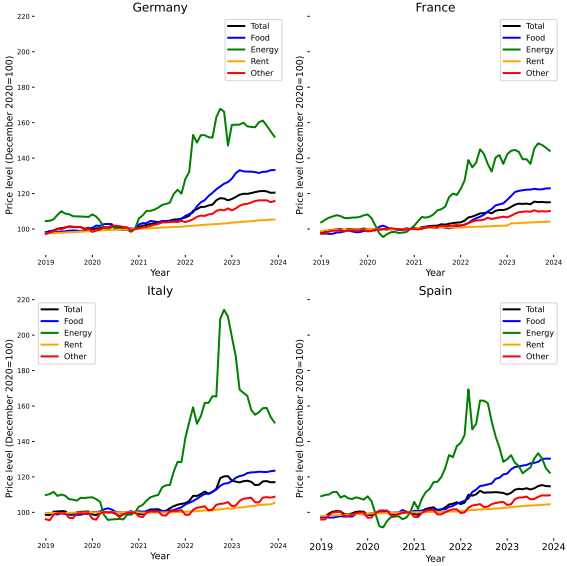
Country	NNP	Fiscal drag	Fiscal support	Pensions	Government consumption		**Total**
					Lower bound	Upper bound	% of GDP
Germany	3.5	0.2	-1.6	-1.1	-0.5	-1.6	-0.6 to 0.5
France	4.8	0.1	-1.3	-0.6	-0.8	-1.6	1.3 to 2.1
Italy	7.5	0.6	-1.8	-0.9	-0.3	-0.9	4.5 to 5.1
Spain	4.5	1.0	-1.2	-1.7	-0.4	-1.0	1.6 to 2.2

Headline inflation



Key drivers: energy and food prices

Back



Expenditure Categories

Consumption Categories			
Class	Label	Class	Label
01	Food	07.21	Spare parts
02	Alcohol and tobacco	07.22	Fuels
03	Clothing	07.23	Vehicle maintenance
04.1	Actual rent	07.24	Other services for transport equipment
04.3	Dwelling maintenance	07.3	Transport services
04.4	Water supply	08	Communication
04.5	Electricity and gas	09	Recreation
05	Furnishings	10	Education
06	Health	11	Restaurants and Hotels
07.1	Vehicles	12	Miscellaneous

Source: Household Budget Survey (2015)

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Price indexes: Actual and counterfactual [starred]

- Individual price deflators P_{it} satisfy the relation $c_{it}P_{it} = \sum_{j=1}^{J} c_{i,jt}P_{jt}$
- Aggregate price deflator $\bar{P}_t$ satisfies same relation for nationwide expenditure shares
- Goods prices P_{jt} paid by consumers include of good-specific taxes and subsidies (energy)

$$P_{jt} = P^*_{jt}\,(1 + \tau_{jt})$$

- Change in household specific price indexes at $t = 0$ induced by the shock:

$$\begin{aligned} d\log P_{i0} &\simeq \sum_{j=1}^{J} xsh_{ij,ss} \cdot d\log P_{j0} \simeq \sum_{j=1}^{J} xsh_{ij,ss} \cdot \left(d\log P^*_{j0} + d\tau_{jt}\right) \\ &= \underbrace{\log P^*_{i0}}_{\text{counterfactual price}} + \underbrace{d\log T_{i0}}_{\text{govt interventions in energy mkt}} \end{aligned}$$

Effect of infl shock consists of: effect on "raw" price and govt interv in energy mkt T_{i0}

Our experiment: One-off increase in infl 2021–23 (MIT shock)

Before $t = 0$ (pre-2021), aggr price level $\bar{P}_{ss}$ constant (zero inflation in steady state)

[A1] At $t = 0$ (short run; years 2021–23),

unanticipated inflation shock $dz_0 \Rightarrow$ permanent jump in aggregate price level

$$\frac{d \log \bar{P}_0}{dz_0} > 0$$

Relative good prices, wages, taxes, dividends, and asset prices left unrestricted at $t = 0$

[A2] At $t = 1$ (long run; after 2023),

price stab restored $d \log \bar{P}_1 = d \log \bar{P}_0$, rel prices back to pre-shock $d \log P_{i1} = d \log \bar{P}_{i0}$

[A3] The shock is neutral in the long run, i.e. at $t = 1$:

$$\frac{d \log W_{i1}}{dz_0} = \frac{d \log T_{i1}}{dz_0} = \frac{d \log D_{i,k1}}{dz_0} = \frac{d \log Q_{k1}}{dz_0} = \frac{dlogP_1}{dz_0}$$

[A4] Long-run adjustment of the govt budget constraint through price level or future real surpluses

Direct component: four sources of heterogeneity

Impact of the raw inflation shock P_{i0}^*

$$dW_i^{DIR} = \left[\underbrace{-\frac{d\log \bar{P}_0^*}{dz_0}}_{\text{average } \pi} - \underbrace{\left(\frac{d\log P_{i0}^*}{dz_0} - \frac{d\log \bar{P}_0^*}{dz_0} \right)}_{\text{1. } \pi \text{ gap raw}} \right] \times$$

$$\left[\underbrace{W_{i0} - T_{i0}}_{\text{2. net income}} + \underbrace{B_{i,S0} + (1 + Q_{L0}\delta)\, B_{i,L0}}_{\text{3. net nominal position (NNP)}} + \underbrace{\sum_{k=1}^{K} D_{k0} a_{i,k0} + \sum_{k=1}^{K} Q_{0k} \left(a_{i,0k} - a_{i,1k} \right)}_{\text{4. dividends + capital gains (K)}} \right]$$

Note that the change in prices is the raw one, P^*, i.e., before fiscal interventions

‘Unconventional’ fiscal policy:

energy market interventions & ad hoc transfers

$$dW_i^{UFP} = \underbrace{\left(\frac{d\log P_{i0}^*}{dz_0} - \frac{d\log P_{i0}}{dz_0}\right)}_{\text{1. } \pi \text{ gap fiscal: energy market interventions}} \times$$

$$\left[W_{i0} - T_{i0} + B_{i,S0} + (1 + Q_{L0}\delta) B_{i,L0} + \sum_{k=1}^{K} D_{k0} a_{i,k0} + \sum_{k=1}^{K} Q_{0k} \left(a_{i,0k} - a_{i,1k}\right)\right]$$

$$- \underbrace{\frac{dT_{i0}^{HOC}}{dz_0}}_{\text{2. ad-hoc transfers}}$$

Recall that:

$$\frac{d\log P_{i0}}{dz_0} - \frac{d\log P_{i0}^*}{dz_0} = \frac{d\log T_{i0}}{dz_0}$$

Indirect component: four sources of heterogeneity

$$dW_i^{IND} = \underbrace{\frac{d\log W_0}{dz_0} W_0}_{\text{1. } \Delta \text{ wages}} - \underbrace{\frac{d\log T_{i0}^{AUT}}{dz_0} T_{i0}^{AUT}}_{\text{2. } \Delta \text{ net taxes}} - \underbrace{\frac{d\log Q_{S0}}{dz_0} Q_{S0} B_{S0} - \frac{d\log Q_{L0}}{dz_0} Q_{L0} \left(B_{i,L1} - \delta B_{i,L0}\right)}_{\text{3. } \Delta \text{ nominal interest rates}}$$

$$+ \underbrace{\sum_{k=1}^{K} \frac{d\log D_{k0}}{dz_0} D_{k0} a_{i,k0} + \sum_{k=1}^{K} \frac{d\log Q_{k0}}{dz_0} Q_{k0} \left(a_{i,k0} - a_{i,k1}\right)}_{\text{4. } \Delta \text{ dividends + stock and house prices}}$$

The inflationary shock affects all prices entering the household budget constraint

Long-run component

$$dW_i^{LR} = -R_{S1}^{-1} \cdot \left(\frac{d \log \bar{P}_1}{dz_0} - \frac{d \log P_{i0}}{dz_0} \right) \left[B_{i,S1} + (1 + Q_{L1}\delta)\, B_{i,L1} \right].$$

- Revaluation of NNP at $t = 1$ due to long-run realignment in relative prices
- This component is zero only if the shock does not affect relative prices at $t = 0$. Then:

$$d \log P_{i0} = d \log \bar{P}_0 = d \log \bar{P}_1$$

Inflation decomposition

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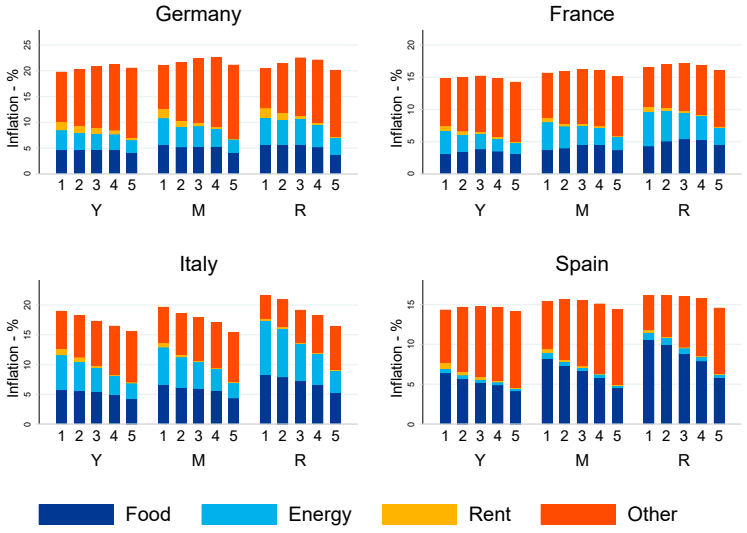

Labor income

- Income distribution: Household Finance and Consumption Survey 2017
- Wages: data on negotiated wage agreements from national statistical agencies
- Minimum wage: national official sources
- Pensions: national data transmitted to the ECB

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Subtract expected inflation from the nominal growth rates

Measurement

Taxes and transfers

- OECD Tax database

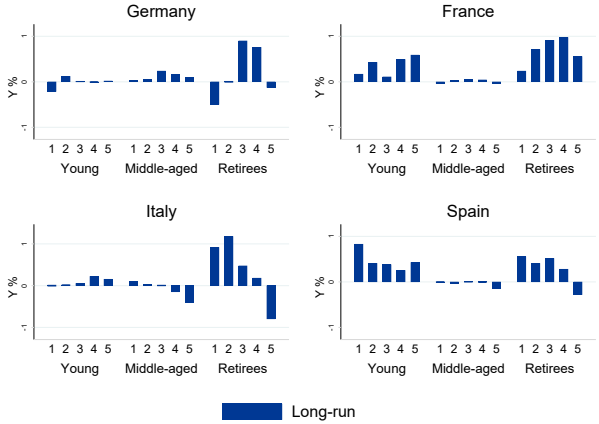
Other sources of income

- Interest, dividends, etc.: Household Finance and Consumption Survey 2017

Asset prices

- Balance sheets: Household Finance and Consumption Survey 2017
- House prices: Reaction of REIT on the day of release of German HICP as instrument for country-level quarterly house price indexes → small effect
- Stock prices: Reaction of daily stock price to release of German HICP → large effect
- Long-term bond prices: Same strategy → small effect

4. Long run component



- Small, except for poor retirees in Italy whose budget share in energy is large

Appendix II: *"Winners and Losers from Unexpected Inflation"*

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):

$$DNP = NA - NL \tag{3}$$

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

$$NNP_i = DNP_i + \theta equity_i \tag{4}$$

   - 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

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

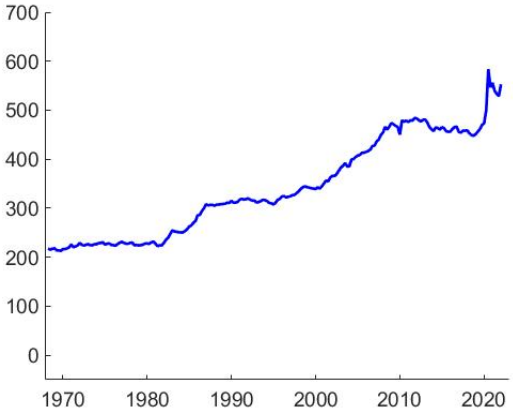


Figure 8: Market value of all outstanding nominal claims between different sectors of the US economy as a percentage of GDP, 1968-2021.

NNP as a % of GDP, detail

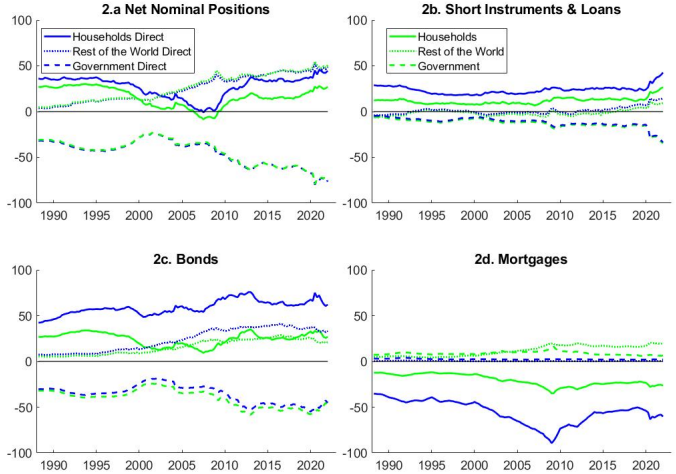


Figure 9: Net nominal positions as a percentage of US GDP, 1988-2022, by sector and class of instrument. Back

Doepke and Schneider (2006) replication with minor adjustments

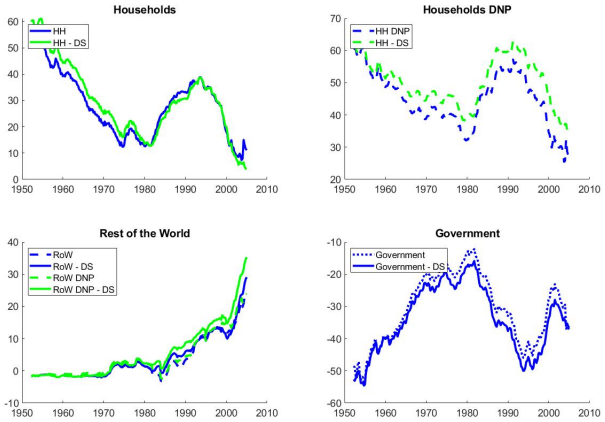


Figure 10: Net nominal positions by sector - my results (blue) versus DS (green). Minor differences are due to revision in FA data and slightly different treatment of sectors and instruments. Back

My results vs DS

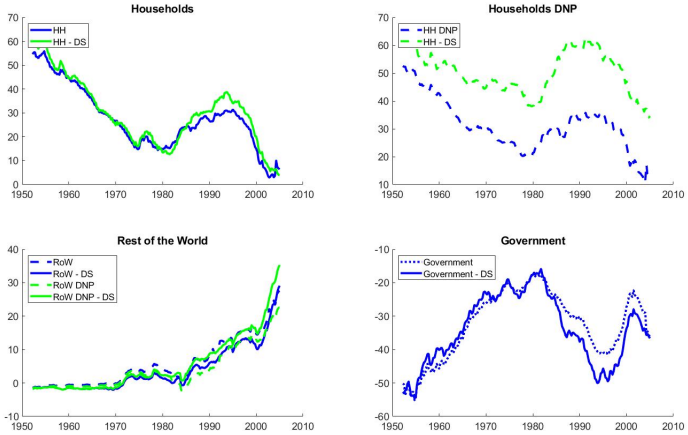


Figure 11: Net nominal positions by sector - my results (blue) versus DS (green). Differences now reflect also market value data reported by the FA and adjustment to SCF aggregates. Back

Duration of nominal positions

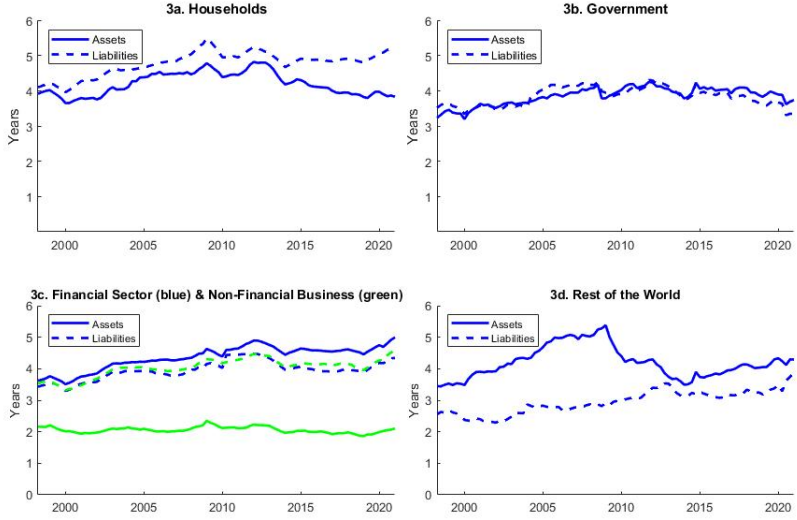


Figure 12: Duration in years of nominal positions for households (panel a), government (b), business (c) and the rest of the world (d). Back

Shock to inflation expectations in 2021

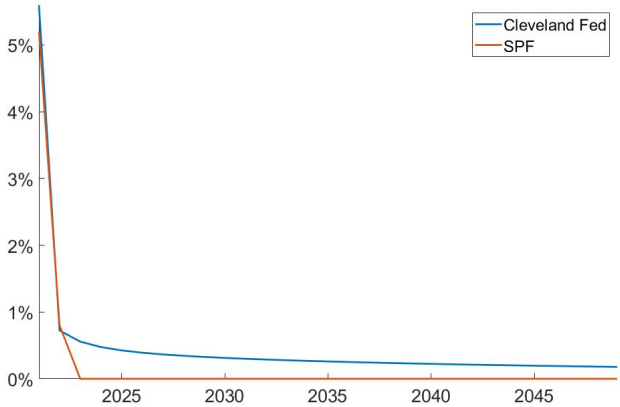


Figure 13: Revision in the term structure of inflation expectations between December 2021 and December 2020 according to the Cleveland Fed model (blue line) and to the Survey of Professional Forecasters (red line).

Redistributive effects

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

1. Full anticipation:

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

2. Full surprise:

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

Back

Redistributive effects

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

1. Full anticipation:

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

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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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Back

Baseline

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

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

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

Back

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.

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

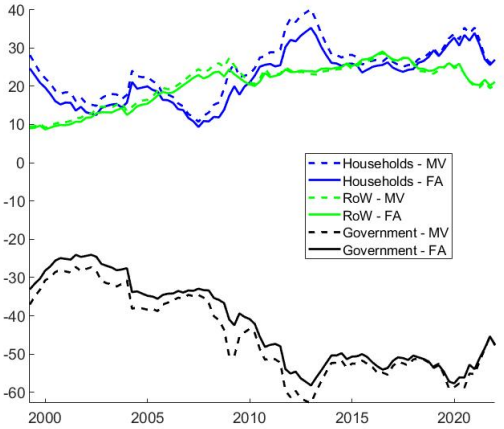


Figure 14: Nominal positions in bonds as a percentage of GDP for Households, Rest of the World, and Government. Dotted lines discount the stream of payments constructed above with the zero coupon yield curve, while solid lines use the market value reported by the Financial Accounts.

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

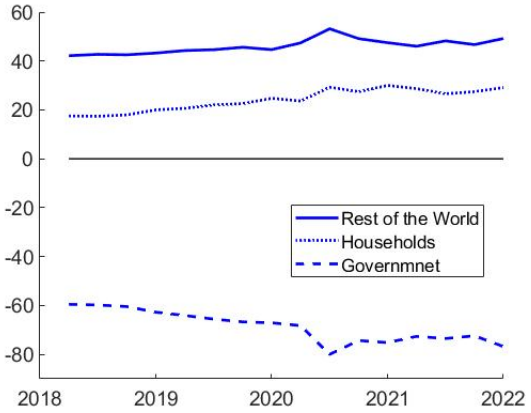


Figure 15: Evolution of net nominal positions relative to GDP for macro-sectors of the US economy, 2018-2021. Back

Evolution of nominal positions - 2021

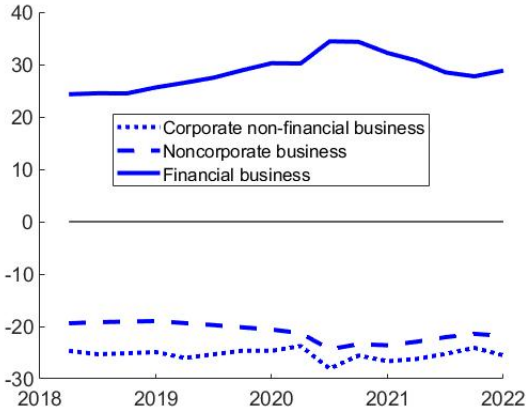


Figure 16: Evolution of net nominal positions relative to GDP for the business sector in the US economy, 2018-2021.

Evolution of nominal positions - 2021

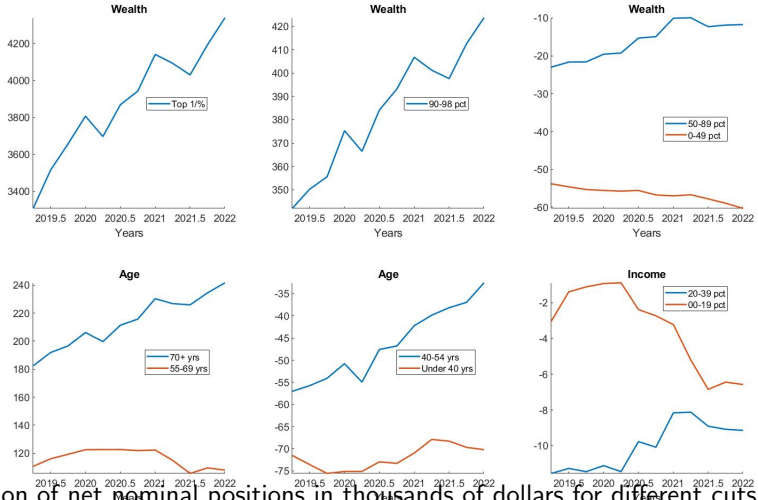


Figure 17: Evolution of net nominal positions in thousands of dollars for different cuts of the household sector according to the DFA - 2019-2021. Back

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

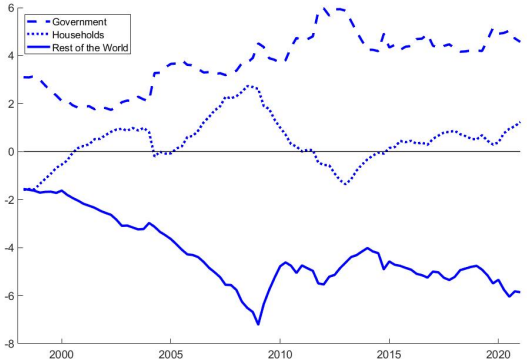
Present value gain or loss in thousands of dollars and as a percentage of household income from the 2021 surge in inflation expectations, measured by the Cleveland FED model. Gain or losses are conditional on having a mortgage for primary residence.

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

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

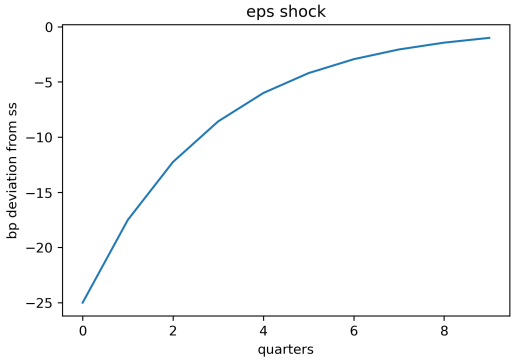
Further policy implications

- 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

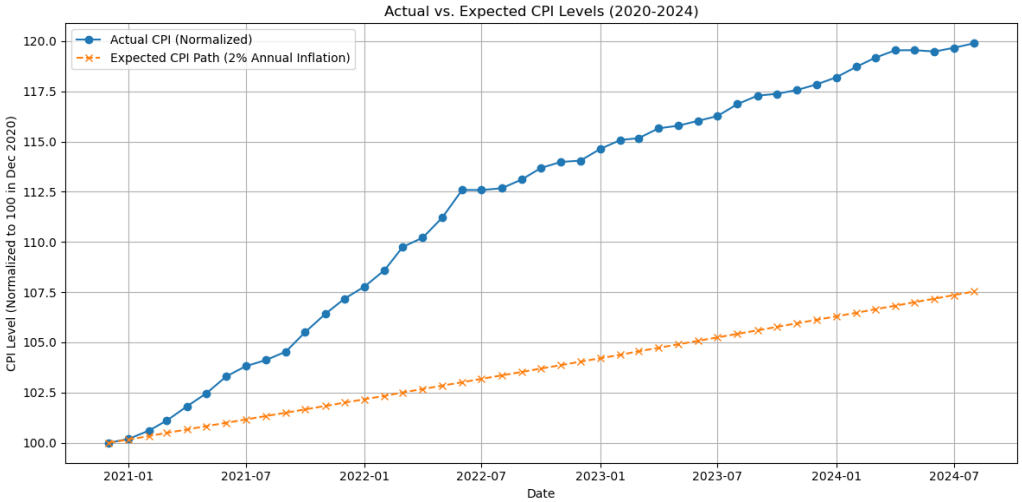
Calibration

Calibration parameters for the model.

Parameter	Description	Value	Parameter	Description	Value
σ	IES	0.5	κ_w	Slope of wage Phillips curve	0.1
v	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

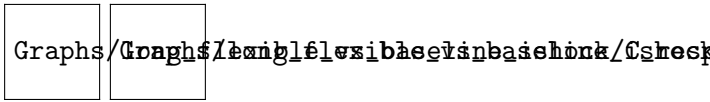


Figure 19: Response of households at different percentiles of the wealth and income distribution

- Debtors increase their consumption substantially Back

Response of households at different percentiles of the distribution

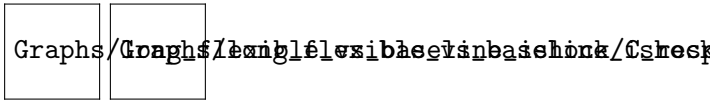


Figure 20: Response of households at different percentiles of the wealth and income distribution.

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A discount factor shock and its inflation response

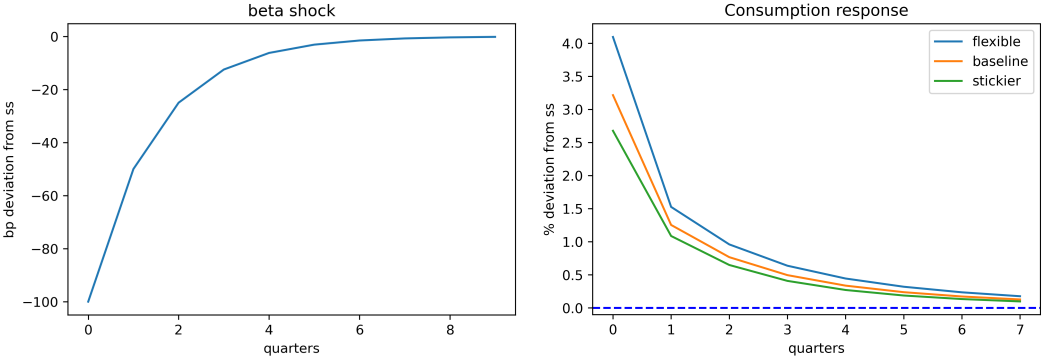


Figure 21: Discount factor shock and the response of consumption in the model. Flexible: $\kappa = 0.09$, baseline: $\kappa = 0.01$, stickier: $\kappa = 0.011$.

Back to discussion

A government spending shock and its inflation response

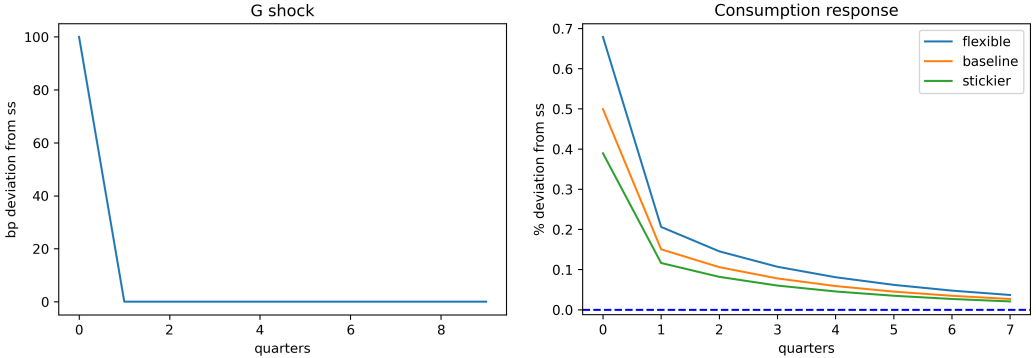


Figure 22: Government spending shock and the response of consumption in the model. Flexible: $\kappa = 0.09$, baseline: $\kappa = 0.01$, stickier: $\kappa = 0.011$.

Back to discussion

Quantitative model with two assets

- Household problem

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

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

$$a \geqslant \underline{a}, \quad Q_t \Lambda \geqslant \underline{b} P_t, \tag{9}$$

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

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

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:

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

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

Back

Paradox of flexibility

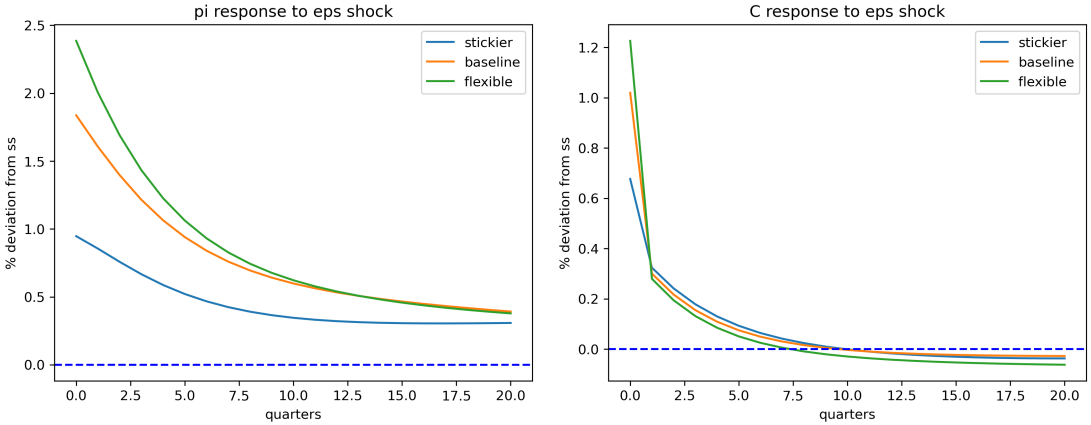


Figure 23: Monetary policy shock and the response of inflation and aggregate consumption in the model. Stickier: $\kappa_p = 0.05$, baseline: $\kappa_p = 0.10$, flexible: $\kappa_p = 0.15$.

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

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 $\leqslant 3$ 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.
- 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 Back

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.

Back

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

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

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

Back

Design 2: Local projections (dynamics)

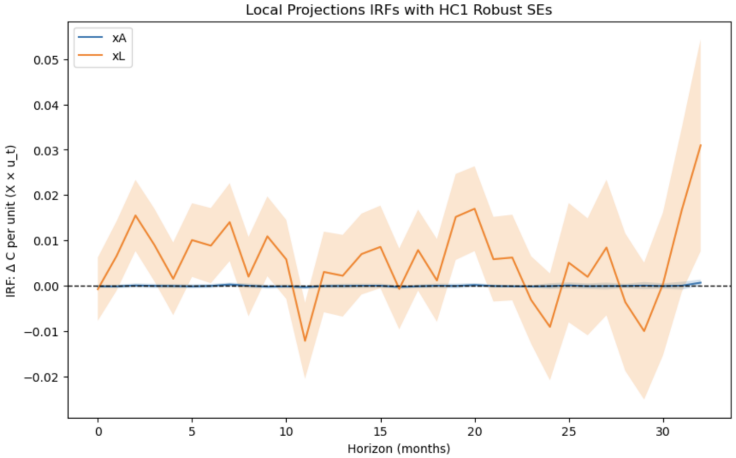
- Horizon-h spending change:
$$\Delta_h C_{i,t} \equiv C_{i,t+h} - C_{i,t}.$$
- Monthly inflation surprise: $\pi_t^s = \pi_t - \pi_t^e$ (expectations fixed at T_0).
- Two-way fixed effects: household FE γ_i and calendar-month FE τ_t.

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

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

Back

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 (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}	
$\hat{\beta}_{NNP}^{LA \Rightarrow NNP}/\Pi^s$	-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: $b_A[\mathrm{Var}(A) - \mathrm{Cov}] = -122\%$; $b_L[\mathrm{Cov} - \mathrm{Var}(L)] = +222\%$.

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. (??))

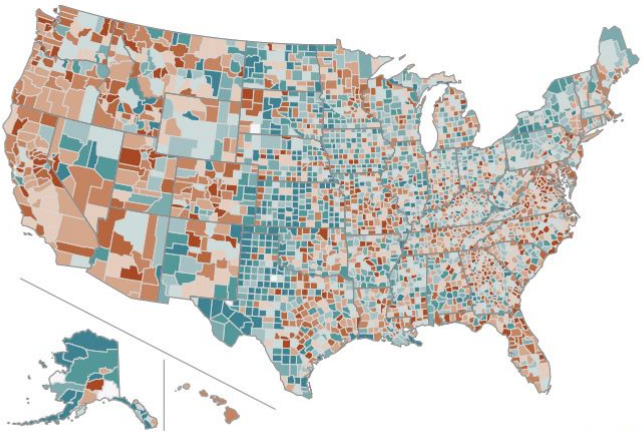
T_0	Jan–Mar	Feb–Apr	Mar–May
$\hat{\beta}_{NNP}$	-0.000***	0.000	-0.000
	(0.000)	(0.000)	(0.000)
N	85,976	85,976	85,976
R^2	0.000	0.000	0.000

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

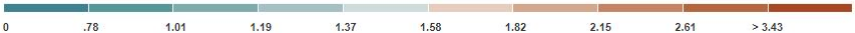
T_0	Jan–Mar	Feb–Apr	Mar–May
$\hat{\beta}_L$	0.001	-0.001	-0.003***
	(0.001)	(0.001)	(0.001)
$\hat{\beta}_A$	-0.000***	0.000	-0.000
	(0.000)	(0.000)	(0.000)
N	85,976	85,976	85,976
R^2	0.000	0.000	0.000

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



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)

$$\frac{NNP_j}{Y_j} = \frac{I_j}{I} \times \frac{NA}{Y_j} - DTI_j \tag{11}$$

- 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

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

- Weighting each county by population

Results (1)

NNP and Spending Growth

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

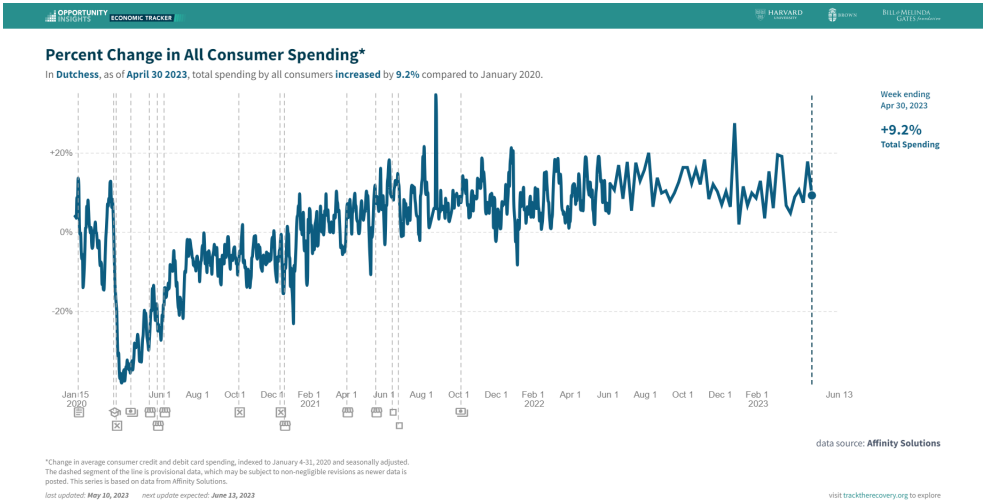
Results (2)

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)

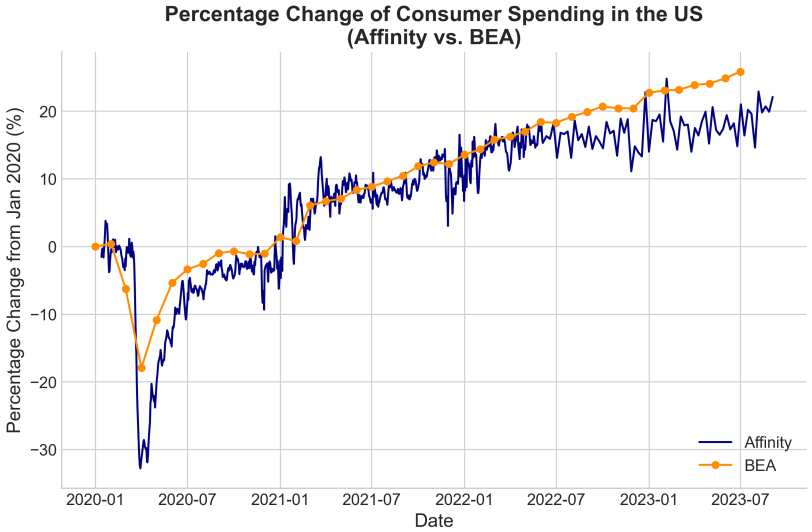
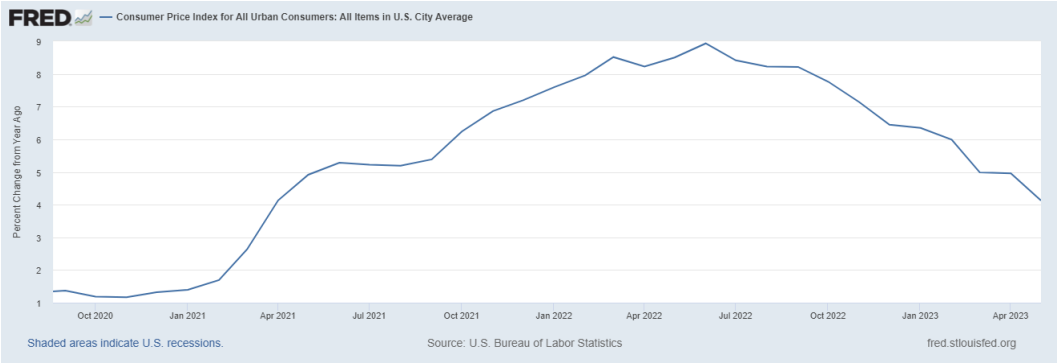


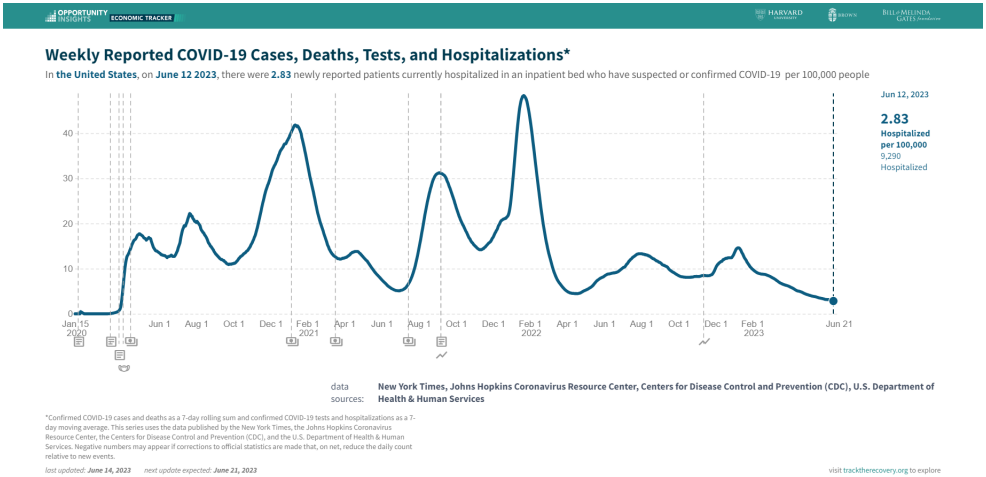
Figure 24: Total consumer spending in the US - Affinity versus BEA Personal Consumption Expenditures

US CPI YoY



Back

Covid-19 cases in the US



Back

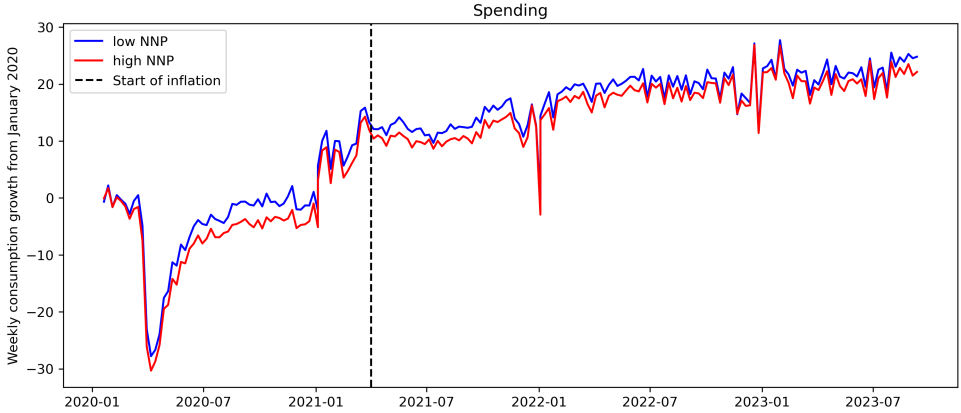
Robustness - timing

- 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