Saving by Consuming: The Intertemporal Behavior of Hand-to-Mouth Households*

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* The experiment developed in this project was registered in the American Economic Association's registry for randomized controlled trials under ID AEARCTR-0012835. The views expressed herein are those of the individual authors and do not necessarily reflect the official positions of the Inter-American Development Bank.

Background

▷ Literature on financial constraints & heterogeneous consumption...
- Hand-to-Mouth, HtM (Campbell and Mankiw, 1989)
  - ↪ Financial markets exclusion, no forward-looking behavior (Galí et al., 2007)

▷ However, many goods have a built-in intertemporal dimension (Attanasio, 1999)
- Durables enable intertemporal choices while consuming, even if not saving

▷ HtM are a sizable portion of the population, $\approx 40\%$ in the U.S. (Aguiar et al., 2025)
- "Getting the micro foundations right" essential for aggregate dynamics

▶ This paper:
- Revisit the role of the HtM agent by allowing durable consumption
  - ↪ Exhibit forward-looking behavior
  - ↪ Expectations matter for individual & aggregate outcomes

This paper: Implications of HtM forward-looking behavior

1. Partial equilibrium model: HtM & durables
   - HtM smooths consumption, reallocates spending within-period/across goods
     ↪ Durable as a saving vehicle; expectations shape consumption choices
   - Expectations shifts: different predictions for HtM/non-HtM/myopic HtM
2. RCT: designed a novel module on Cleveland FED's SCE
   - Causally estimate consumption responses to changes in inflation expectations
     ↪ Exogenous variation by randomized treatment exposure
   - Results validate predictions of PE model
3. Incorporate durables into a two-agent New Keynesian (TANK) model
   - Spending becomes more volatile, consumption becomes more stable
   - Durables dampen the role of household heterogeneity

Contributions

1. Consumption responses to expectations Bachmann et al. (2015); Armantier et al. (2016); Cavallo et al. (2017); Roth and Wohlfart (2020); D'Acunto et al. (2021); Coibion et al. (2022, 2023); Roth et al. (2023); Andrade et al. (2023); Coibion et al. (2024); Candia (2024); Hajdini et al. (2024); Jiang et al. (2024); Aktug and Atesagaoglu (2024)
    - Causal evidence linking inflation expectations & consumption decisions on durable categories for HtM & non-HtM consumers

2. The HtM agent & TANK models Campbell and Mankiw (1989); Zeldes (1989); Alvarez et al. (2001); Galí et al. (2007); Bilbiie (2008, 2020); Bilbiie et al. (2012); Kaplan and Violante (2014); Kaplan et al. (2014); Debortoli and Galí (2024); Aguiar et al. (2025), & durables Attanasio (1999); Caballero (1993); Barsky et al. (2007, 2016); McKay et al. (2016); McKay and Wieland (2021, 2022); Beraja and Wolf (2021); Bachmann et al. (2024)
    - Show that durability introduces a forward-looking behavior for HtM agents
    - Extend the TANK framework with durables, redefining HtM agents' role in GE models

Two-agent, two-good framework

Two households & two goods | Key ingredients

- ▷ Two infinitely lived households: $i = \{\mathrm{H}, \mathrm{S}\}$
  - HtM, $i = \mathrm{H}$: excluded from financial markets (Galí et al., 2007; Bilbiie, 2008)
  - non-HtM, $i = \mathrm{S}$: access to financial markets
- ▷ Two goods: $j = \{d, c\}$
  - $c_{i,t}$: non-durable consumption in t
  - $d_{i,t}$: stock of durables at the end of t
- ▷ Law of motion: $d_{i,t} = z_{i,t} + (1 - \delta)\, d_{i,t-1}$
  - δ: depreciation rate
  - $z_{i,t}$: new durables acquisition in t, reversibility
- ▷ One-period, risk-free bond: B_t, only for non-HtM
  - R_{t+1}: gross nominal return, no-arbitrage condition

Households' optimization problem

▷ HtM solves

$$\max_{\{z_{i,k},\, c_{i,k}\}_{k\geq t}} \sum_{k\geq t} \beta^{k-t} \mathbb{E}_t \left[u\left(c_{i,k},\, d_{i,k}\right) \right]$$

s.t.

$$\begin{aligned} P_{c,t} c_{i,t} + P_{d,t} z_{i,t} &= P_{w,t} \\ d_{i,t} &= z_{i,t} + (1-\delta)\, d_{i,t-1} \end{aligned}$$

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▷ non-HtM solves

$$\max_{\{z_{i,k},\, c_{i,k},\quad\}_{k\geq t}} \sum_{k\geq t} \beta^{k-t}\mathbb{E}_t\left[u\left(c_{i,k},\, d_{i,k}\right)\right]$$

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▷ non-HtM solves

$$\max_{\{z_{i,k},\, c_{i,k},\, B_k\}_{k\geq t}} \sum_{k\geq t} \beta^{k-t}\mathbb{E}_t\left[u\left(c_{i,k},\, d_{i,k}\right)\right]$$

$$\text{s.t.} \quad \begin{aligned} P_{c,t}c_{i,t} + P_{d,t}z_{i,t} &= P_{w,t} + (R_t B_{t-1} - B_t) \\ d_{i,t} &= z_{i,t} + (1-\delta)\, d_{i,t-1} \end{aligned}$$

Households' optimization problem

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▷ Numeraire: non-durable, $P_{c,t} =$

$\left(\pi_{c,t} = P_{c,t}/P_{c,t-1}\text{: gross inflation}\right)$

$$\begin{cases} q_t = P_{d,t}/P_{c,t}: & \text{relative price of durables} \\ w_t = P_{w,t}/P_{c,t}: & \text{real wage} \\ r_t = R_t/\pi_{c,t}: & \text{real interest rate} \end{cases}$$

Dual nature: consumption good & storable asset

- ▷ Example: two future states, $t+1$ onward
  - High-income: $P_{w,k} = Y_h$ for $k \geq t+1$, with probability p
  - Low-income: $P_{w,k} = Y_l < Y_h$, with probability $(1-p)$

Dual nature: consumption good & storable asset

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- High-income: $P_{w,k} = Y_h$ for $k \geq t+1$, with probability p
- Low-income: $P_{w,k} = Y_l < Y_h$, with probability $(1-p)$

▷ Trade-off: two benefits offset the cost of reducing $c_{i,t}$

- Marginal increase in $d_{i,t}$, immediate utility
- Undepreciated marginal $d_{i,t}$, discounted expected future utility

$$mu^{c}_{\mathrm{H},1} = mu^{d}_{\mathrm{H},1} + \beta\,(1-\delta)\left[p \cdot mu^{d}_{\mathrm{H},2}\,(Y_h) + (1-p) \cdot mu^{d}_{\mathrm{H},2}\,(Y_l)\right]$$

▷ Durability intertemporal benefits: bias the decision towards $d_{i,t}$

- Beliefs (p) shape consumption choices
- Stronger incentives for accumulation in Y_l $(p=0)$ scenario
- Saving vehicle $d_{i,t}$: smooth consumption despite lack of bonds

▶ Indifference curves

Inflation expectations | Optimal consumption responses

- ▷ One-time/isolated/exogenous change in expected inflation
- ▷ Households learn about inflation expectations changes one period ahead, $\mathbb{E}_t\left[\pi_{j,t+1}\right]$
- ▷ What are the optimal consumption responses?

$$\frac{\partial z_{i,t}}{\partial \mathbb{E}_t\left[\pi_{j,t+1}\right]} \quad \& \quad \frac{\partial c_{i,t}}{\partial \mathbb{E}_t\left[\pi_{j,t+1}\right]} \quad \text{with} \quad i = \{\mathrm{H}, \mathrm{S}\}, \quad j = \{d, c, w\}$$

  - Policy function: household-specific
  - Responses hinge on changes in expected relative prices: $\mathbb{E}_t\left[q_{t+1}\right]$, $\mathbb{E}_t\left[w_{t+1}\right]$ & $\mathbb{E}_t\left[r_{t+1}\right]$
  - HtM: no sensitivity to changes in expected real interest rate

▶ Lemma 1

No durables, canonical TANK | Myopic HtM

Proposition 1

If durables fully depreciate ($\delta = 1$), HtM is unresponsive to changes in inflation beliefs

$$\left.\frac{\partial z_{\mathrm{H},t}}{\partial \mathbb{E}_t\left[\pi_{j,t+1}\right]}\right|_{\delta=1} = \left.\frac{\partial c_{\mathrm{H},t}}{\partial \mathbb{E}_t\left[\pi_{j,t+1}\right]}\right|_{\delta=1} = 0$$

By contrast, the non-HtM remains responsive even when $\delta = 1$, adjusting its consumption of every good in the same direction.

- Without durables, HtM expectations play no role
- non-HtM expectations matter: intertemporal substitution via financial markets

Durables, $\delta < 1$ | Expected income shock

Proposition 2

Given a one-time, isolated and exogenous change in the expected inflation of the nominal wage $\mathbb{E}_t[\pi_{w,t+1}]$, the HtM responses satisfy

$$\frac{\partial z_{\mathrm{H},t}}{\partial \mathbb{E}_t[\pi_{w,t+1}]} < 0 \quad \& \quad \frac{\partial c_{\mathrm{H},t}}{\partial \mathbb{E}_t[\pi_{w,t+1}]} > 0$$

By contrast, given the non-arbitrage condition, the non-HtM responses satisfy

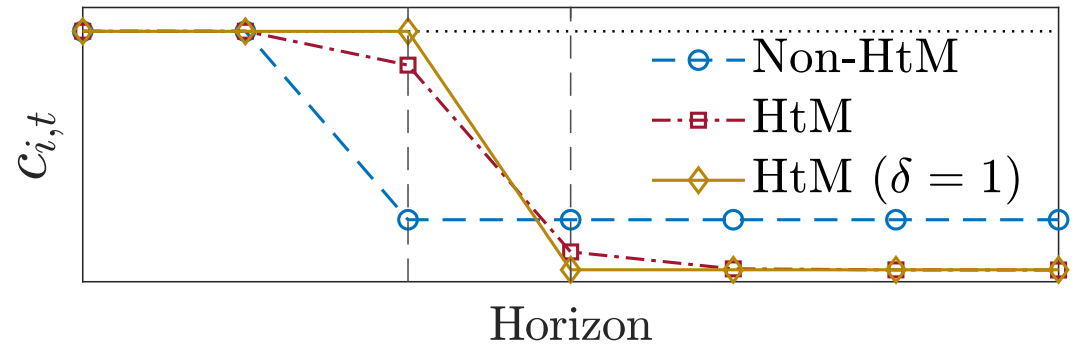
$$\frac{\partial z_{\mathrm{S},t}}{\partial \mathbb{E}_t[\pi_{w,t+1}]} > 0 \quad \& \quad \frac{\partial c_{\mathrm{S},t}}{\partial \mathbb{E}_t[\pi_{w,t+1}]} > 0 \quad \& \quad \frac{\partial b_{\mathrm{S},t}}{\partial \mathbb{E}_t[\pi_{w,t+1}]} < 0$$

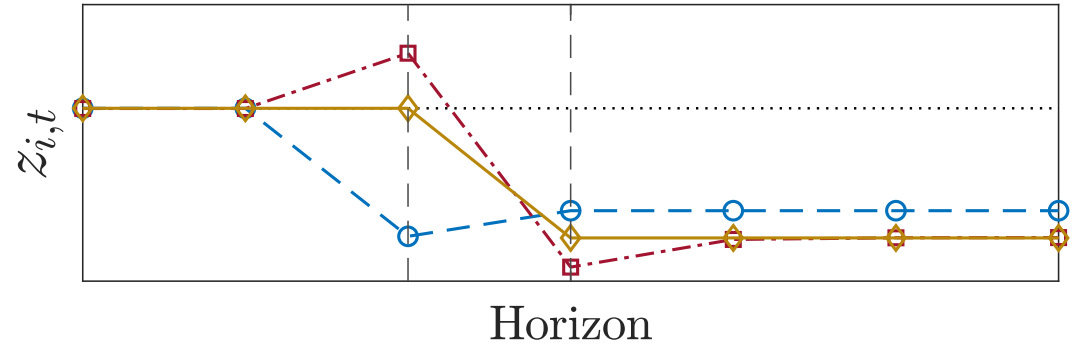
- To smooth consumption, HtM use durables as a borrowing instrument

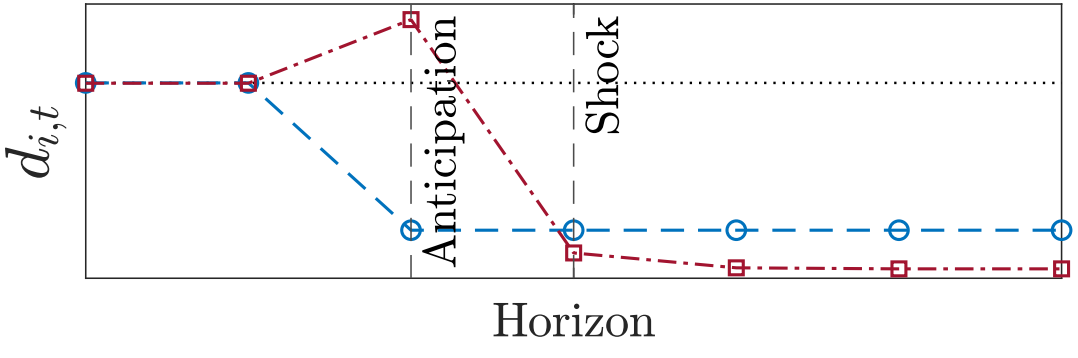
Expected income shock

▷ Lower expected wage inflation

- non-HtM: Permanent Income Hypothesis
- Forward-looking HtM: wealth effect accelerates durable accumulation (saving instrument)
- Myopic HtM ($\delta = 1$): unresponsive







Inflation expectations shocks | Predictions

▷ **Prediction 1**: ↑ aggregate inflation expectations = ↓ expected real wages & ↓ real rate

▷

Household	Higher aggregate inflation expectations		
	Durable	Non-durable	
HtM			
non-HtM			

Inflation expectations shocks | Predictions

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▷

Household	Higher aggregate inflation expectations		
	Durable	Non-durable	
HtM	**Up**	**Down**	
non-HtM			

Inflation expectations shocks | Predictions

▷ **Prediction 1**: ↑ aggregate inflation expectations = ↓ expected real wages & ↓ real rate

▷

Household	Higher aggregate inflation expectations		
	Durable	Non-durable	
HtM	**Up**	**Down**	
non-HtM	**Up*** / Down	**Up*** / Down	

Inflation expectations shocks | Predictions

- ▷ **Prediction 1**: ↑ aggregate inflation expectations = ↓ expected real wages & ↓ real rate
- ▷ **Prediction 2**: ↑ durable inflation expectations = ↑ expected relative price of durables

Household	Higher aggregate inflation expectations		Higher durable inflation expectations	
	Durable	Non-durable	Durable	Non-durable
HtM	**Up**	**Down**	**Up**	**Down**
non-HtM	**Up*** / Down	**Up*** / Down	**Up**	**Up*** / Down

Data

Data source | Cleveland Fed's Survey of Consumer Expectations

- ▷ Novel module
  - Designed by us for this specific experiment
  - Integrated into the Cleveland Fed's SCE (Knotek II et al., 2020; Dietrich et al., 2022)
- ▷ Key features
  - Repeated cross-section with daily frequency
  - Online U.S. representative sample restricted to +18 years old
- ▷ Sample: $\approx$ 5,500 valid observations post-filters (Haaland et al., 2023)
- ▷ Collected between November 21, 2023, & February 13, 2024
- ▶ **RCT**: information treatments to generate exogenous variation in expectations

Experimental setup | Timeline

I. Collect baseline information: (1) background / HtM status, (2) past consumption expenditure, & (3) short-run inflation expectations / prior

↓

II. Apply treatments: 1 passive control group & 1 placebo & 2 information treatments

↓

III. Collect post-treatment information: medium-run inflation expectations / posterior

↓

IV. Collect post-treatment information: intended consumption expenditure

HtM candidates | Who are the HtM?

▷ Identifying HtM respondents is challenging

▷ Our approach: key indicators of HtM status

- Self-perception using "*living paycheck-to-paycheck*"
- Self-perception of financial constraints
- Effective financial market participation
- Liquid assets relative to consumption

▶ HtM questions

▷ Dimension reduction: PCA to synthesize multivariate information

- 1st component eigenvalue $\gg$ Kaiser threshold; captures $\approx 60\%$ of variance
- Captures dominant and significant share of common variation

▶ Scatterplot & scree plot

▶ **HtM**: bottom 40% (baseline) of 1st component distribution, robustness 30%-50% (Campbell and Mankiw, 1989; Kaplan and Violante, 2014; Kaplan et al., 2014; Aguiar et al., 2025)

▶ Demographics by HtM status

Inflation expectations | Prior beliefs

- ▷ Quantitative point forecast: accurate on first-moment predictions (Clements, 2010, 2014)
- ▷ Established two-step framework to elicit point forecast (Armantier et al., 2017)

Prior : *short-run inflation expectations*

QI.1 Over the next 12 months, do you think that there will be inflation or deflation?

- ◯ Inflation
- ◯ Deflation (the opposite of inflation)

As a follow-up question. . .

↪ What do you expect the rate of ⟨inflation⟩ ⟨deflation⟩ to be over the next 12 months? Please give your best guess.

- I expect the rate of ⟨inflation⟩ ⟨deflation⟩ to be _____ percent over the next 12 months.

Information treatments | Random assignment

Treatment 1 : *expected aggregate inflation*

T1 According to the Survey of Professional Forecasters conducted by the Federal Reserve Bank of Philadelphia, the annual aggregate inflation rate at the end of the year 2024 will be 2.5%. / 1,410 observations

Treatment 2 : *past semi-durables inflation*

T2 According to the Bureau of Labor Statistics, between 2012 and 2019, average apparel prices stayed relatively constant. On average, these prices decreased by 0.24% annually. In the last 12 months, average apparel prices have increased by 3.1%. / 1,354 observations

Placebo : *past population growth*

P According to the Census, the U.S. population grew 2.9% between 2018 and 2022. / 1,370 observations

- Passive control group / 1,395 observations

▶ Balance tests

Inflation expectations | Posterior beliefs

▷ Horizon difference to avoid question repetition bias (Haaland et al., 2023)

Posterior : *medium-run inflation expectations*

QI.2 Over the next 5 years, do you think there will be inflation or deflation on average?

- ◯ Inflation.
- ◯ Deflation (the opposite of inflation).

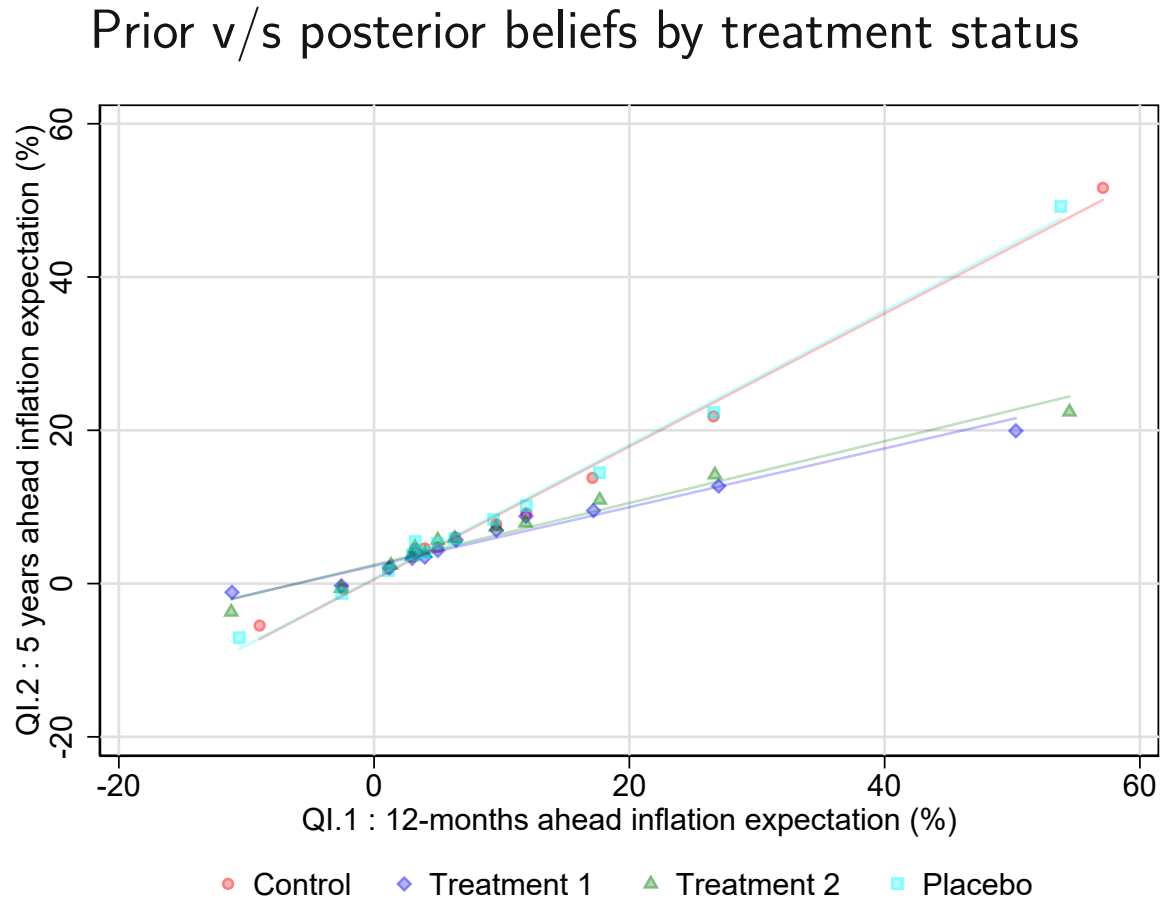
As a follow-up question...

↪ What do you expect the average annual rate of ⟨inflation⟩ ⟨deflation⟩ to be over the next 5 years? Please give your best guess.

- I expect the average annual rate of ⟨inflation⟩ ⟨deflation⟩ to be _____ percent per year over the next 5 years.

▶ Time series ▶ Descriptive statistics

Treatments | Validation



- Treatments moderate expectations, similarly across treated groups
- Placebo indistinguishable from control group

▶ Kernel by treatment status

Treatments | Validation

▷ To evaluate treatment effects on medium-run expectations

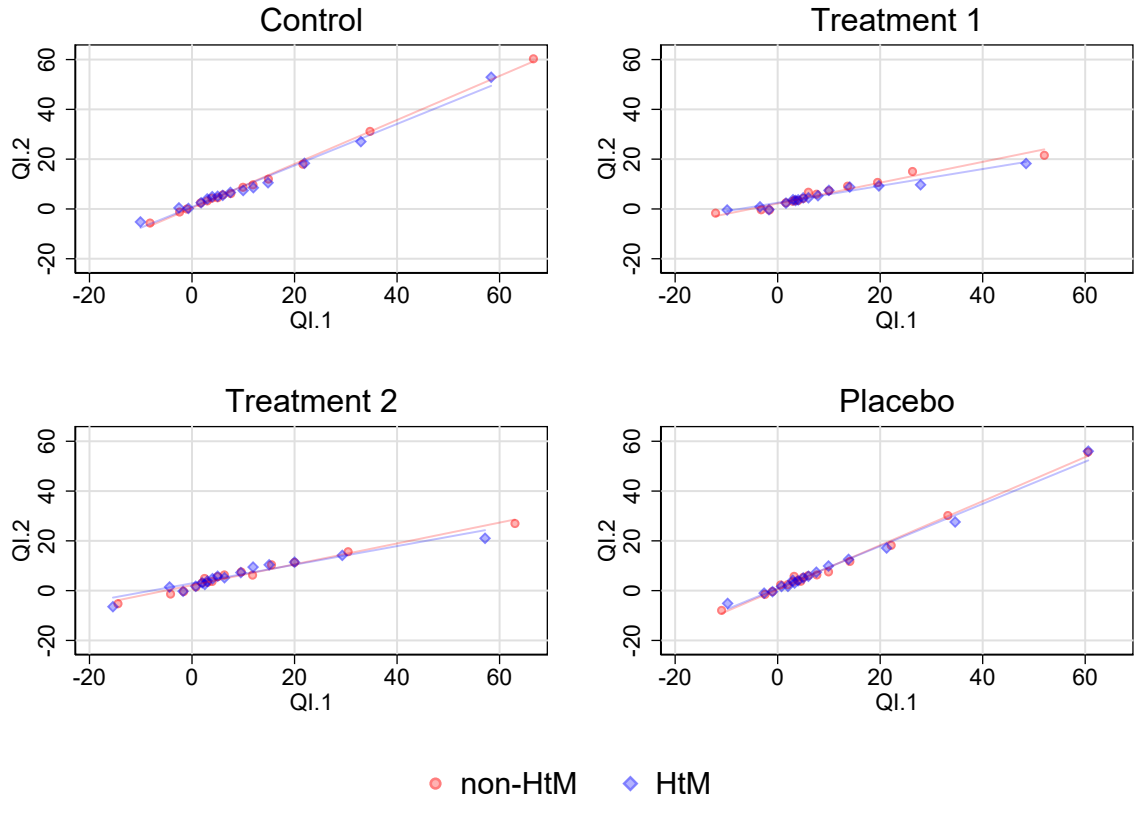
$$post_j = \alpha + \mathbf{X}_j\boldsymbol{\beta}' + \eta \cdot prior_j + \sum_{\tau=\{1,2,P\}} [\gamma_{\tau,1} \cdot treat_{j,\tau} + \gamma_{\tau,2}\,(treat_{j,\tau} \times prior_j)] + \upsilon_j$$

- $prior_j$: 12-month inflation expectations of respondent j
- $post_j$: 5-year average annual inflation expectations
- $treat_{j,\tau} = \{0, 1\}$: 1 if j received the treatment $\tau = \{1, 2\}$ or placebo P, 0 otherwise
- $\mathbf{X}_j$: baseline respondent-level covariates, measured before treatment

- **Key coefficients**: $\gamma_{\tau,2}$ captures learning from treatment τ

Treatments across HtM status | Validation

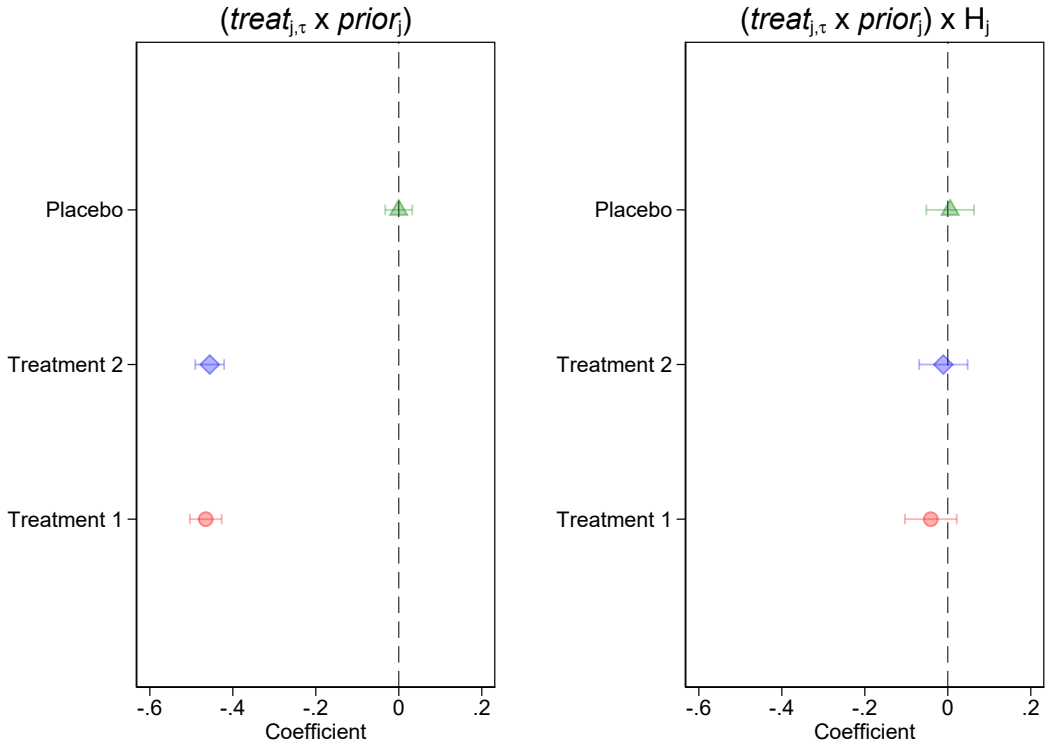
Prior v/s posterior beliefs by treatment and HtM status



- HtM and non-HtM respondents show similar slopes across treatment groups
- Suggest no significant differences in beliefs updating by HtM status

Treatments | Two key results

Treatment effects on medium-run inflation expectations



- Placebo: no effect on belief updating / T1 & T2: significant revision
- HtM v/s non-HtM: no differences in treatment assimilation

▶ Regression results

Past & intended consumption | Survey questions

▷ Survey spending plans track actual behavior (Schnorpfeil et al., 2023; Kotsogiannis and Sakellaris, 2025)

Intended consumption : *total spending*

QC.1 Compared with your spending last month, how do you expect your total spending to change in the next . . . 1. One month? / 2. One year?

- ◯ Go up by _____ %.
- ◯ No change.
- ◯ Go down by _____ %.

QC.2 Services: *medical and dental care, haircuts, and restaurant meals. . .*

QC.3 Non-durables: *food and beverage products from grocery stores, and gasoline and other energy goods. . .*

QC.4 Semi-durables: *clothing and footwear, jewelry, watches, silverware, toys, tools and garden equipment, and household textiles and utensils. . .*

QC.5 Durables: *household appliances, radio and television sets, sporting and wheeled goods. . .*

Empirical strategy & results

Identification strategy, no heterogeneity | 2SLS

▷ First-stage: expectations updating

$$post_j = \alpha + \mathbf{X}_j\boldsymbol{\beta}' + \eta \times prior_j + \sum_{\tau=\{1,2\}} \left[\gamma_{\tau,1} \times treat_{j,\tau} + \gamma_{\tau,2}\left(treat_{j,\tau} \times prior_j\right)\right] + \upsilon_j$$

- $prior_j$: 12-month inflation expectations of respondent j
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Identification strategy, no heterogeneity | 2SLS

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- $treat_{j,\tau} = \{0, 1\}$: 1 if j received the treatment $\tau = \{1, 2\}$, and 0 otherwise

▷ Second-stage: consumption responses

$$\%\triangle c^e_{j,k,h} = \alpha_{k,h} + \mathbf{X}_j\boldsymbol{\beta}'_{k,h} + \eta_{k,h} \times prior_j + \theta_{k,h} \times \widehat{post}_j + \varepsilon_{j,k,h}$$

- $\%\triangle c^e_{j,k,h}$: respondent j's intended expenditure growth on category k at horizon h
- **Key coefficients**: $\theta_{k,h}$ captures the expectations' causal effect on $\%\triangle c^e_{j,k,h}$

Heterogeneous effects by HtM status | 2SLS

▷ Adapt the first-stage

- HtM identifier

$$\mathrm{H}_j = \begin{cases} 1 & \text{if respondent } j \text{ is HtM} \\ 0 & \text{otherwise} \end{cases}$$

- Two household-type-specific variables to instrumentalize

$$[\ post_j \times (1 - \mathrm{H}_j)\ ,\ post_j \times \mathrm{H}_j\ ]$$

▷ Second-stage:

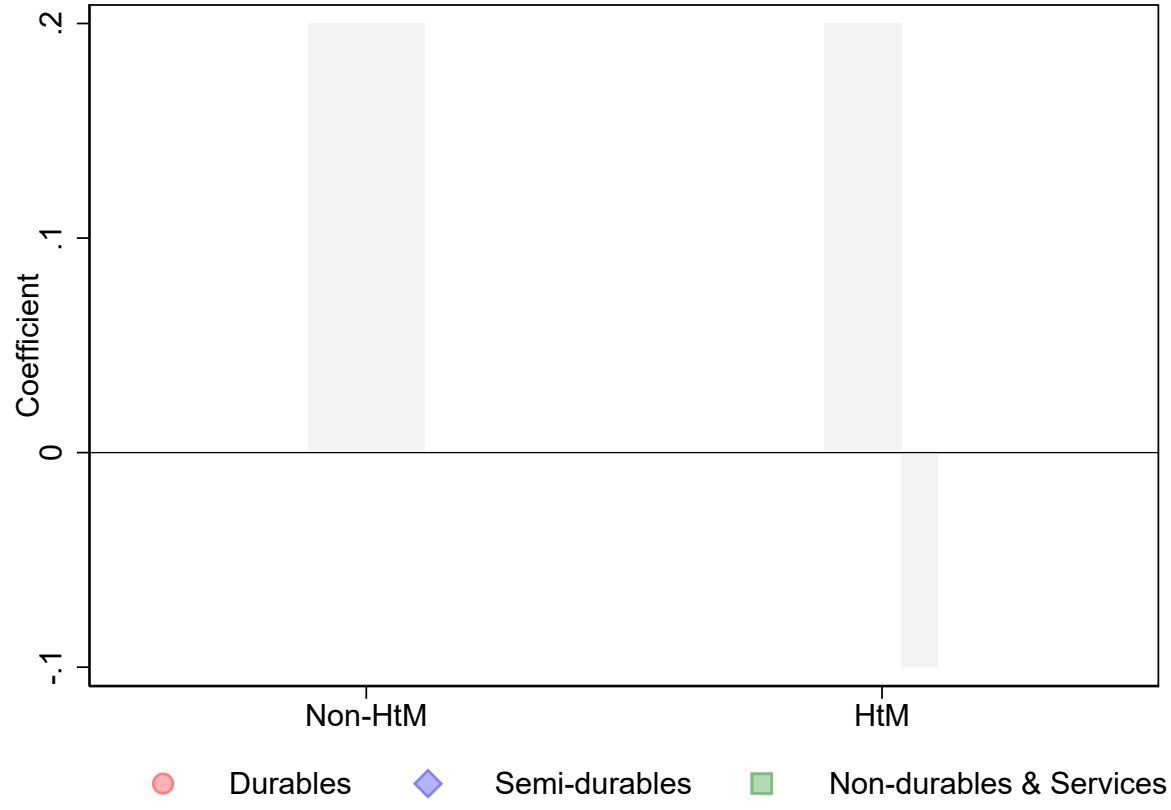
$$\%\triangle c^e_{j,k,h} = \alpha_{k,h} + \mathbf{X}_j\boldsymbol{\beta}'_{k,h} + \eta_{k,h} \times prior_j + \theta^{\mathrm{S}}_{k,h} \times \widehat{post_j \times (1 - H_j)} + \theta^{\mathrm{H}}_{k,h} \times \widehat{post_j \times H_j} + \varepsilon_{j,k,h}$$

- **Key coefficients**: $\theta^i_{k,h}$ captures the expectations' causal effect for $i = \{\mathrm{H}, \mathrm{S}\}$

▶ Details

PE | Prediction 1: Higher aggregate inflation expectations

Aggregate inflation expectations changes on consumption by HtM status

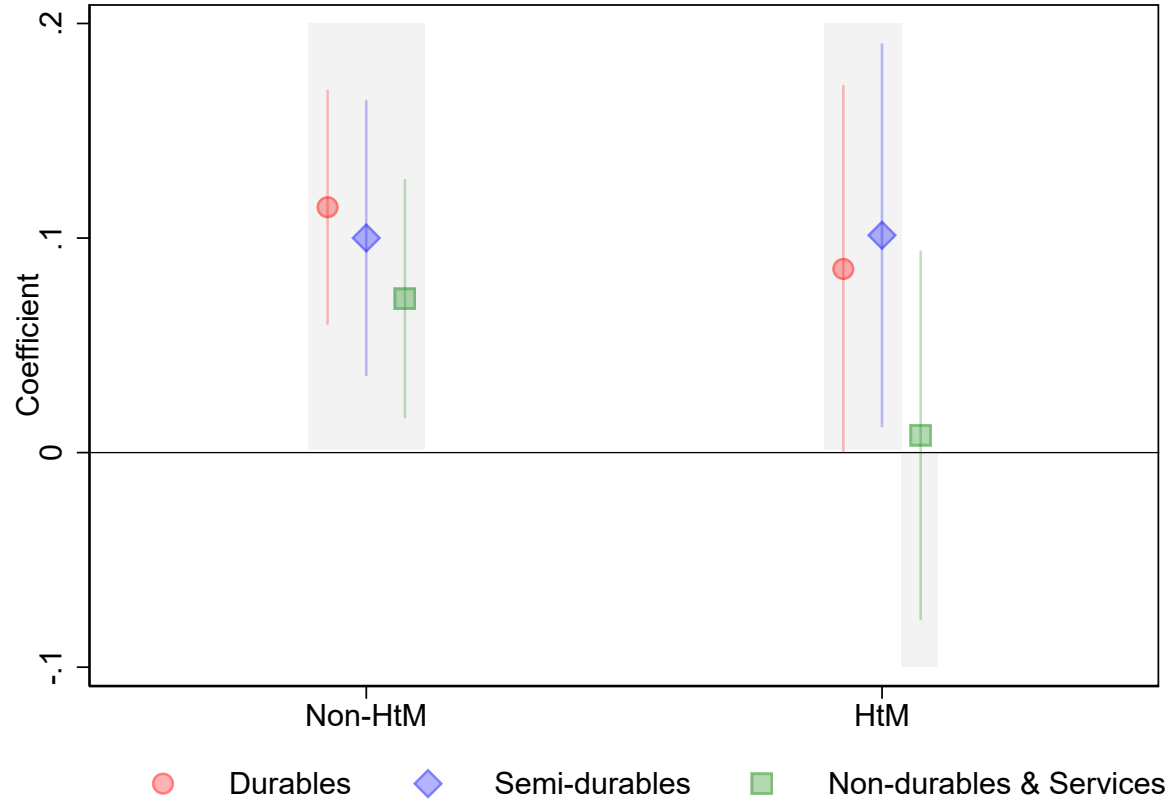


- Non-HtM: increases spending in all consumption categories
- HtM: increases durable investment, sacrificing non-durable expenditure

► Full results
► Sensitivity

Evidence | Higher aggregate inflation expectations, pooled

Aggregate inflation expectations changes on consumption by HtM status



- Non-HtM: increases spending in all consumption categories
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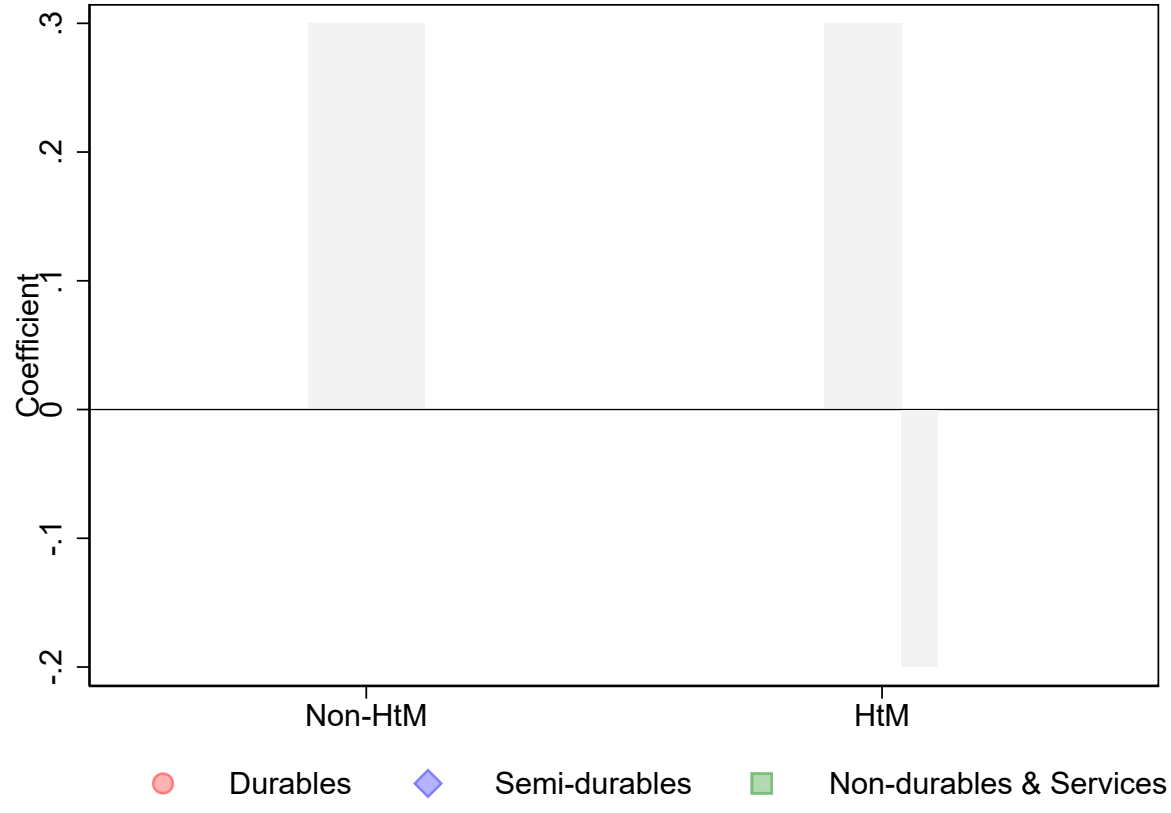
► Full results
► Sensitivity

PE | Prediction 2: Higher durable inflation expectations

Durable inflation expectations changes on consumption by HtM status



- Non-HtM: increases spending in all consumption categories
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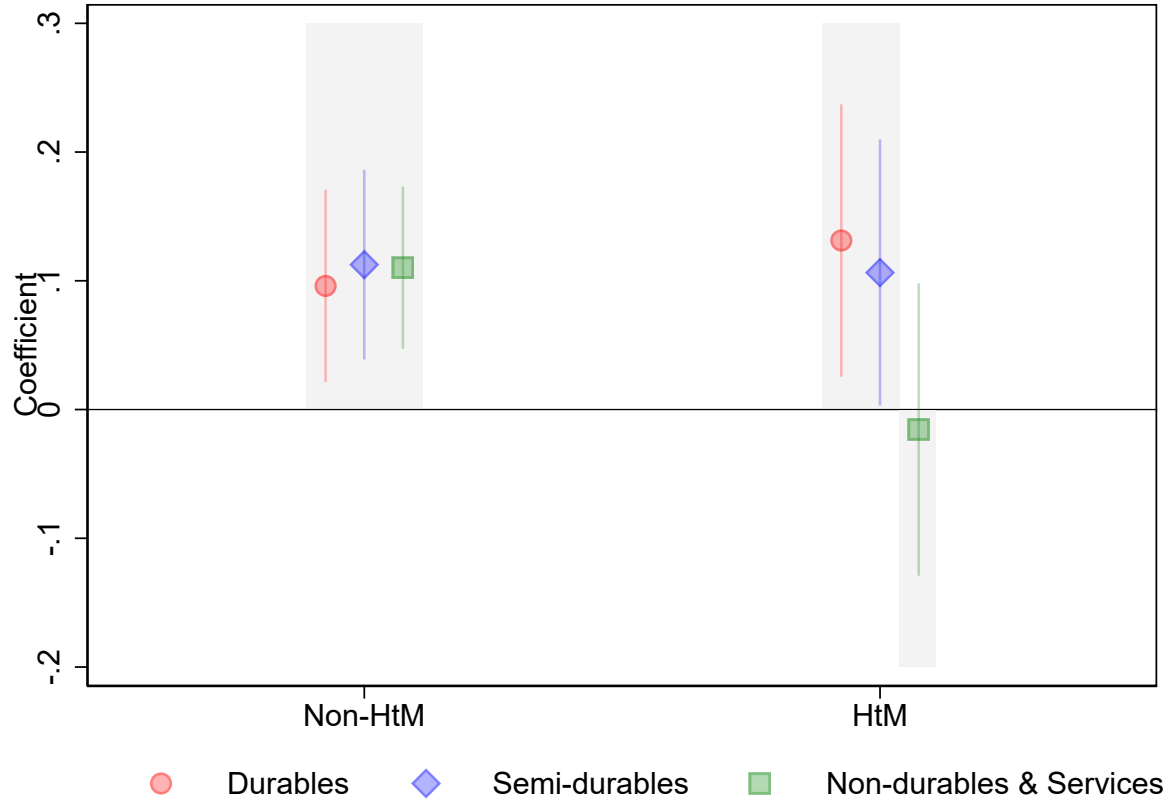
▶ Full results

Evidence | Higher durable inflation expectations, T2

Durable inflation expectations changes on consumption by HtM status

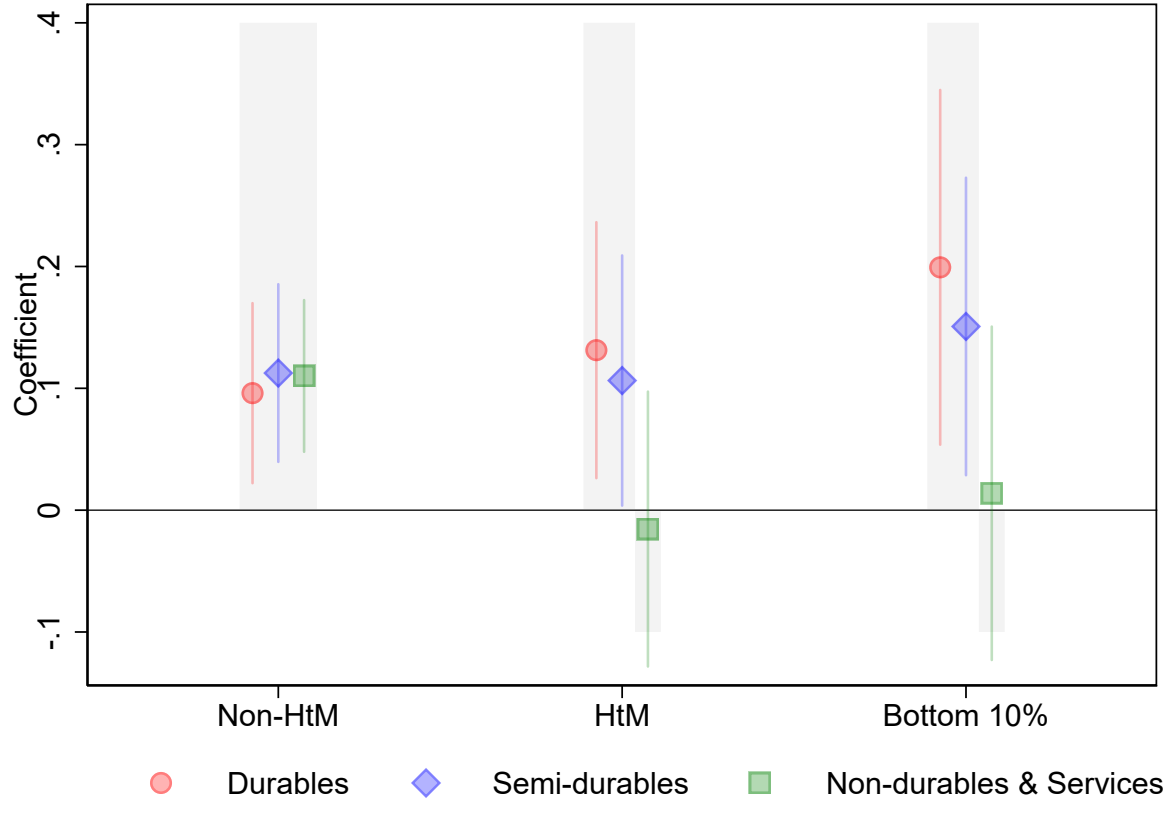


- Non-HtM: increases spending in all consumption categories
- HtM: increases durable investment, sacrificing non-durable expenditure

▶ Full results

Evidence | Higher durable inflation expectations, T2

Durable inflation expectations changes on consumption of most restricted HtM



- **Most restricted HtM**: financial constraints amplify adjustments; relevance of durables as a smoothing mechanism for most vulnerable households

General equilibrium analysis

Model sketch

- **Environment**: textbook TANK + durable industry

▷ Two representative households consuming durables & non-durables

▷ Rest of the economy

  - Labor-only production of intermediate goods, under nominal rigidities
  - Abstract from zero-net-supply in the market of bonds
  - Nominal interest rate set by a monetary authority

Households | Overview

▷ Unit mass of infinitely lived households with identical preferences

- HtM ($i = \mathrm{H}$): share $\Lambda^{\mathrm{H}} \in (0, 1)$
- non-HtM ($i = \mathrm{S}$): share $\Lambda^{\mathrm{S}} = (1 - \Lambda^{\mathrm{H}})$

▷ Identical situation at the household-type-level: two representative agents

▷ Different from the PE model

- Endogenous labor supply
- non-HtM acquires equity shares (Bilbiie, 2008)
  - ↪ $\Omega_{j,t-1}$: shares in sector $j = \{c, d\}$ at the beginning of t
  - ↪ $v_{j,t}$: average market value of $\Omega_{j,t}$
  - ↪ $P_{j,t}\Pi_{j,t}$: nominal profits per share

Households | Optimization problem

▷ Representative household $i = \{\mathrm{H}, \mathrm{S}\}$ solves

$$\max_{\left\{z_{i,k},\, c_{i,k},\, l_{i,k},\, \left\{B_k,\, \{\Omega_{j,k}\}_{j=\{d,c\}}\right\} \cdot \mathbb{1}_{i=\mathrm{S}}\right\}_{k\geq t}} \sum_{k\geq t} \beta^{k-t} \mathbb{E}_t \left[u\left(c_{i,k},\, d_{i,k},\, l_{i,k}\right)\right]$$

$$\begin{aligned} \text{s.t.} \qquad P_{c,t} c_{i,t} + P_{d,t} z_{i,t} \;=\; & P_{w,t} l_{i,t} + T_{i,t} + \left(R_t B_{t-1} - B_t\right) \cdot \mathbb{1}_{i=\mathrm{S}} \\ & + \sum_{j=\{d,c\}} \left(\Omega_{j,t-1}\left(v_{j,t} + P_{j,t}\Pi_{j,t}\right) - \Omega_{j,t} v_{j,t}\right) \cdot \mathbb{1}_{i=\mathrm{S}} \end{aligned}$$

$$d_{i,t} \;=\; z_{i,t} + (1-\delta)\, d_{i,t-1}$$

▷ non-HtM transversality condition: $\lim_{k\to\infty} \prod_{h=0}^{k} (R_{t+h})^{-1} B_{t+k} \;=\; 0$

▶ Optimality conditions

▶ Preferences

Firms

- ▷ Two industries: $j = \{c, d\}$
- ▷ Split the production process, two stages
  - A perfectly competitive final good producer aggregates ...
  - ... intermediate varieties supplied by monopolistically competitive firms
- ▷ Labor-only technology
- ▷ NK optimal subsidy removes steady-states markup distortions (Debortoli and Galí, 2024)
- ▷ Sector-specific NK Phillips Curve (Calvo, 1983)

$$\hat{\pi}_{j,t} = \beta \mathbb{E}_t \left[\hat{\pi}_{j,t+1}\right] + (1 - \theta_j)(1 - \beta\theta_j)(\theta_j)^{-1} \widehat{mc}_{j,t}$$

  - $mc_{j,t}$: real marginal cost of intermediate firms in sector j
  - $(1 - \theta_j)$: probability of price setting of intermediate firms in sector j

Counterpart of savings & monetary policy

- ▷ Exogenous and constant non-durables endowment ω_c, no labor supply
- ▷ Maximizes utility from non-durable consumption $c_{x,t}$, using bond holdings $B_{x,t}$
  - Balances the non-HtM's saving position
- ▷ To correct saving imbalances: $R_{x,t+1} = R_{t+1} e^{-\phi_B B_{x,t}}$ (Schmitt-Grohé and Uribe, 2003)
- ▷ The policy instrument adjusts to sectoral inflation and a non-systematic disturbance

$$R_{t+1} = \bar{R}^{1-\rho_R} R_t^{\rho_R} e^{\iota_{m,t}} \prod_{j=\{d,c\}} (\pi_{j,t})^{\phi_j}$$

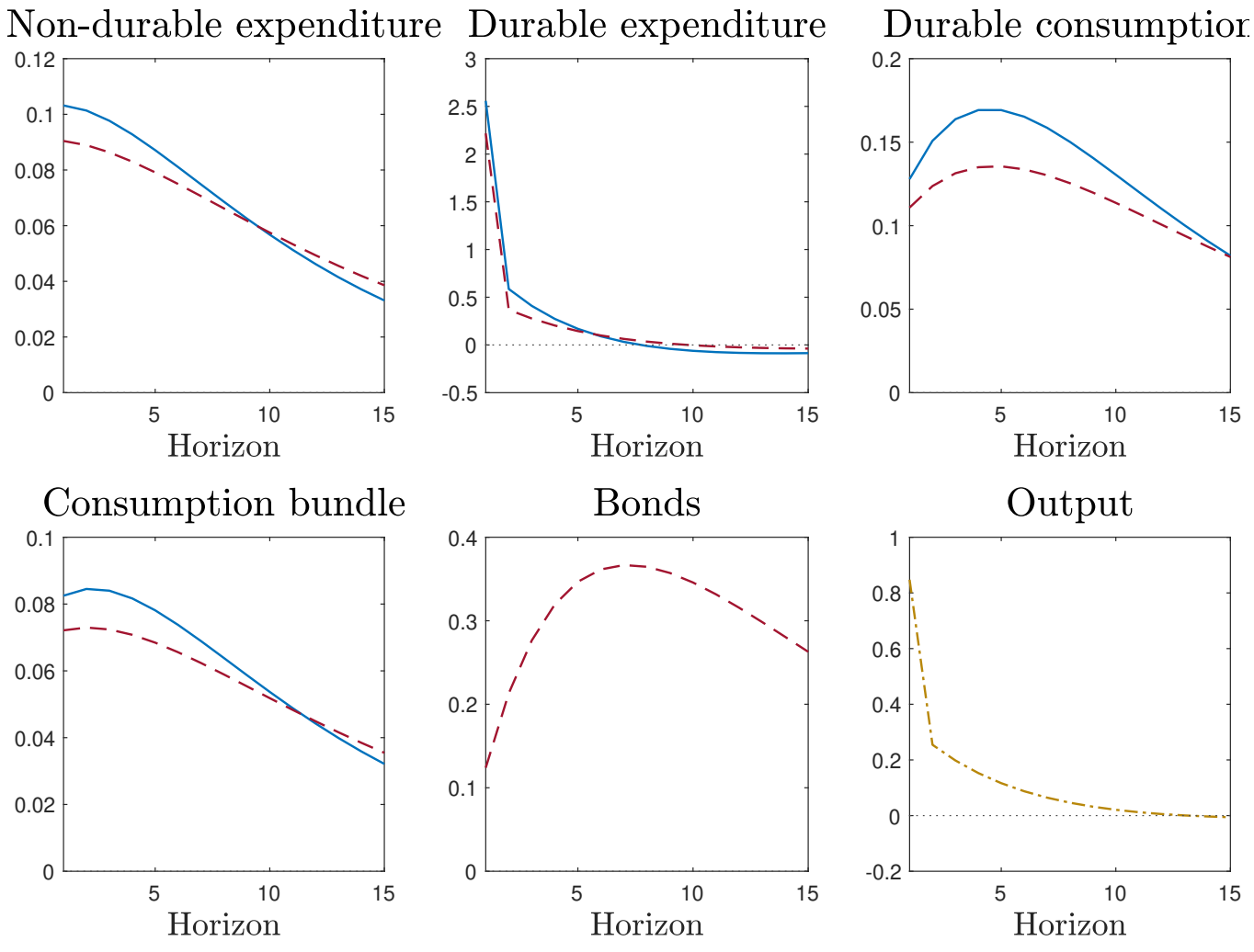
  - $\phi_j > 1$: sector-specific reaction coefficient
  - $\iota_{m,t}$: AR(1) monetary policy shock
- ▷ Equal after-profit transfers across households

▶ Market clearing conditions

Calibration

Parameter	Value	Source	Description
β	0.99	Beraja and Wolf (2021)	Households' discount factor
δ	0.05	Barsky et al. (2016)	Rate of depreciation of durables
κ	0.00	Beraja and Wolf (2021)	Governs the convexity of durables' adjustment costs
σ	1.00	Beraja and Wolf (2021)	Inverse of the intratemporal elasticity of substitution
ζ	1.00	Beraja and Wolf (2021)	Inverse of the intertemporal elasticity of substitution
η	0.50	Bachmann et al. (2024)	Inverse of the Frisch labor supply elasticity
χ	10.0	Bachmann et al. (2024)	Households' relative labor utility cost
ϕ	0.70	Barsky et al. (2016)	Steady-state share of non-durable consumption
θ	0.75	Bachmann et al. (2024)	Calvo's price stickiness in each sector.
ϕ_j	1.50	Auclert et al. (2020)	Reaction to sectoral inflation
ρ_m	0.83	Auclert et al. (2020)	Persistence of monetary policy shocks
σ_m	0.57	Auclert et al. (2020)	Standard deviation of monetary policy shocks

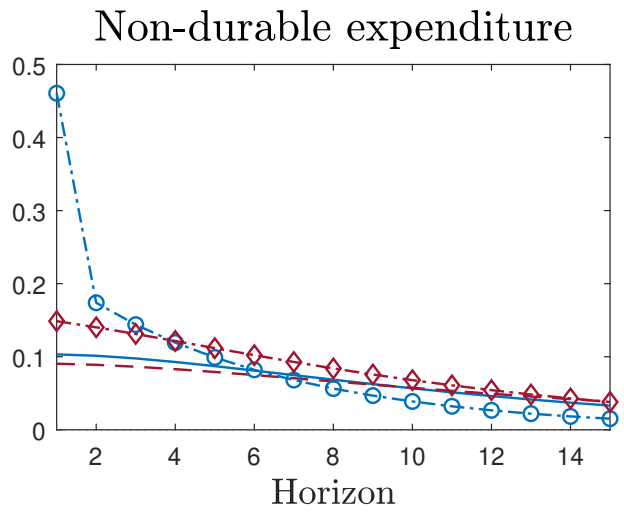
Monetary policy shock | Result 1: HtM & non-HtM

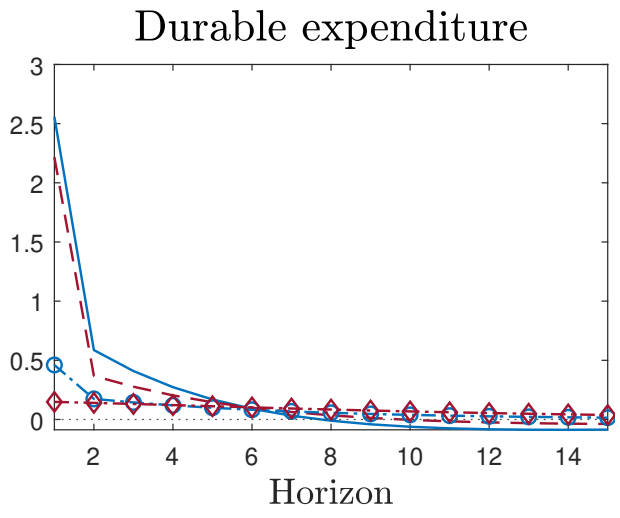


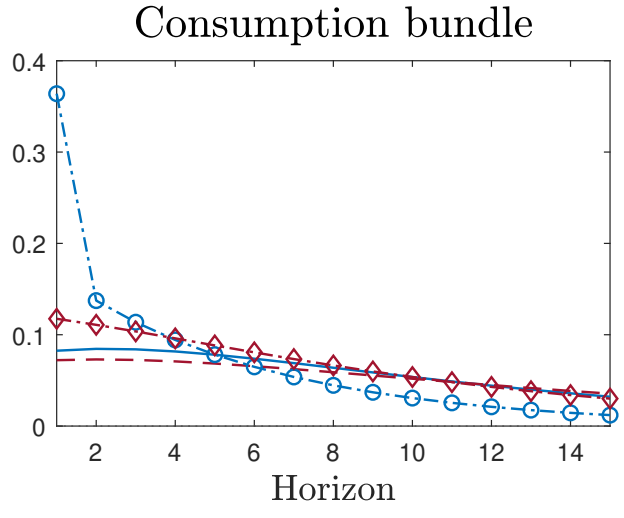
- Durables substitute for financial assets in smoothing consumption
- Durables loosen the consumption-income link

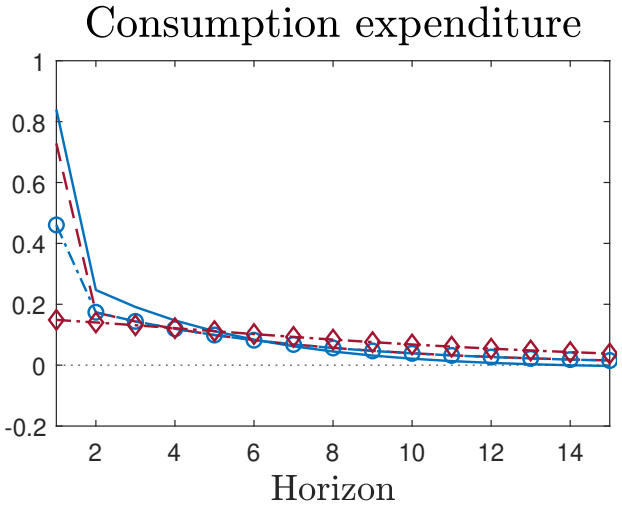
▶ All figures

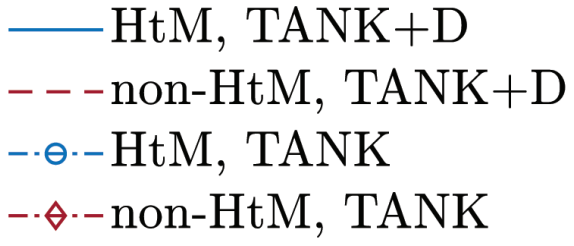
Monetary policy shock | Result 2: TANK+D & TANK





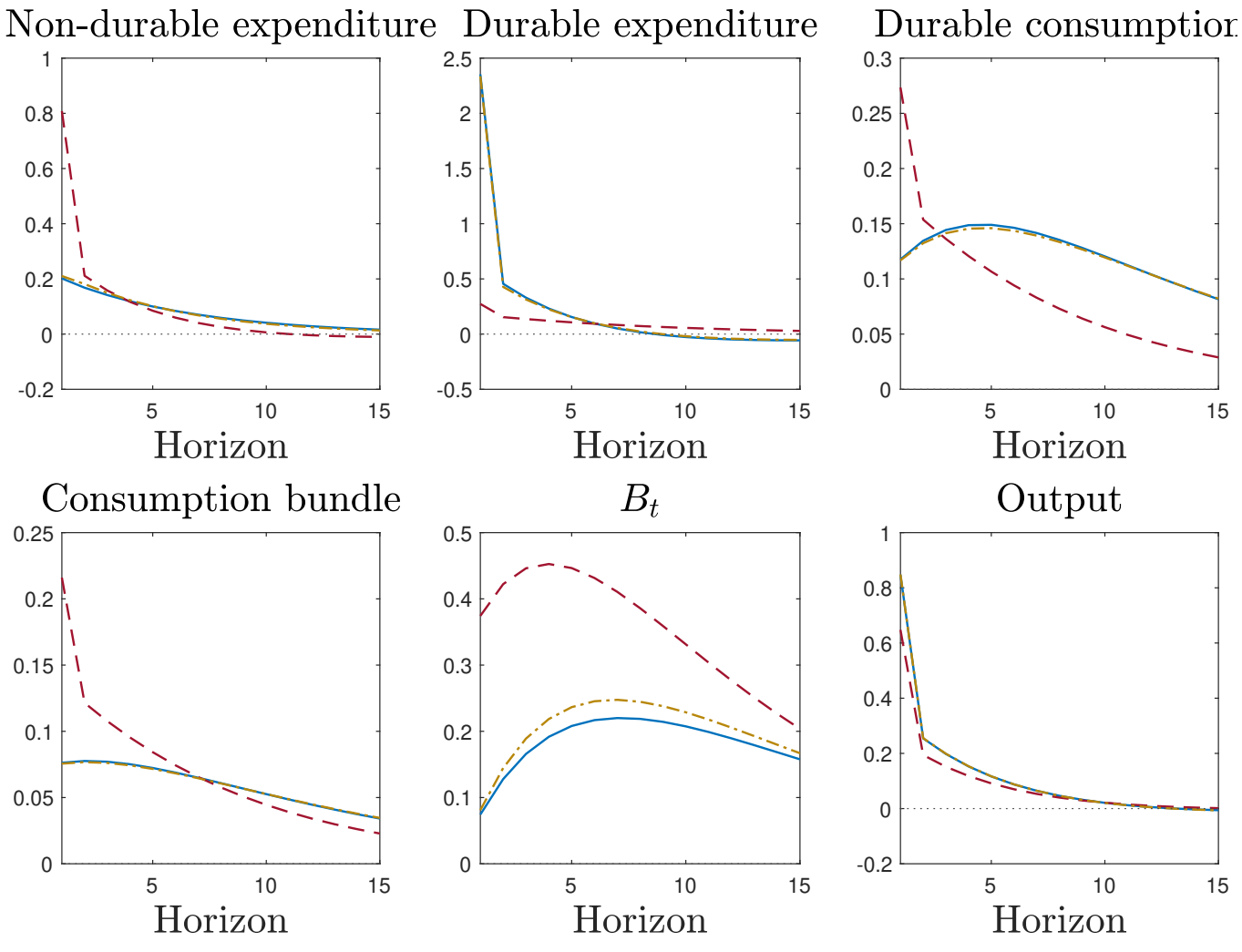






- Sharp reaction on durable spending, front-loading to smooth consumption
- Spending becomes more volatile, yet consumption is stabilized

Monetary policy shock | Result 3: TANK+D & RANK



- The forward-looking HtM makes TANK+D to closely resemble RANK
- Durables smooth consumption, dampening households heterogeneity

▶ All figures

Conclusions

- ▷ Durables introduce a forward-looking dimension for the HtM household
- ▷ The forward-looking behavior of the HtM household is relevant for individual & aggregate outcomes
- ▷ We provide empirical validation of the forward-looking HtM households
- ▷ Integrating durables into TANK models dampens the role of household heterogeneity for aggregate results

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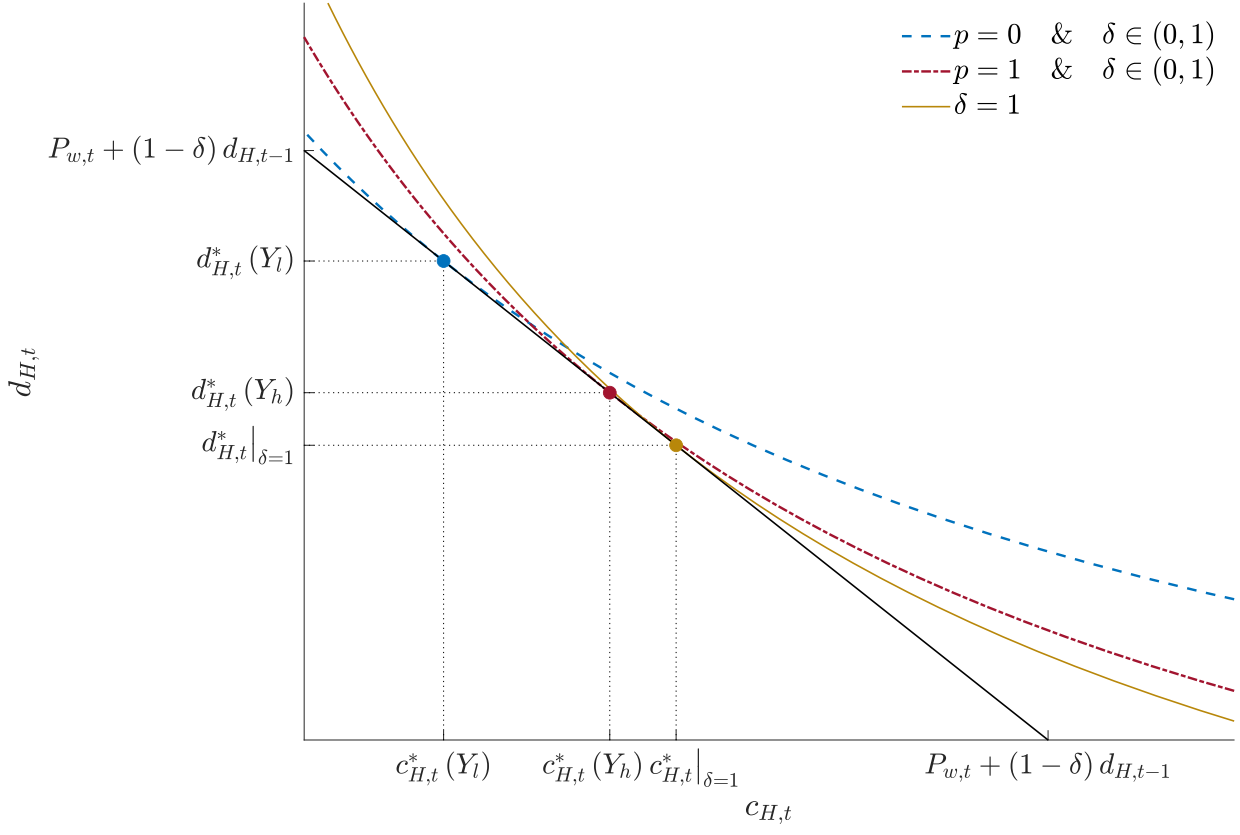
Optimal HtM consumption

HtM consumption in period t using the stripped-down model



- $\delta = 1$: allocations are independent of future states of the world, p is irrelevant
- $\delta \in (0,1)$ flattens the IC, more when anticipating higher marginal utility

Return

Optimal consumption responses

Lemma 1

Given a one-time, isolated and exogenous change in the expected inflation $\mathbb{E}_t[\pi_{j,t+1}]$ of the nominal price $P_{j,t}$ / $j = \{d, c, w\}$, optimal consumption responses satisfy

$$\frac{\partial z_{i,t}}{\partial \mathbb{E}_t[\pi_{j,t+1}]} = \mathcal{D}_i\left(\frac{\partial \mathbb{E}_t[q_{t+1}]}{\partial \mathbb{E}_t[\pi_{j,t+1}]}, \frac{\partial \mathbb{E}_t[w_{t+1}]}{\partial \mathbb{E}_t[\pi_{j,t+1}]}, \frac{\partial \mathbb{E}_t[r_{t+1}]}{\partial \mathbb{E}_t[\pi_{j,t+1}]} \cdot \mathbb{1}_{i=\mathrm{S}} \,\middle|\, \Theta\right)$$
$$\frac{\partial c_{i,t}}{\partial \mathbb{E}_t[\pi_{j,t+1}]} = \mathcal{C}_i\left(\frac{\partial \mathbb{E}_t[q_{t+1}]}{\partial \mathbb{E}_t[\pi_{j,t+1}]}, \frac{\partial \mathbb{E}_t[w_{t+1}]}{\partial \mathbb{E}_t[\pi_{j,t+1}]}, \frac{\partial \mathbb{E}_t[r_{t+1}]}{\partial \mathbb{E}_t[\pi_{j,t+1}]} \cdot \mathbb{1}_{i=\mathrm{S}} \,\middle|\, \Theta\right)$$

where $i = \{\mathrm{H}, \mathrm{S}\}$, and $\mathcal{D}_i(\bullet), \mathcal{C}_i(\bullet) : \mathbb{R}^3 \to \mathbb{R}$.

- Policy function: household-specific
- Responses: hinge on changes in expected relative prices
- HtM: no sensitivity to changes in expected real interest rate

Return

HtM candidates | Survey questions

Question 1 : *paycheck-to-paycheck*

QH.1 Thinking about your current household's situation, how strongly do you agree or disagree with the statement: "My household lives *paycheck-to-paycheck*"?

- ◯ I strongly agree.
- ◯ I somewhat agree.
- ◯ I neither agree nor disagree.
- ◯ I somewhat disagree.
- ◯ I strongly disagree.

Question 2 : *borrow*

QH.2 If your household needed to borrow one week's worth of your monthly household income, how easy or difficult would it be for your household to come up with the money?

- ◯ It would be extremely difficult.
- ◯ It would be relatively difficult.
- ◯ It would be neither easy nor difficult.
- ◯ It would be relatively easy.
- ◯ It would be extremely easy.

HtM candidates | Survey questions

Question 3 : *savings*

QH.3 Which fraction of your income do you save?

- ◯ I spend all of my income each month.
- ◯ I spend more money than I earn, and I often use credit cards or other loans to supplement my monthly income.
- ◯ I save around 10% of my monthly income.
- ◯ I save around 25% of my monthly income.
- ◯ I save at least 50% of my monthly income.

Question 4 : *weeks*

QH.4 Suppose your household loses its primary source of income today. How long can your household cover its weekly expenses with your household's total money in checking and savings accounts or other liquid financial assets such as cash, stocks, government and corporate bonds, and mutual and money market funds? Please give your best guess.

- If my household loses its primary source of income today, we can cover our expenses for _____ week(s) using the money in our checking and saving accounts plus other liquid financial assets.

Return

Mean values by HtM status

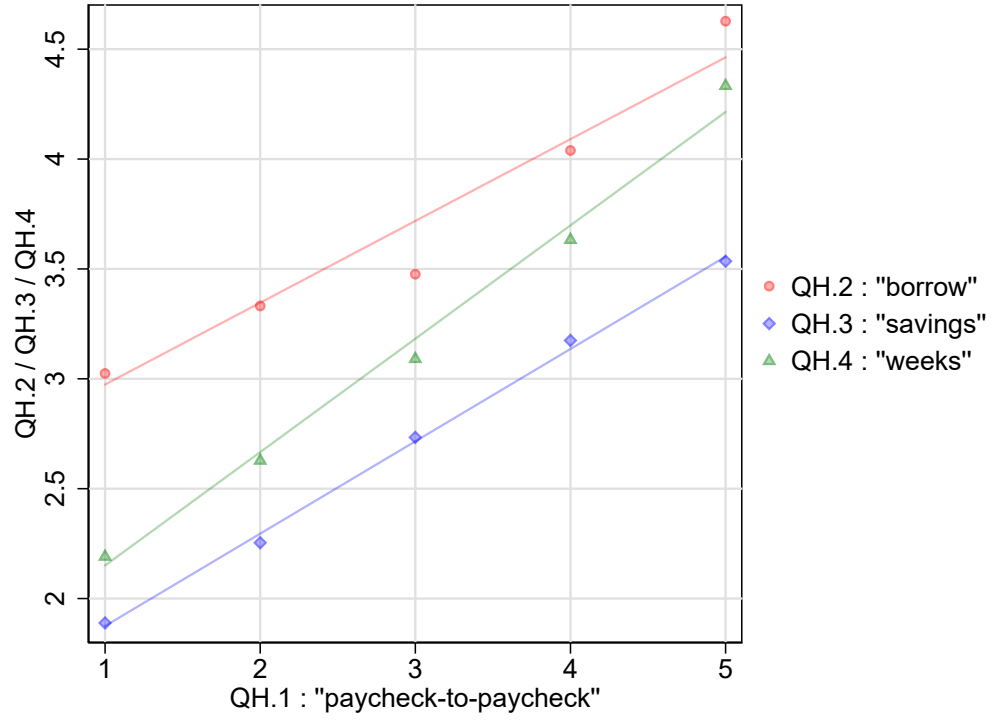
Mean value of demographic and socioeconomic variables by HtM status

	Full sample	non-HtM	HtM
Age	49.1	49.8	48.1
Female	0.50	0.44	0.58
Number of children	1.50	1.55	1.44
Education	Some college, but no degree	Some college, but no degree	Some college, but no degree
Income	$35,000-$49,999	$50,000-$99,999	$35,000-$49,999
Completion time	12.68	12.60	12.80
Observations	5,529	3,231	2,298

Return

Strong correlation & internal consistency

Relationship between the answers to the different HtM questions



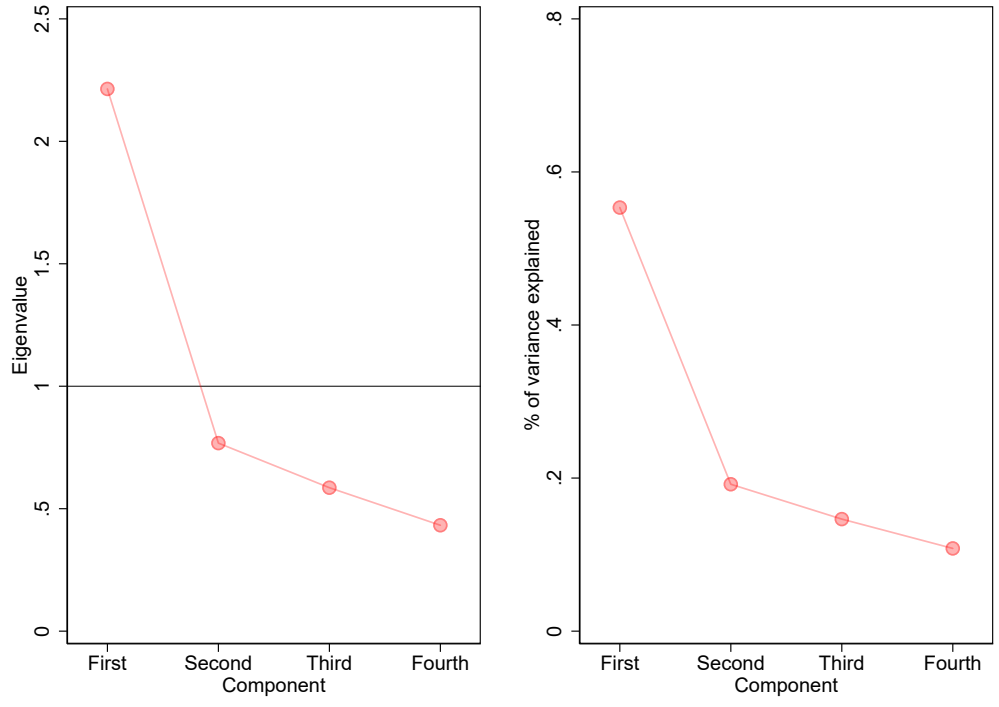
Note: The figure presents binned scatter plots between the different HtM questions and the question labeled as "*paycheck-to-paycheck*" (QH.1), with the latter plotted on the x-axis and the remaining questions on the y-axis. The number of bins used in each plot is 5.

- Lower values represent a higher probability of being an HtM respondent

Return

Dominant & significant share of variance

Eigenvalue and Variance explained of each principal component



Note: The figure provides two scree plots summarizing the results of the PCA. The left panel plots the eigenvalue associated with each principal component, while the right panel illustrates the proportion of total variance explained by each principal component.

Return

Sample balanced across treatment arms

Balance test on pre-treatment covariates

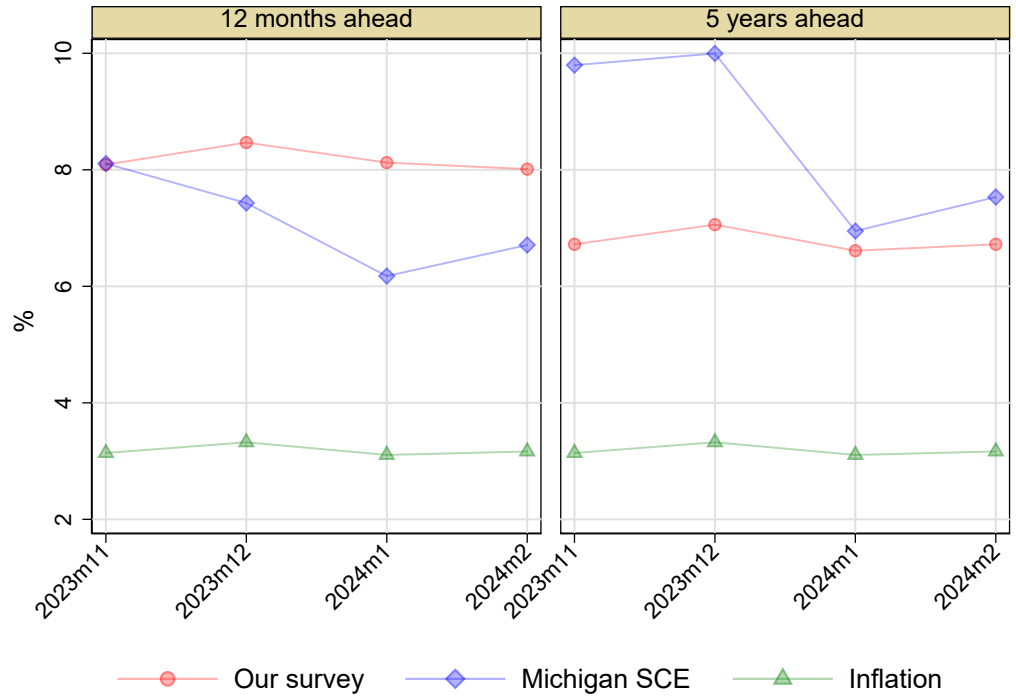
	T-test or χ^2-test p-value					
	C & T1	C & T2	C & P	T1 & T2	T1 & P	T2 & P
Age	0.92	0.82	0.23	0.92	0.34	0.40
Gender	0.54	0.37	0.99	0.81	0.59	0.44
Education level	0.55	0.14	0.82	0.13	0.39	0.75
Civil status	0.22	0.20	0.24	0.70	0.34	0.64
Household net income	0.09	0.32	0.07	0.05	0.10	0.05
Number of children	0.58	0.91	0.67	0.70	0.94	0.77
Political affiliation	0.51	0.95	0.74	0.27	0.77	0.45
English fluency	0.46	0.08	0.39	0.56	0.21	0.05

Note: The columns in the table report p-values from balance tests conducted across treatment groups for different demographic and socioeconomic variables measured before treatment implementation. We conducted a t-test or a χ^2-test depending on the variable's nature. C denotes the passive control group, P corresponds to the placebo group, and T1 and T2 are the first and second treatment groups. The second row in the table provides information about the comparison groups in the analysis performed in each column.

Return

Prior & posterior beliefs

Inflation expectations and actual inflation rate



Note: The figure presents the time series of the averages of our collected data and the raw data from the University of Michigan's Survey of Consumers. The series plotted are the annual inflation expectations 12 months and 5 years ahead, alongside the actual inflation rate. Our collected inflation expectations data have been trimmed at the weekly frequency by excluding the top and bottom 2.5% of the distribution.

Return

Descriptive statistics by survey & HtM status

Summary statistics on respondents' inflation expectations

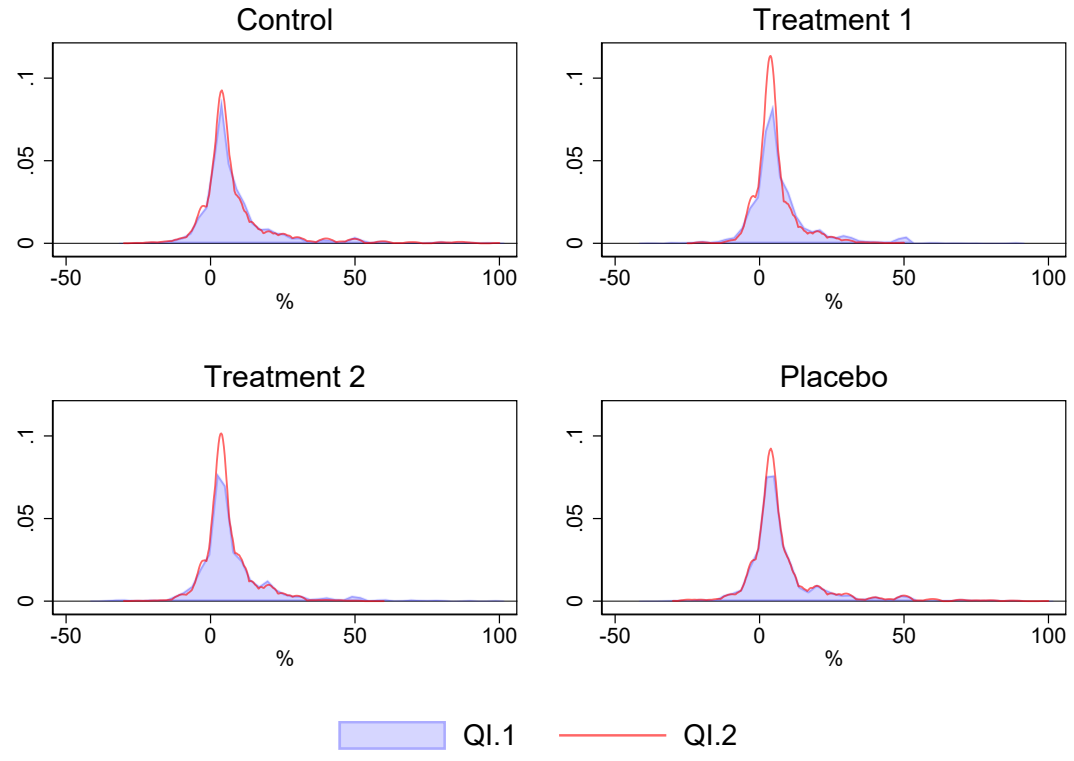
Inflation expectations	Michigan SCE		Full sample		HtM		non-HtM	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
12 months ahead	6.8	6.7	8.2	5.0	8.7	5.0	7.8	4.0
5 years ahead	8.3	7.5	6.8	4.0	6.9	5.0	6.6	4.0

Note: The table reports descriptive statistics of the answers to the prior (QI.1) and posterior (QI.2) questions using our collected data and the raw data from the University of Michigan's Survey of Consumers. Our collected inflation expectations data have been trimmed at the weekly frequency by excluding the top and bottom 2.5% of the distribution.

Return

Treatments | Validation

Kernel density of inflation expectations by treatment status



- Posterior densities of T1 & T2: bunching on treatment value & larger kurtosis
- Suggestive evidence of successful treatments affecting beliefs

Return

Treatments | Validation

Treatment effects on medium-run inflation expectations

	(1)	(2)	
Variable$_j$		Variable$_j$	Variable$_j \times H_j$
$prior_j$	0.856***	0.857***	−0.033
	(0.012)	(0.008)	(0.023)
$treat_{j,1}$	1.798***	1.540***	0.284
	(0.197)	(0.276)	(0.289)
$treat_{j,1} \times prior_j$	− 0.486***	− 0.424***	−0.041
	(0.018)	(0.035)	(0.037)
$treat_{i,2}$	1.894***	1.526***	0.926***
	(0.204)	(0.226)	(0.324)
$treat_{j,2} \times prior_j$	− 0.459***	− 0.442***	−0.010
	(0.017)	(0.031)	(0.035)
$treat_{i,3}$	0.149	−0.036	0.424
	(0.194)	(0.221)	(0.278)
$treat_{j,3} \times prior_j$	0.001	−0.000	0.005
	(0.016)	(0.019)	(0.035)
Observations	5,529	5,529	
R^2	0.792	0.793	

Note: The dependent variable is the posterior belief measure $post_j$. The omitted category is the passive control group. Robust standard errors are reported in parentheses. The set of fixed effects includes week and U.S. state fixed effects. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. The inflation expectations data have been trimmed at the weekly frequency by excluding the top and bottom 2.5% of the distribution.

Return

Heterogeneous effects by HtM status | 2SLS

▷ First-stage:

$$\begin{aligned} post_j \times (1 - \mathrm{H}_j) &= \alpha^{\mathrm{S}} + \mathbf{X}_j (\boldsymbol{\beta}^{\mathrm{S}})' + \eta^{\mathrm{S}} \times prior_j + \sum_{\tau=\{1,2\}} \Big[\gamma^{\mathrm{S}}_{\tau,1,\mathrm{S}} (treat_{j,\tau} \times (1 - \mathrm{H}_j)) + \gamma^{\mathrm{S}}_{\tau,1,\mathrm{H}} (treat_{j,\tau} \times \mathrm{H}_j) \\ &\quad + \gamma^{\mathrm{S}}_{\tau,2,\mathrm{S}} (treat_{j,\tau} \times prior_j \times (1 - \mathrm{H}_j)) + \gamma^{\mathrm{S}}_{\tau,2,\mathrm{H}} (treat_{j,\tau} \times prior_j \times \mathrm{H}_j) \Big] + \upsilon^{\mathrm{S}}_j \\ post_j \times \mathrm{H}_j &= \alpha^{\mathrm{H}} + \mathbf{X}_j (\boldsymbol{\beta}^{\mathrm{H}})' + \eta^{\mathrm{H}} \times prior_j + \sum_{\tau=\{1,2\}} \Big[\gamma^{\mathrm{H}}_{\tau,1,\mathrm{S}} (treat_{j,\tau} \times (1 - \mathrm{H}_j)) + \gamma^{\mathrm{H}}_{\tau,1,\mathrm{H}} (treat_{j,\tau} \times \mathrm{H}_j) \\ &\quad + \gamma^{\mathrm{H}}_{\tau,2,\mathrm{S}} (treat_{j,\tau} \times prior_j \times (1 - \mathrm{H}_j)) + \gamma^{\mathrm{H}}_{\tau,2,\mathrm{H}} (treat_{j,\tau} \times prior_j \times \mathrm{H}_j) \Big] + \upsilon^{\mathrm{H}}_j \end{aligned}$$

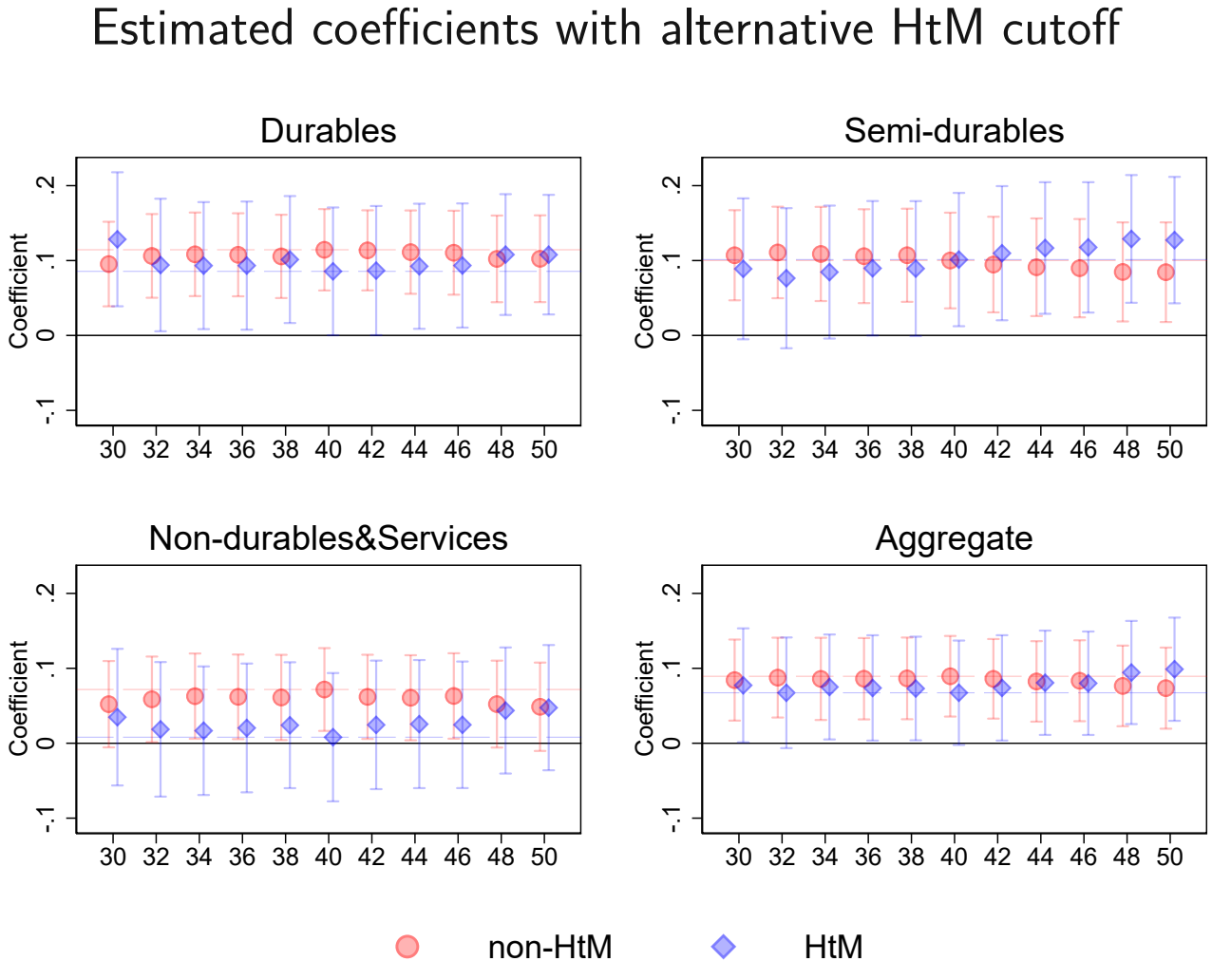
▷ Second-stage:

$$\%\triangle c^{e}_{j,k,h} = \alpha_{k,h} + \mathbf{X}_j \boldsymbol{\beta}'_{k,h} + \eta_{k,h} \times prior_j + \theta^{\mathrm{S}}_{k,h} \times \widehat{post_j \times (1 - H_j)} + \theta^{\mathrm{H}}_{k,h} \times \widehat{post_j \times H_j} + \varepsilon_{j,k,h}$$

- **Key coefficients**: $\theta^{i}_{k,h}$ captures the expectations' causal effect for $i = \{\mathrm{H}, \mathrm{S}\}$

Return

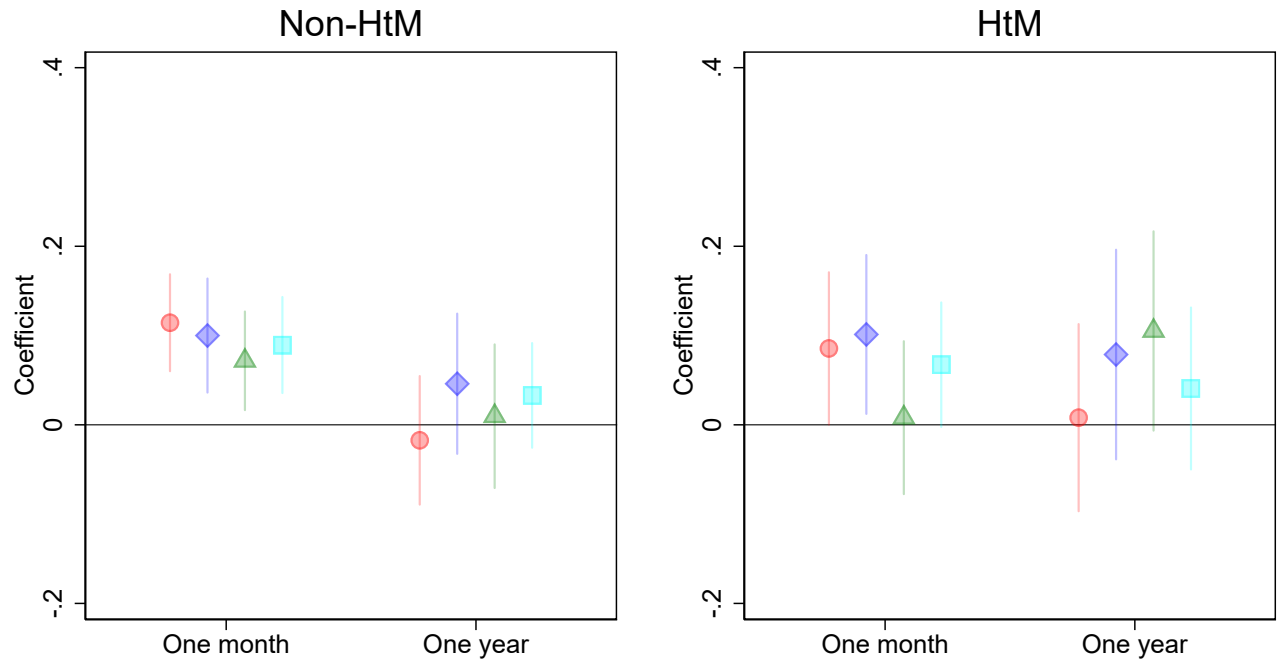
Stability of the inflation expectations coefficients



Return

Evidence | Higher aggregate inflation expectations, pooled

Aggregate inflation expectations changes on consumption by HtM status



Return

Evidence | Higher aggregate inflation expectations, pooled

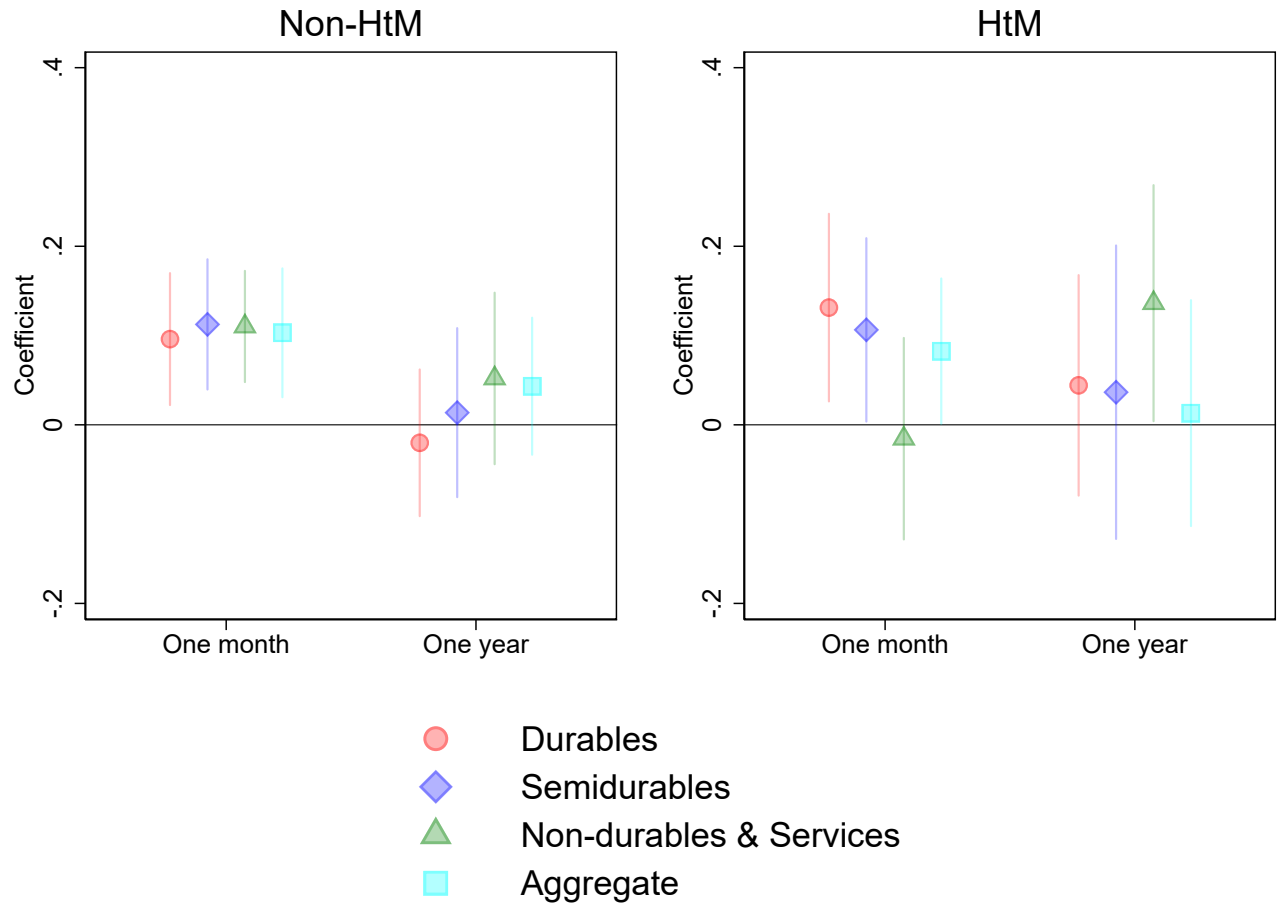
Effects of durable inflation expectations on consumption

	$\%\triangle c^{e}_{j,k,h}$: Intended consumption growth on category k at horizon h							
	Durables		Semi-durables		Non-durables and Services		Aggregate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$post_j \times (1 - \mathrm{H}_j)$	0.114***	-0.017	0.100***	0.046	0.071**	0.009	0.089***	0.033
	(0.033)	(0.043)	(0.038)	(0.047)	(0.033)	(0.048)	(0.032)	(0.035)
$post_j \times \mathrm{H}_j$	0.085*	0.008	0.101*	0.078	0.008	0.105	0.067	0.040
	(0.051)	(0.063)	(0.054)	(0.071)	(0.052)	(0.067)	(0.042)	(0.055)
Horizon	One month	One year	One month	One year	One month	One year	One month	One year
Observations	5,099	5,087	5,095	5,106	4,946	4,953	5,147	5,160
Fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-stat, non-HtM	179.9	176.9	174.0	178.5	171.6	173.7	183.5	184.2
F-stat, HtM	154.8	157.4	158.5	159.0	145.1	151.3	154.0	155.9
R^2	0.134	0.069	0.139	0.079	0.150	0.077	0.223	0.205

Return

Evidence | Higher durable inflation expectations, T2

Durable inflation expectations changes on consumption by HtM status



Return

Evidence | Higher durable inflation expectations, T2

Durable inflation expectations changes on consumption by HtM status

	$\%\triangle c^e_{j,k,h}$: Intended consumption growth on category k at horizon h							
	Durables		Semi-durables		Non-durables and Services		Aggregate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$post_j \times (1 - H_j)$	0.096**	-0.020	0.112**	0.013	0.110**	0.052	0.103**	0.043
	(0.044)	(0.049)	(0.044)	(0.057)	(0.037)	(0.058)	(0.043)	(0.046)
$post_j \times H_j$	0.131**	0.044	0.106*	0.036	-0.015	0.136*	0.082*	0.013
	(0.063)	(0.075)	(0.062)	(0.099)	(0.037)	(0.058)	(0.049)	(0.076)
Horizon	One month	One year	One month	One year	One month	One year	One month	One year
Observations	3,788	3,776	3,796	3,810	3,689	3,690	3,837	3,843
Fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-stat, non-HtM	190.0	186.5	188.3	201.1	198.2	197.1	208.3	203.7
F-stat, HtM	164.4	164.4	167.7	169.7	155.9	163.5	163.1	166.5
R^2	0.146	0.074	0.153	0.093	0.161	0.094	0.224	0.204

Return

Households | Optimality conditions

▷ Two for HtM & non-HtM, $i = \{\mathrm{H}, \mathrm{S}\}$

$$w_t = -\frac{mu^l_{i,t}}{mu^c_{i,t}}$$

$$mu^d_{i,t} = q_t mu^c_{i,t}\left(1 + \frac{\partial \psi_{i,t}}{\partial d_{i,t}}\right) - \beta \mathbb{E}_t\left[q_{t+1} mu^c_{i,t+1}\left((1-\delta)\left(1 + \frac{\partial \psi_{i,t+1}}{\partial d_{i,t+1}}\right) - \frac{\partial \psi_{i,t+1}}{\partial d_{i,t}}\right)\right]$$

▷ Two extra conditions for non-HtM, $i = \mathrm{S}$

$$1 = \beta R_{t+1} \mathbb{E}_t\left[mu^c_{\mathrm{S},t+1}\left(mu^c_{\mathrm{S},t}\right)^{-1}\left(\pi_{c,t+1}\right)^{-1}\right]$$

$$v_{j,t} = \beta \mathbb{E}_t\left[mu^c_{\mathrm{S},t+1}\left(mu^c_{\mathrm{S},t}\right)^{-1}\left(v_{j,t+1} + P_{j,t+1}\Pi_{j,t+1}\right)\left(\pi_{c,t+1}\right)^{-1}\right]$$

Return

Households | Preferences

▷ Quadratic adjustment costs: $\kappa \geq 0$ governs convexity (Beraja and Wolf, 2021)

$$\psi(d_{i,t}; d_{i,t-1}) = \frac{\kappa}{2}\left(\frac{d_{i,t}}{d_{i,t-1}} - 1\right)^2 d_{i,t}$$

▷ King-Plosser-Rebelo type of preferences (King et al., 1988)

$$x\left(c_{i,t}, d_{i,t}\right) = \left[\varrho^{\sigma}\left(c_{i,t}\right)^{1-\sigma} + (1-\varrho)^{\sigma}\left(d_{i,t}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$$

$$u\left(x_{i,t}, l_{i,t}\right) = \frac{\left(x_{i,t}\right)^{1-\zeta}}{(1-\zeta)} - \chi\frac{\left(l_{i,t}\right)^{1+\eta}}{(1+\eta)}$$

- $\sigma \in (0,1)$: inverse of the intratemporal elasticity of substitution
- $\zeta > 0$: inverse of the intertemporal elasticity of substitution
- $\eta > 0$: inverse of the Frisch labor supply elasticity
- $\varrho \in (0,1)$: preference parameter for non-durable goods

Return

Market clearing conditions

- ▷ Bonds market clears: $B_{x,t} = \Lambda^{\mathrm{S}} B_t$
- ▷ Equity market clears in each sector $j = \{d, c\}$: $(\Lambda^{\mathrm{S}})^{-1} = \Omega_{j,t}$
- ▷ Labor market clears:

$$\sum_{i=\{\mathrm{H},\mathrm{S}\}} \Lambda^i l_{i,j,t} = \int_{s_j \in \mathcal{F}_j} n_{s_j,t} ds_j = n_{j,t}$$

$$\sum_{i=\{\mathrm{H},\mathrm{S}\}} \Lambda^i L_{i,t} = \sum_{j=\{d,c\}} \int_{s_j \in \mathcal{F}_j} n_{s_j,t} ds_j = \sum_{j=\{d,c\}} n_{j,t}$$

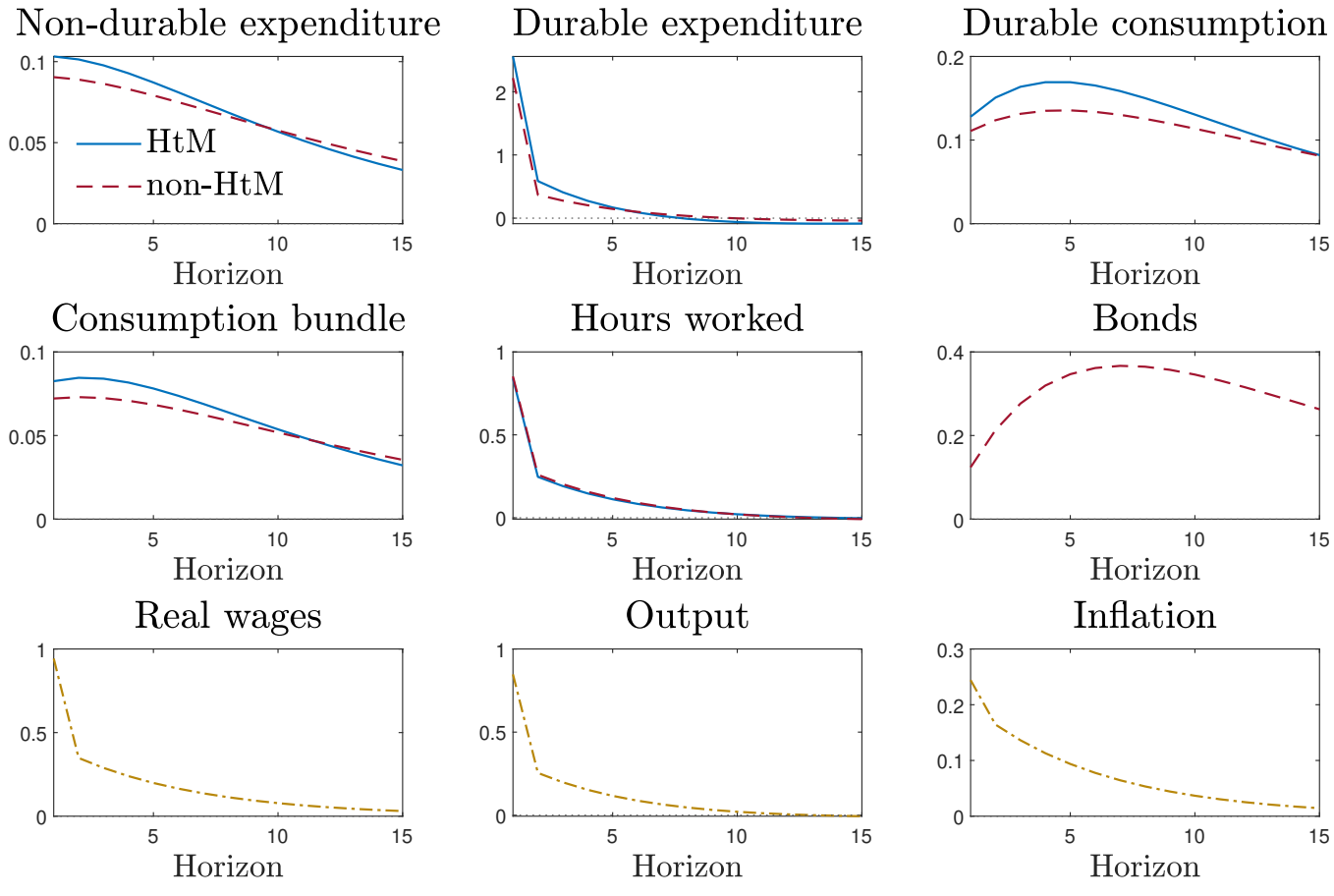
- ▷ Both goods markets clear:

$$y_{c,t} + \omega_c = \sum_{i=\{\mathrm{H},\mathrm{S}\}} \Lambda^i c_{i,t} + c_{x,t}$$

$$y_{d,t} = \sum_{i=\{\mathrm{H},\mathrm{S}\}} \Lambda^i \left[z_{i,t} + \psi \left(d_{i,t}; d_{i,t-1} \right) \right]$$

Return

Expansionary monetary policy shock | HtM v/s non-HtM



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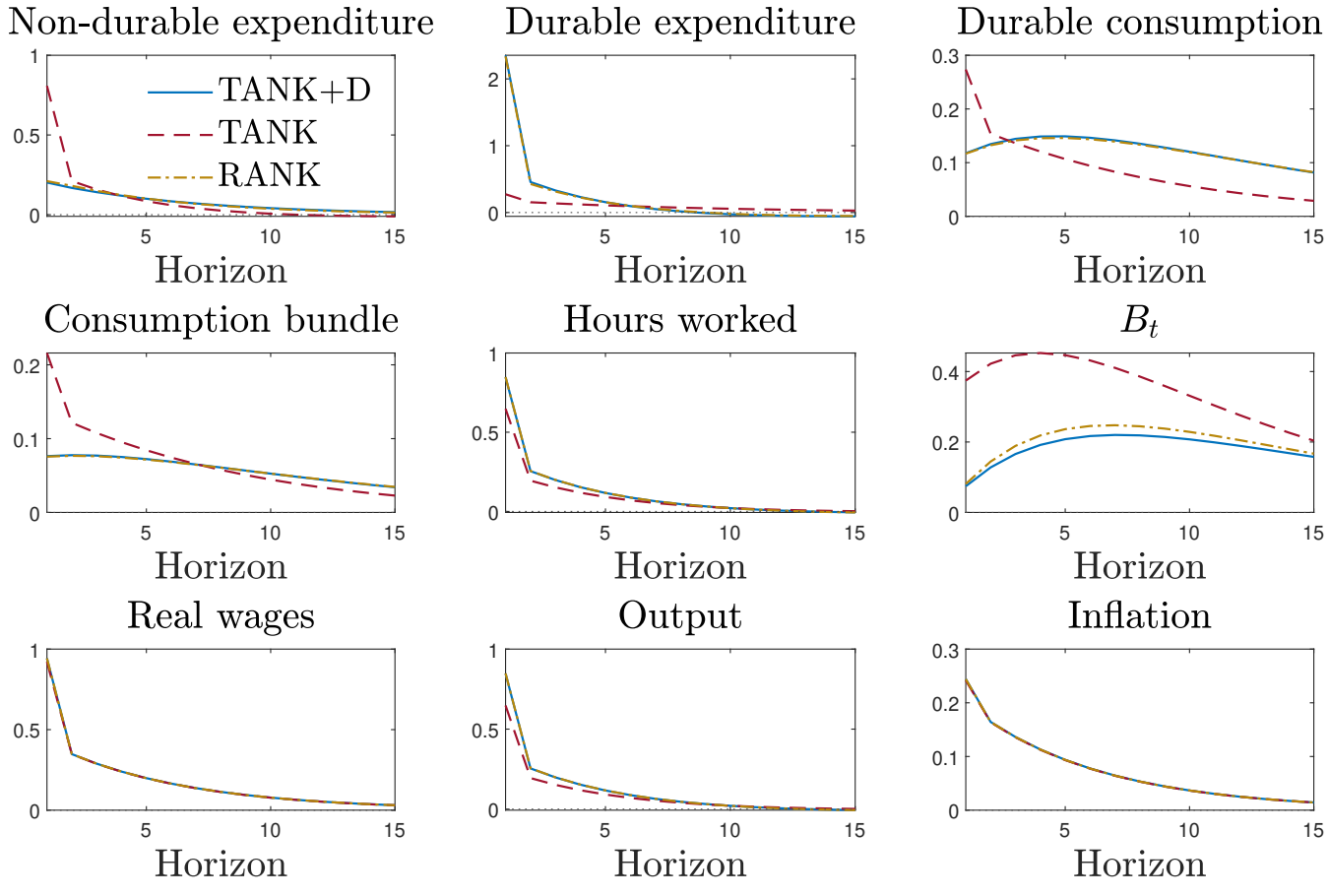
Expansionary monetary policy shock | TANK+D v/s RANK



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