Tractable Heterogeneous Agents Models

C. Cantore[1]

[1] Bank of England & University of Surrey

Guildford
13/09/2021

Any material and views expressed in these slides are those of the author and are not necessarily reflective of views at the Bank of England its committees.

Intro

- Since the seminal work of [Bilbiie, 2008] and [Galí et al., 2004] TANK models have been used in many context.
- A recent growing literature on HANK models has highlighted various limitations of TANK models.
- In this session we will look at a Capitalist-Worker version of TANK.

Readings for this session

- [Cantore and Freund, 2021] and Online Appendix.
- [Bilbiie, 2019a] & [Bilbiie, 2019b] (only very briefly).
- Follow up readings:
  - [Kaplan and Violante, 2018] for a review of what we ARE NOT going to do in this course.
  - [Bilbiie et al., 2020] tHANK with capital: *complementarity between capital and income inequality*.

Limitations of TANK models

- **Extreme intertemporal Marginal Propensity to Consume** (iMPCs) [Auclert et al., 2018] [Hagedorn et al., 2019]
- Implausible **effects of profits on labor supply** [Broer et al., 2019]
- **Indeterminacy** issues with flexible wages: requires **high Frish elasticity** of labor supply [Galí et al., 2007].
- **Time varying precautionary savings**
- Other issues with sticky wages and Fiscal shocks

Notation and changes

- **Savers** will now be called **Unconstrained** (and indexed by U).
- The TANK model we saw earlier will be TANK-UH.
- Assume Calvo sticky prices.
- Both agents supply the same amount of hours
- The model(s) will be augmented with a very simple form of fiscal policy.

Equal Hours

- All households' labor inputs are bundled by a union that sets wages on their behalf according to a wage schedule $\hat{n}_t = \varphi^{-1}(\hat{w}_t - \hat{c}_t)$, where $c_t \equiv \int_0^1 c_t^i di$ and $n_t \equiv \int_0^1 n_t^i di$. T
- This specification, used by [Debortoli and Galí, 2018] and [Bilbiie, 2019b] amongst others, keeps the supply side simple and, in particular, allows for a straightforward introduction of wage stickiness.
- But can have very strong implications for the *marginal propensity to earn* generated by these models ...

Fiscal Policy

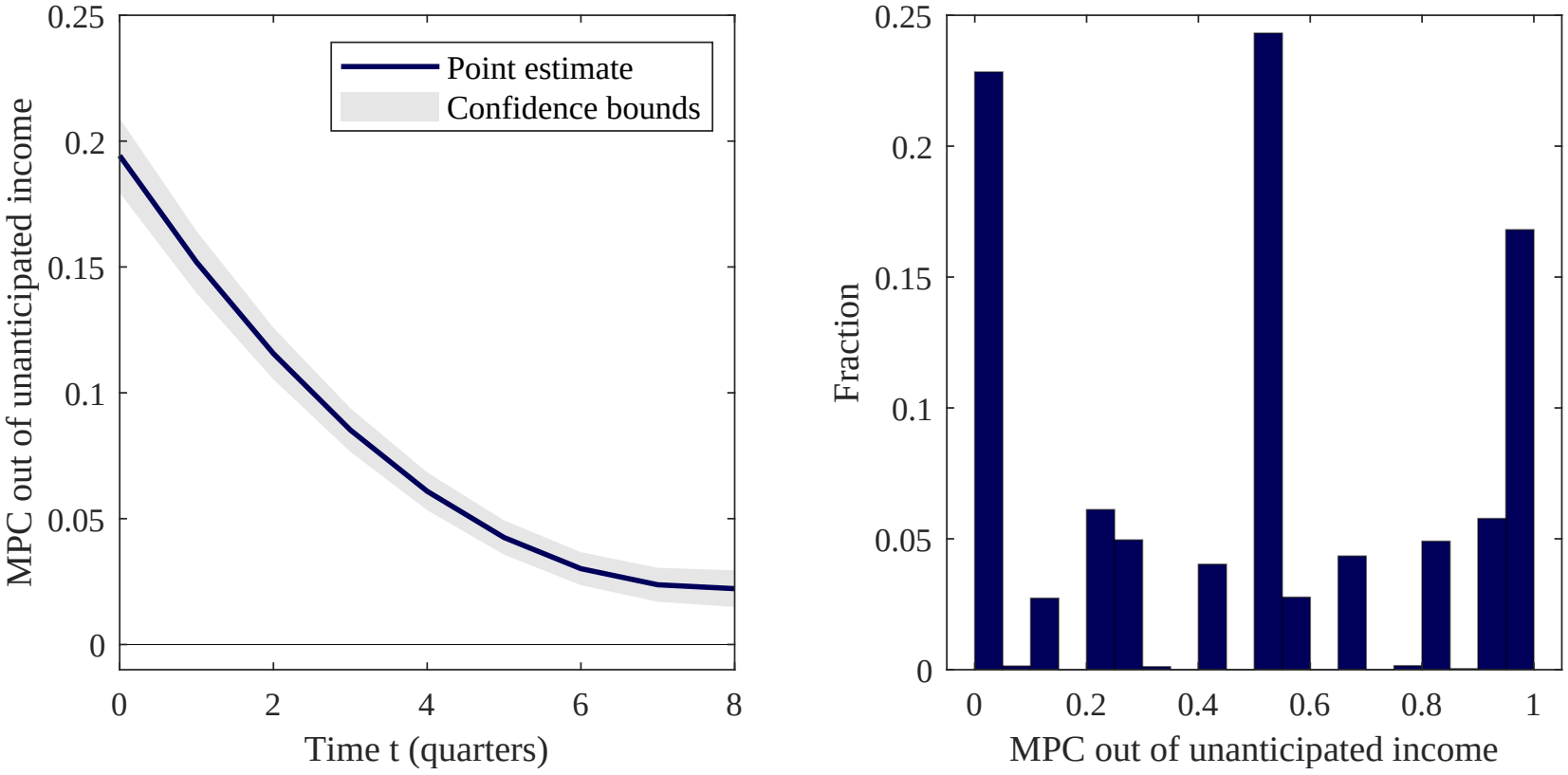
- We abstract from taxes on dividends. Instead both types of agents are subject to a scheme of lump-sum taxes to finance government purchases.
- As in [Bilbiie, 2019b] we impose that total real net taxes t_t are split such that HtM pay (or receive) a share $\lambda t_t^H = \nu t^t$, while unconstrained agents pay (or receive) $(1-\lambda)t_t^U = (1-\nu)t_t$, and impose that $\nu = \lambda$.
- The fiscal authority finances real spending, g_t, which follows an AR(1) process, by issuing one-period bonds and levying lump-sum taxes as described above.
- The financing mix to support spending is determined by a tax rule as in [Galí et al., 2007]

Benchmark TANK

Description	Equation
Euler equation U	$\hat{c}_t^U = E_t \hat{c}_{t+1}^U - (\hat{R}_t - E_t \hat{\Pi}_{t+1})$
Budget constraint U	$\hat{c}_t^U + \tilde{b}_t^U = \hat{n}_t + \hat{w}_t + \frac{\tilde{d}_t}{1-\lambda} - \tilde{t}_t + R\tilde{b}_{t-1}^U$
Budget constraint H	$\hat{c}_t^H = \hat{n}_t + \hat{w}_t - \tilde{t}_t$
Aggregate consumption	$\hat{c}_t = \lambda \hat{c}_t^H + (1-\lambda)\hat{c}_t^U$
Aggregate labor supply	$\hat{n}_t = \varphi^{-1}(\hat{w}_t - \hat{c}_t)$
Dividends	$\tilde{d}_t = -\hat{w}_t$
Phillips curve	$\hat{\Pi}_t = \beta E_t \hat{\Pi}_{t+1} + \frac{(1-\theta)(1-\beta\theta)}{\theta}\hat{w}_t$
Government budget constraint	$\tilde{b}_t = R\tilde{b}_{t-1} + \tilde{g}_t - \tilde{t}_t$
Government spending	$\tilde{g}_t = \rho^g \tilde{g}_{t-1} + \epsilon_t^g$
Fiscal rule	$\tilde{t}_t = \phi^{\tau t}\tilde{t}_{t-1} + \phi^{\tau B}\tilde{b}_t + \phi^{\tau G}\tilde{g}_t$
Taylor rule	$\hat{R}_t = \phi^{\pi}\hat{\Pi}_t$
Fisher equation	$\hat{r}_t = \hat{R}_t - E_t\hat{\Pi}_{t+1}$
Bond holdings	$\tilde{b}_t = (1-\lambda)\tilde{b}_t^U$

Table 1: TANK - U(nconstrained) H(and-to-Mouth)

Empirical iMPCs



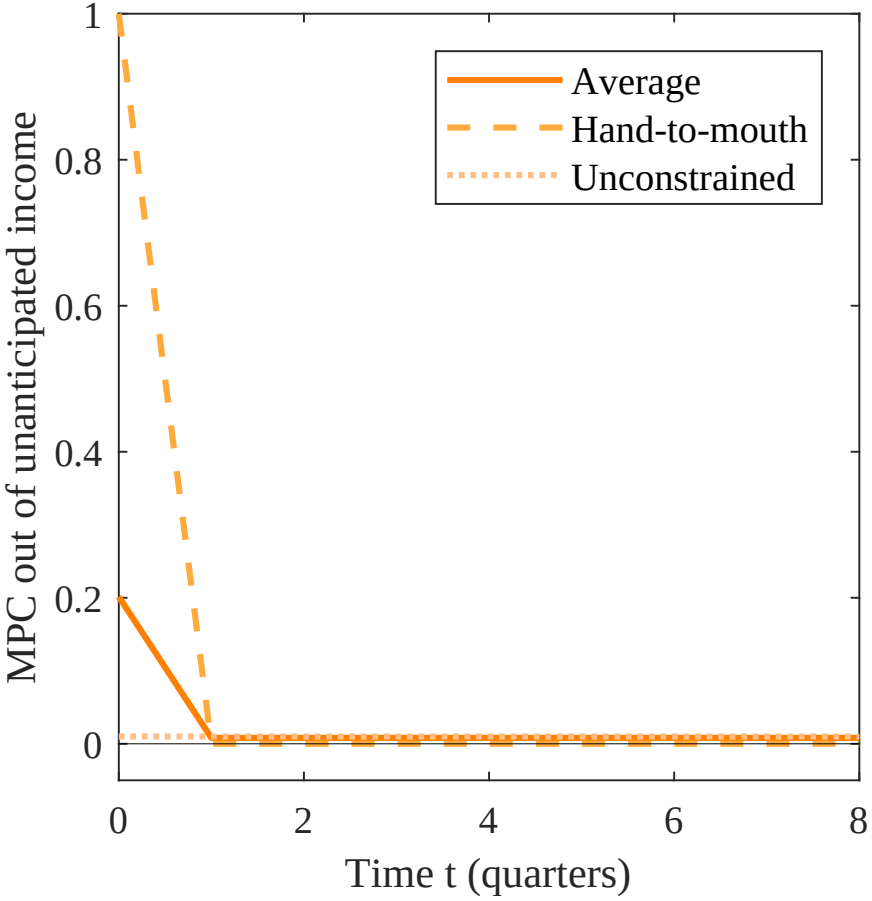
(a) Intertemporal MPCs

(b) Distribution of MPCs

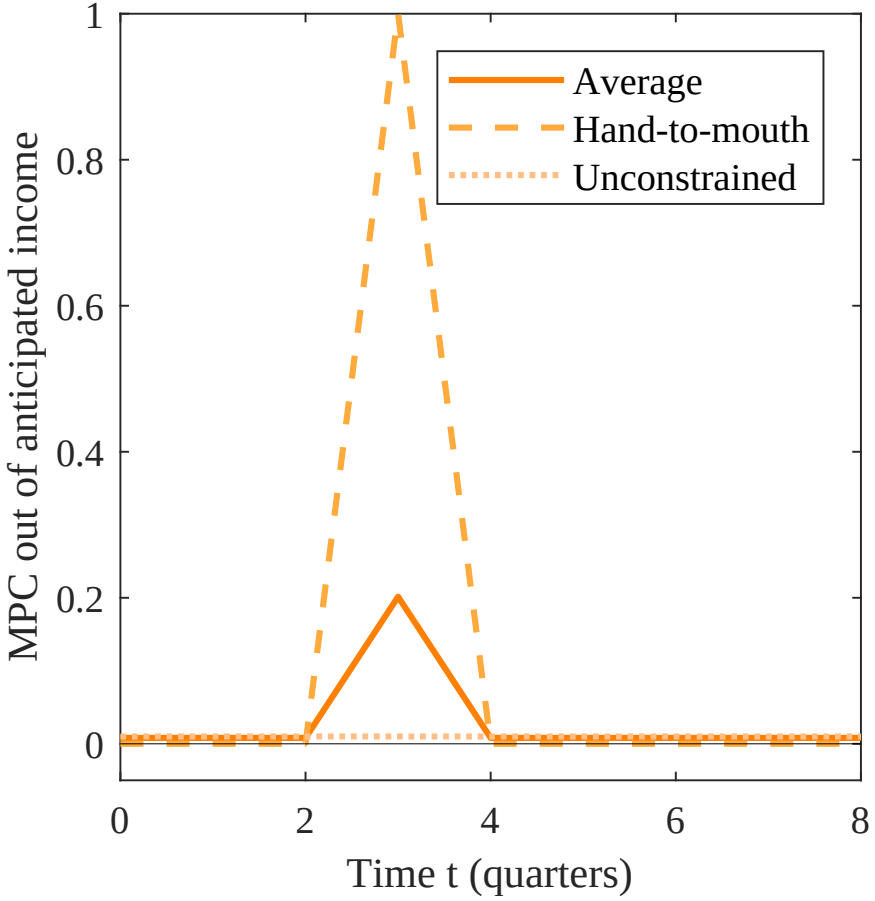
Figure 1: MPCs in the Data

Notes: The left panel shows the dynamic consumption response of a household to an unanticipated income shock estimated by [Fagereng et al., 2018] and analyzed in [Auclert et al., 2018]. The right panel replicates Fig. 1 from [Jappelli and Pistaferri, 2014]: distribution of self-reported MPCs from an unexpected income shock in the 2010 Italian Survey of Household Income and Wealth (SHIW).

UH-TANK iMPCs



(a) $t = 0$ shock



(b) $t = 3$ shock

Income effects of profits on labor supply TANK-UH

- Point made by [Broer et al., 2019] for Monetary policy: strong wealth effect of profits on labor supply of unconstrained.
- Here generalized to Fiscal Policy as well.
- Assume $\tilde{b}_t = 0$ for simplicity.

$$\begin{aligned}
\varphi \hat{n}_t + \hat{c}_t &= \hat{w}_t, \\
\hat{c}_t^U &= \hat{w}_t + \hat{n}_t - \tilde{t} + \frac{\tilde{d}_t}{1-\lambda}, \\
\hat{c}_t^H &= \hat{w}_t + \hat{n}_t - \tilde{t}_t, \\
\hat{c}_t &= \lambda \hat{c}_t^H + (1-\lambda)\hat{c}_t^U, \\
\tilde{t}_t &= \tilde{g}_t
\end{aligned}$$

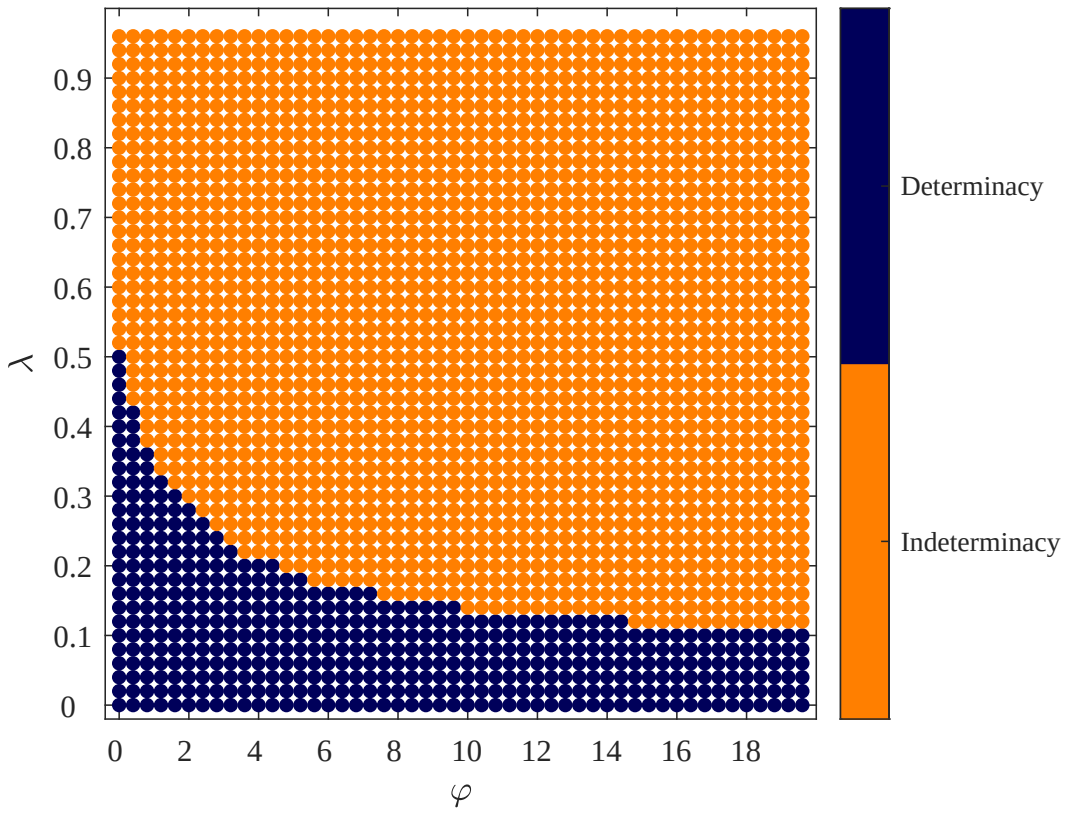
$$\Rightarrow \hat{n}_t = \frac{(\tilde{g}_t - \tilde{d}_t)}{1+\varphi}$$

Income effects of profits on labor supply TANK-CH

- Now let's break the link between profits and labor supply as in [Broer et al., 2019].
- U(nconstrained) become C(apitalist).

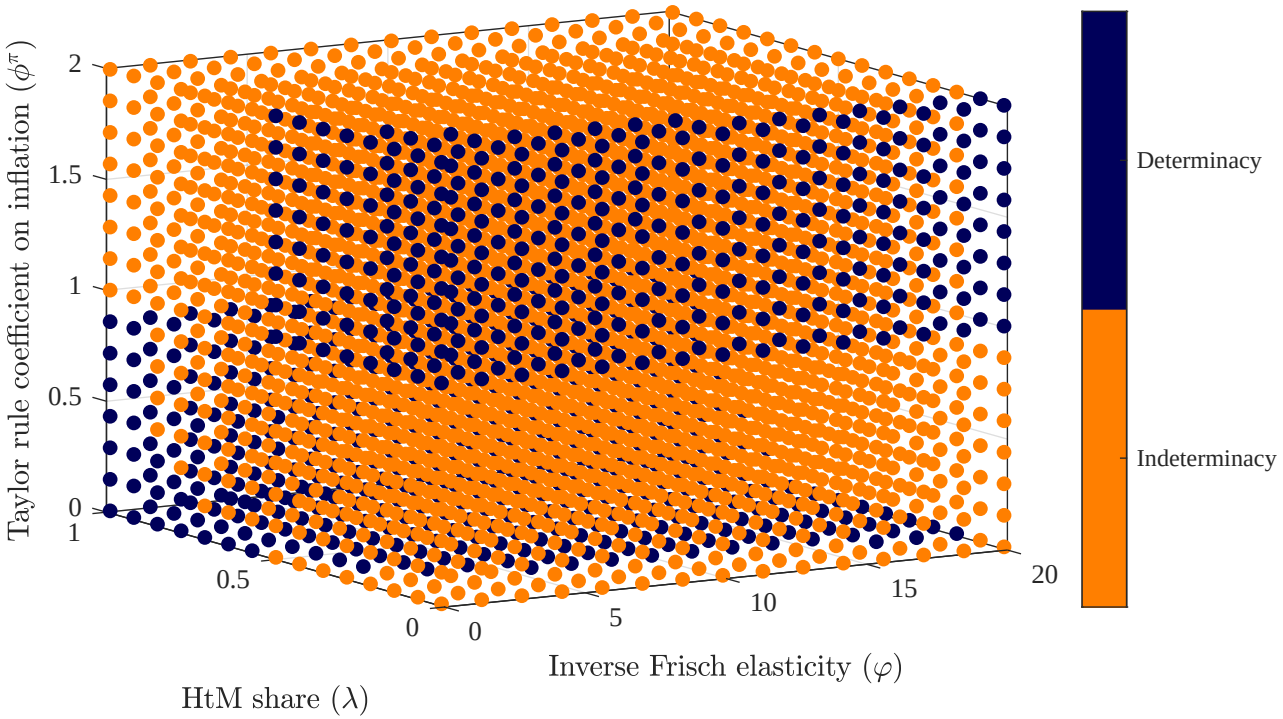
$$
\begin{aligned}
\hat{n}_t^C &= 0, \\
\hat{c}_t^C &= \frac{\tilde{d}_t}{1-\lambda} - \tilde{t}_t, \\
\hat{n}_t &= \lambda \hat{n}_t^H, \\
\varphi \hat{n}_t^H + \hat{c}_t^H &= \hat{w}_t, \\
\hat{c}_t^H &= (\hat{w}_t + \hat{n}_t^H) n^H - \tilde{t}_t, \\
\hat{c}_t &= \lambda \hat{c}_t^H + (1-\lambda) \hat{c}_t^C,
\end{aligned}
\qquad \Rightarrow \hat{n}_t = \frac{\tilde{g}_t}{1+\varphi}
$$

Stability



Stability – λ (H share) vs. φ (inverse of Frish elasticity) TANK-UH.

Stability



Stability regions in the benchmark TANK-UH model

Stability - [Colciago, 2011]

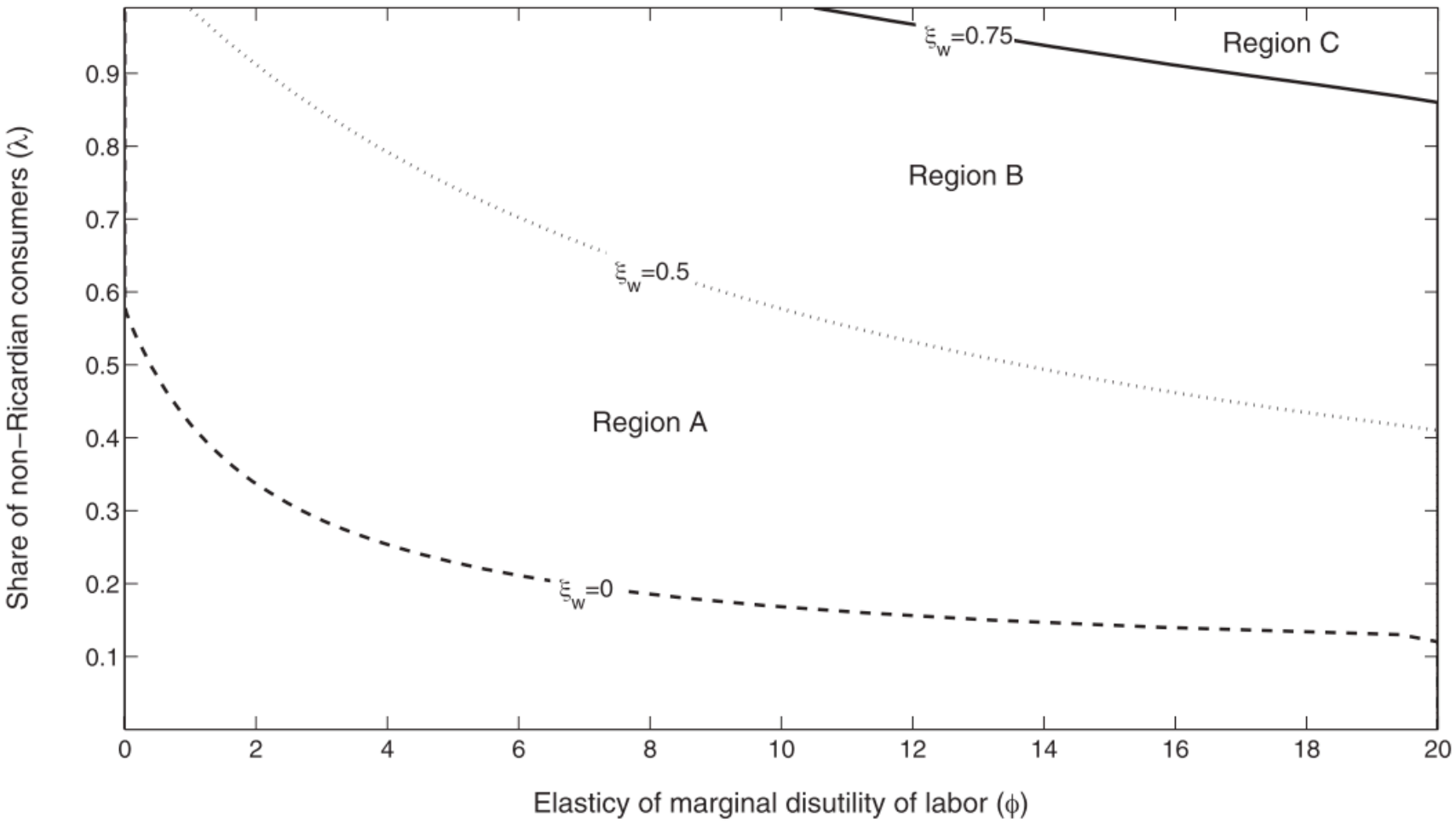


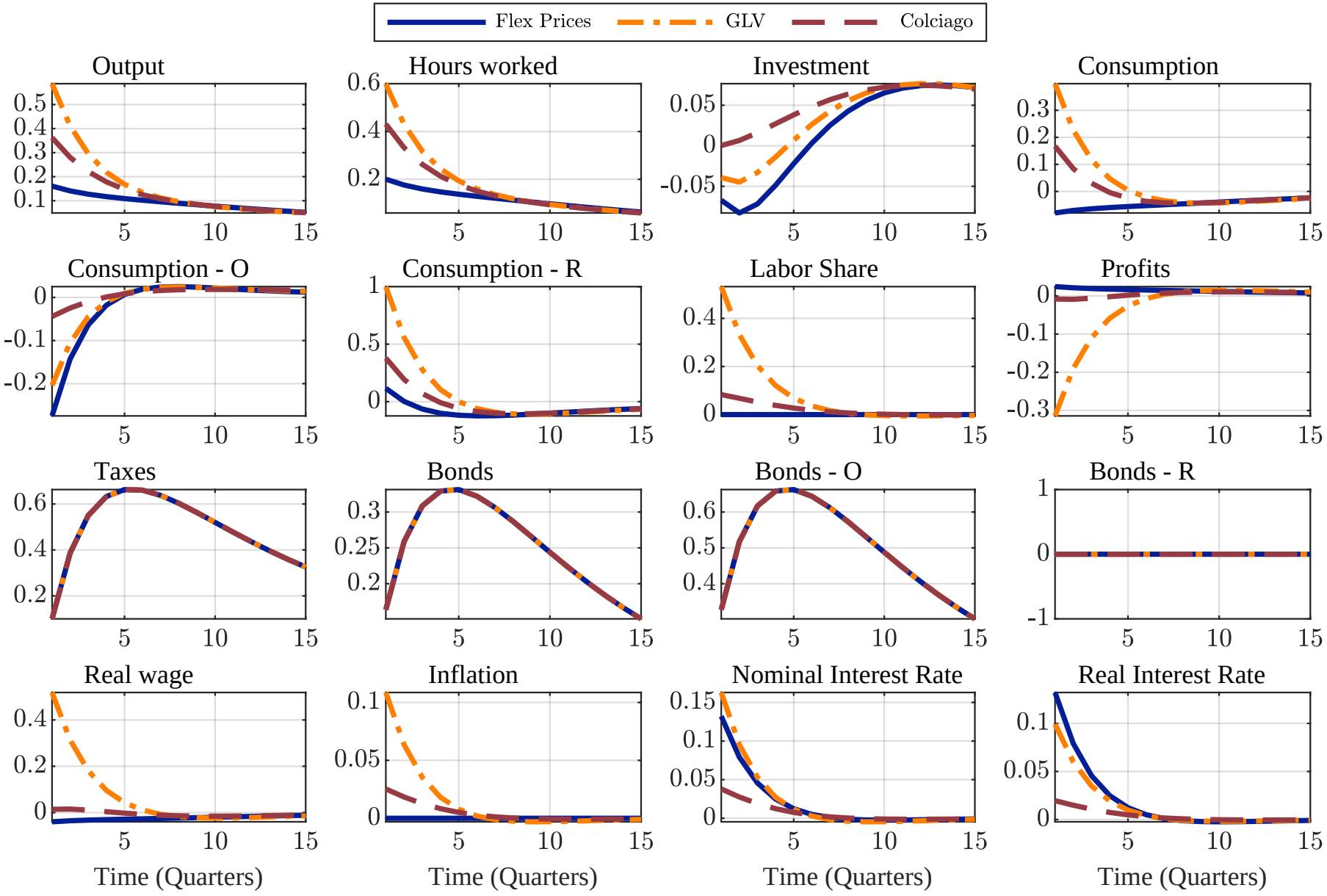
FIG. 2. Determinacy and the Value of ϕ.

NOTES: Indeterminacy regions under alternative degrees of wage stickiness when the monetary authority is assumed to satisfy the Taylor Principle ($\tau_\pi = 1.5$). A + B + C: indeterminacy region under flexible wages; B + C: indeterminacy region when wages have an average duration of two quarters ($\xi_w = 0.5$); C: indeterminacy region when wages have an average duration of four quarters ($\xi_w = 0.75$).

Sticky Wages IRFs

- With sticky wages [Colciago, 2011]:
  - large % of H agents required to generate consumption crowding-in
  - generates acyclical real wage plus procyclical investment

Sticky Wages IRFs



Capitalists & Workers - TANK

- 2 main modifications of standard TANK-UH

  1. **Workers** (**W**) can save subject to **PACs**/ **Hand to mouth** can't (**H**).

  2. **Capitalists** (**C**) do not work / **Unconstrained** (**U**) do.

Portfolio Adjustment costs (PACs): Partial Eq'm

- **Intermediately-constrained** household.
- Let's consider a household of type W(orker) that receives an exogenous post-tax income x_t^i every period and makes consumption/savings choices to maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t u(c_t^i), \tag{1}$$

- Following [Schmitt-Grohe and Uribe, 2003] and [Neumeyer and Perri, 2005], the household is **penalized when their holdings deviate from some benchmark level** $\bar{b}^W$; the strength of this friction is measured by ψ^W
- The per-period budget constraint accordingly is

$$b_t^W + \frac{\psi^W}{2}\left(b_t^W - b^W\right)^2 = x_t^W + b_{t-1}^W \frac{R_{t-1}}{\Pi_t} + f_t - c_t^W, \quad t = 0, 1, 2, \ldots. \tag{2}$$

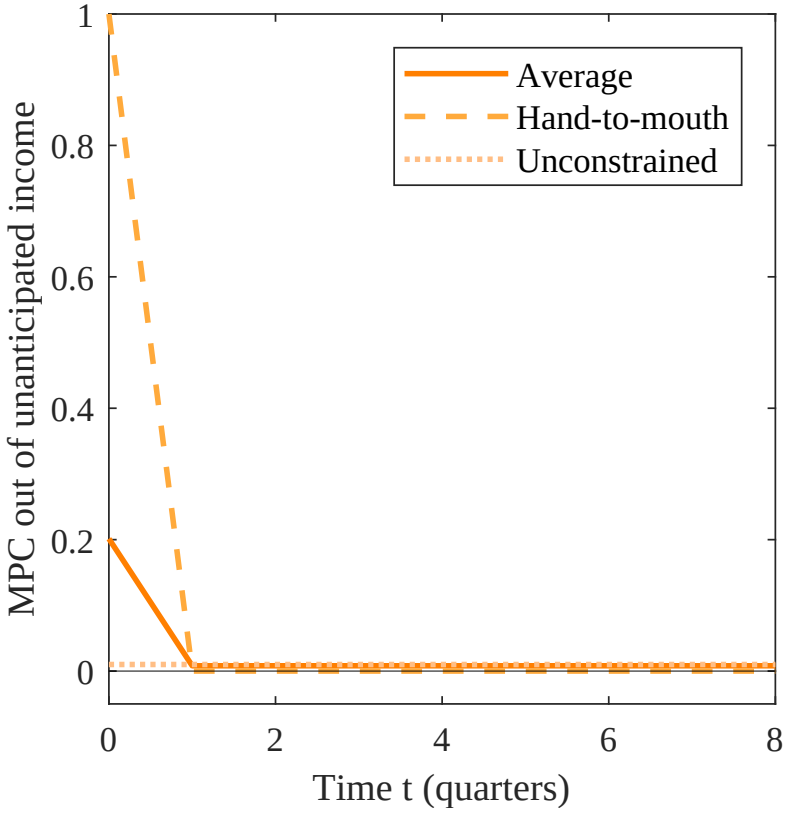
Portfolio Adjustment costs: Partial Eq'm

- Solving the household's problem for the optimal choice of a process for consumption and bond holdings $\{c_t^i, b_t^i\}_{t=0}^{\infty}$ yields the Euler equation

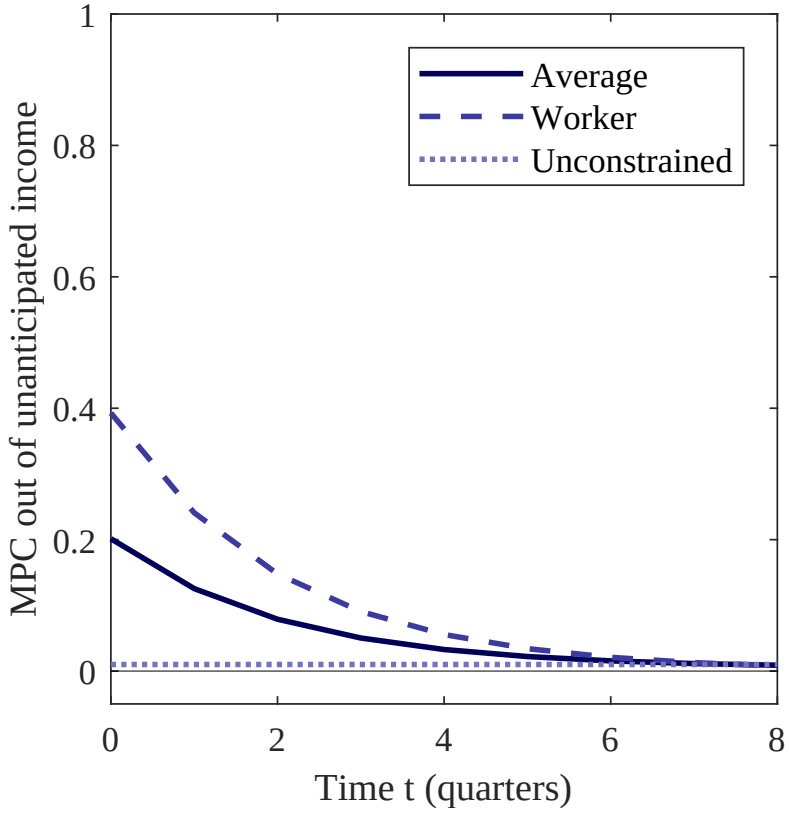
$$u'(c_t^W) = \beta E_t u'(c_{t+1}^W) \frac{(R_t/\Pi_{t+1})}{\mathbf{1} + \psi^{\mathbf{W}}(\mathbf{b_t^W} - \mathbf{b^W})}. \tag{3}$$

- **Endogenous wedge**: RANK is nested for $\psi^W = 0$, whereas if $\psi^W \to \infty$ bank in TANK-UH.

Portfolio Adjustment costs: Partial Eq'm iMPCs



(c) Hand-to-Mouth



(d) PACs

Theoretical iMPCs – Unanticipated Windfall

Portfolio Adjustment costs: Partial Eq'm iMPCs

- Why does the introduction of portfolio adjustment costs help with matching iMPCs?
- The marginal benefit of savings is declining in the level of savings in an proportional way (ψ^W) as it exceeds the steady-state benchmark.
- Consumption smoothing motive is muted.

Portfolio Adjustment costs: Partial Eq'm iMPCs

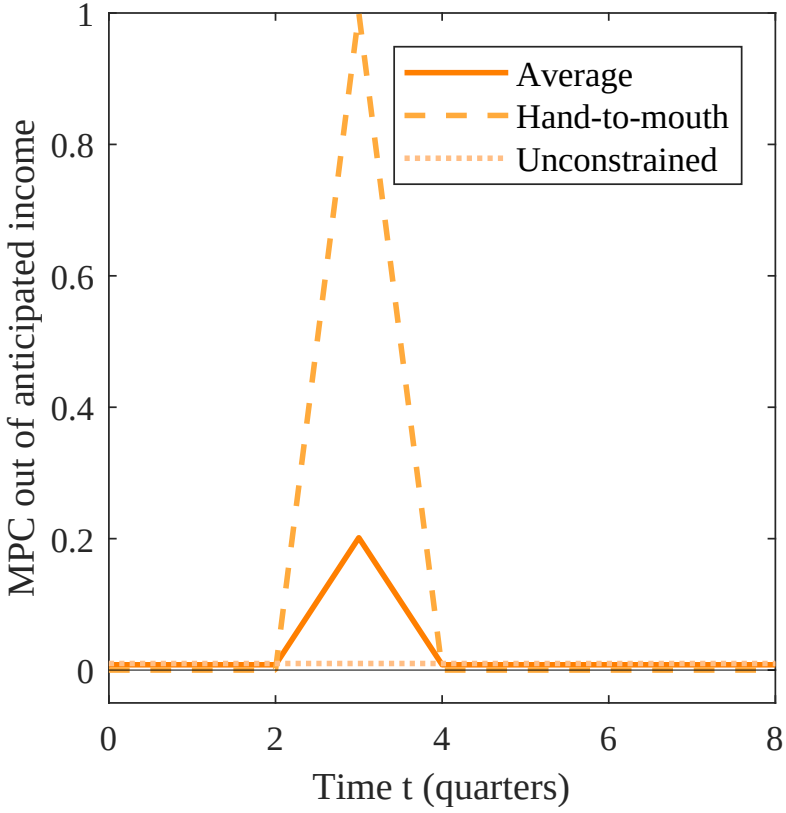
- Combining the log-linearized Euler equation and budget constraint yields

$$\hat{c}_t^W = \underbrace{\frac{1}{1+\psi^W}}_{\equiv\Phi_1}\left[E_t\hat{c}_{t+1}^W - \hat{r}_t\right] + \underbrace{\frac{\psi^W}{1+\psi^W}}_{\equiv\Phi_2}\hat{x}_t + \underbrace{\frac{\psi^W}{1+\psi^W}}_{\equiv\Phi_2} R\tilde{b}_{t-1}^W. \tag{4}$$

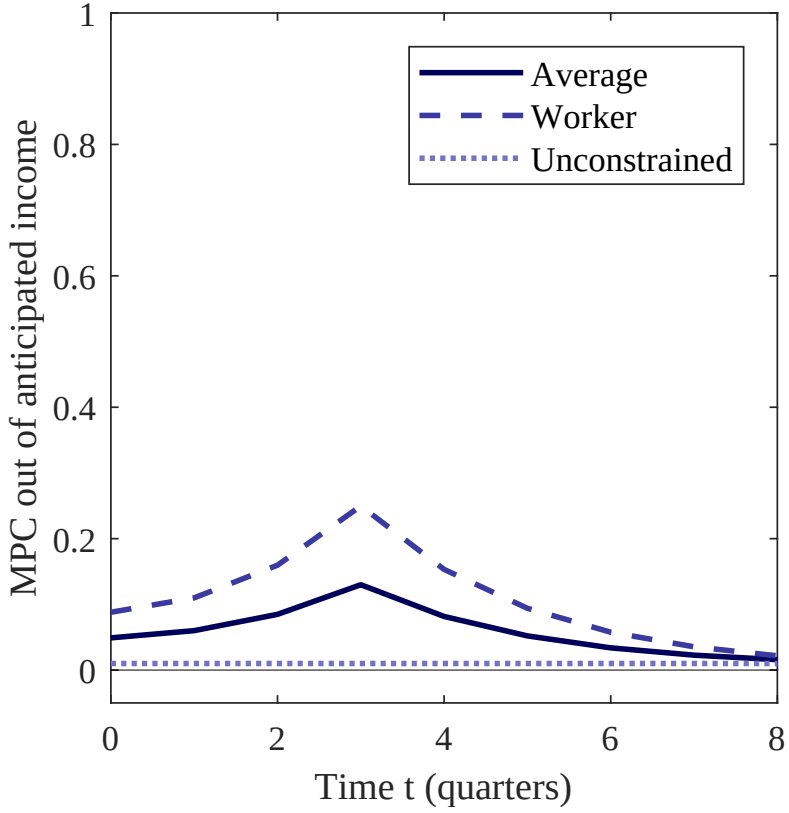
- For $\psi^W > 0$ (and, hence, $\Phi_1 < 1$) the responsiveness of current consumption to shocks to future income (or the interest rate) is more modest the farther away they lie in the future.

- The muted sensitivity of household consumption to interest rates and the greater responsiveness to variations in current income is characteristic of heterogeneous-agent models.

Portfolio Adjustment costs: Partial Eq'm iMPCs



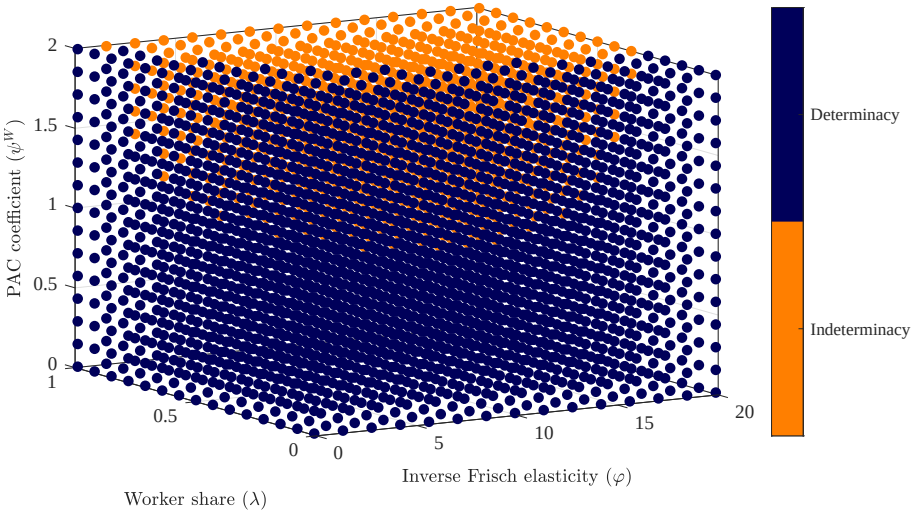
(e) Hand-to-Mouth



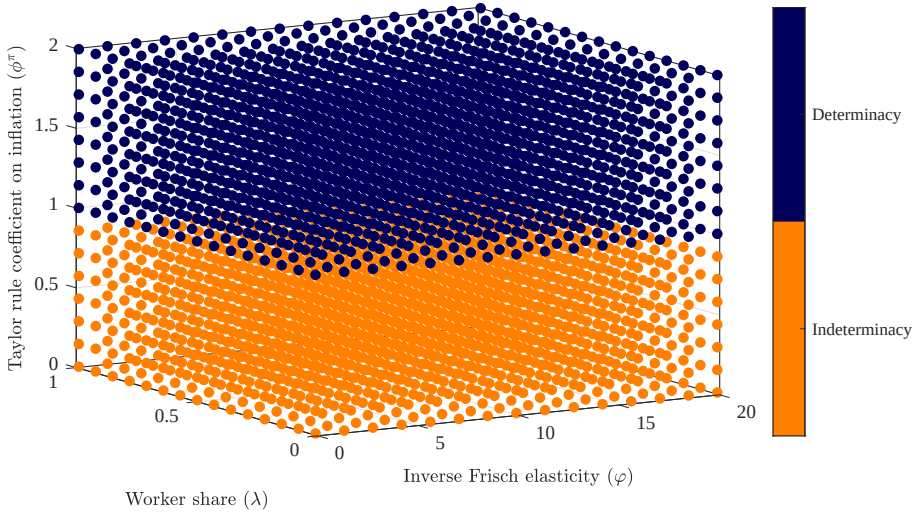
(f) PACs

Theoretical iMPCs – Anticipated Windfall

Portfolio Adjustment costs: Stability - UW



(g) Stability in $(\varphi, \lambda, \psi^W)$ space



(h) Stability in $(\varphi, \lambda, \phi^\pi)$ space

Income effects of profits on labor supply TANK-CH

- We can break the link between profits and labor supply as in [Broer et al., 2019].
- U(nconstrained) become C(apitalist).

$$
\begin{aligned}
\hat{n}_t^C &= 0, \\
\hat{c}_t^C &= \frac{\tilde{d}_t}{1-\lambda} - \tilde{t}_t, \\
\hat{n}_t &= \lambda \hat{n}_t^H, \\
\varphi \hat{n}_t^H + \hat{c}_t^H &= \hat{w}_t, \\
\hat{c}_t^H &= (\hat{w}_t + \hat{n}_t^H) n^H - \tilde{t}_t, \\
\hat{c}_t &= \lambda \hat{c}_t^H + (1-\lambda) \hat{c}_t^C,
\end{aligned}
\qquad \Rightarrow \hat{n}_t = \frac{\tilde{g}_t}{1+\varphi}
$$

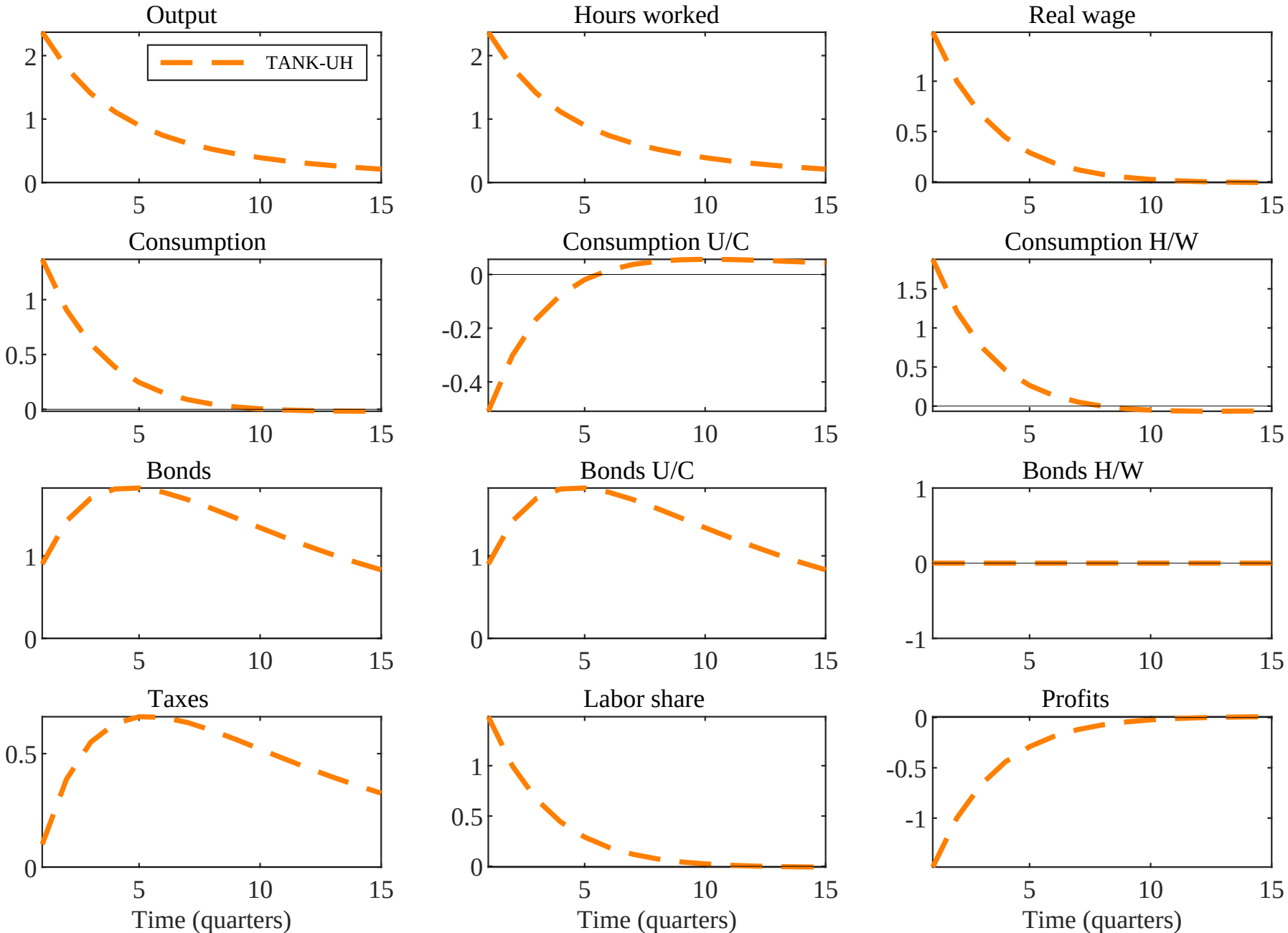
Capitalists & Workers - TANK

Description	Equation
Euler equation C	$\hat{c}_t^C = E_t \hat{c}_{t+1}^C - (\hat{R}_t - E_t \hat{\Pi}_{t+1})$
Budget constraint C	$\tilde{b}_t^C = \frac{\tilde{d}_t}{1-\lambda} - \tilde{t}_t + R\tilde{b}_{t-1}^C - \hat{c}_t^C$
Euler equation W	$\hat{c}_t^W = E_t \hat{c}_{t+1}^W - (\hat{R}_t - E_t \hat{\Pi}_{t+1}) + \psi^W \tilde{b}_t^W$
Budget constraint W	$\tilde{b}_t^W = \left(\hat{n}_t^W + \hat{w}_t\right) n^W - \tilde{t}_t + R\tilde{b}_{t-1}^W - \hat{c}_t^W$
Aggregate consumption	$\hat{c}_t = \lambda \hat{c}_t^W + (1-\lambda)\hat{c}_t^C$
Labor supply	$\hat{n}_t^W = \varphi^{-1}\left(\hat{w}_t - \hat{c}_t^W\right)$
Dividends	$\tilde{d}_t = -\hat{w}_t$
Phillips curve	$\hat{\Pi}_t = \beta E_t \hat{\Pi}_{t+1} + \frac{(1-\theta)(1-\beta\theta)}{\theta}\hat{w}_t$
Government budget constraint	$\tilde{b}_t = R\tilde{b}_{t-1} + \tilde{g}_t - \tilde{t}_t$
Government spending	$\tilde{g}_t = \rho^g \tilde{g}_{t-1} + \epsilon_t^g$
Fiscal rule	$\tilde{t}_t = \phi^{\tau t}\tilde{t}_{t-1} + \phi^{\tau B}\tilde{b}_t + \phi^{\tau G}\tilde{g}_t$
Taylor rule	$\hat{R}_t = \phi^\pi \hat{\Pi}_t$
Fisher equation	$\hat{r}_t = \hat{R}_t - E_t \hat{\Pi}_{t+1}$
Bond holdings	$\tilde{b}_t = \lambda \tilde{b}_t^W + (1-\lambda)\tilde{b}_t^C$

Table 2: TANK-CW.

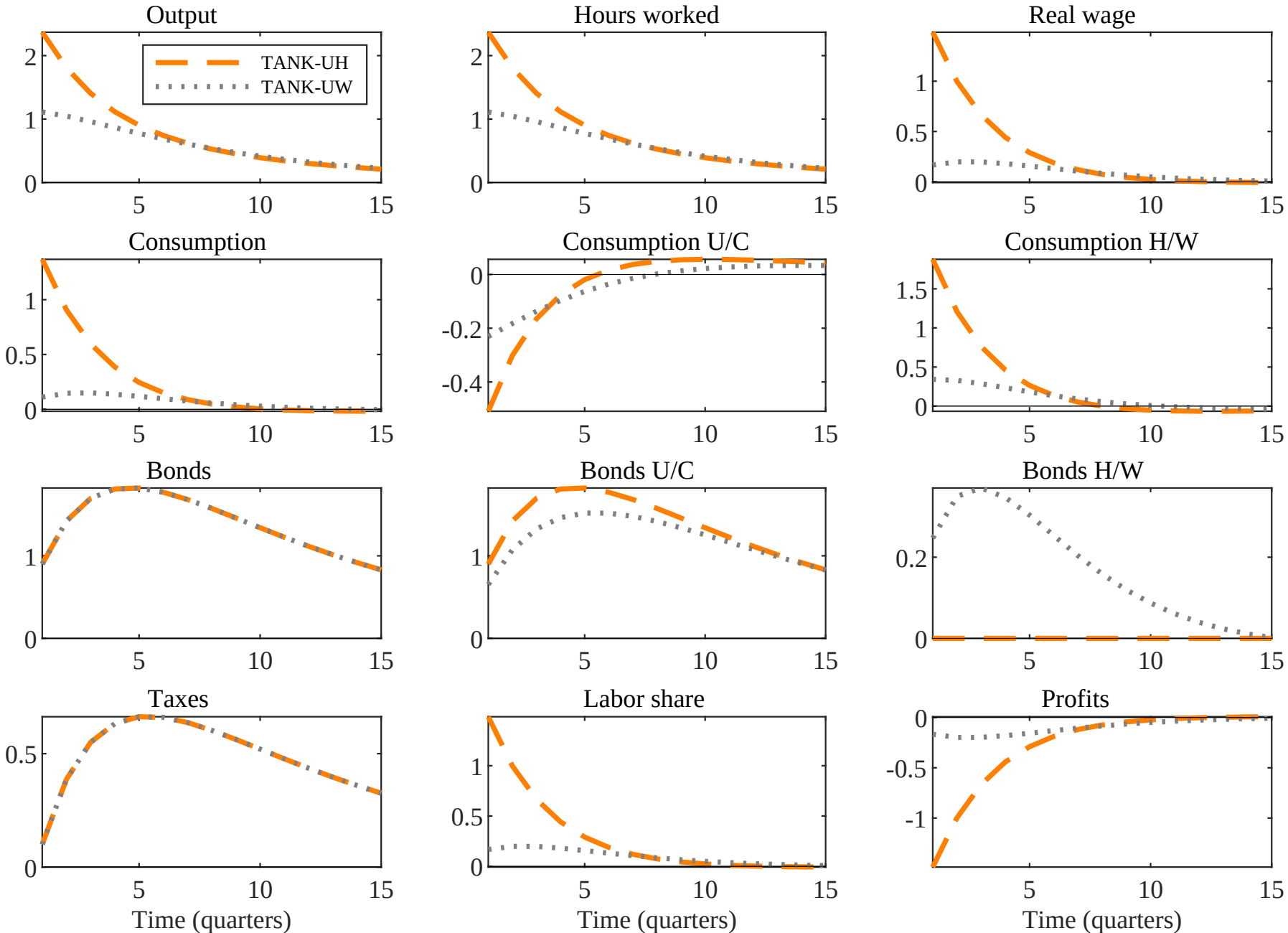
TANK-UH

Calibration



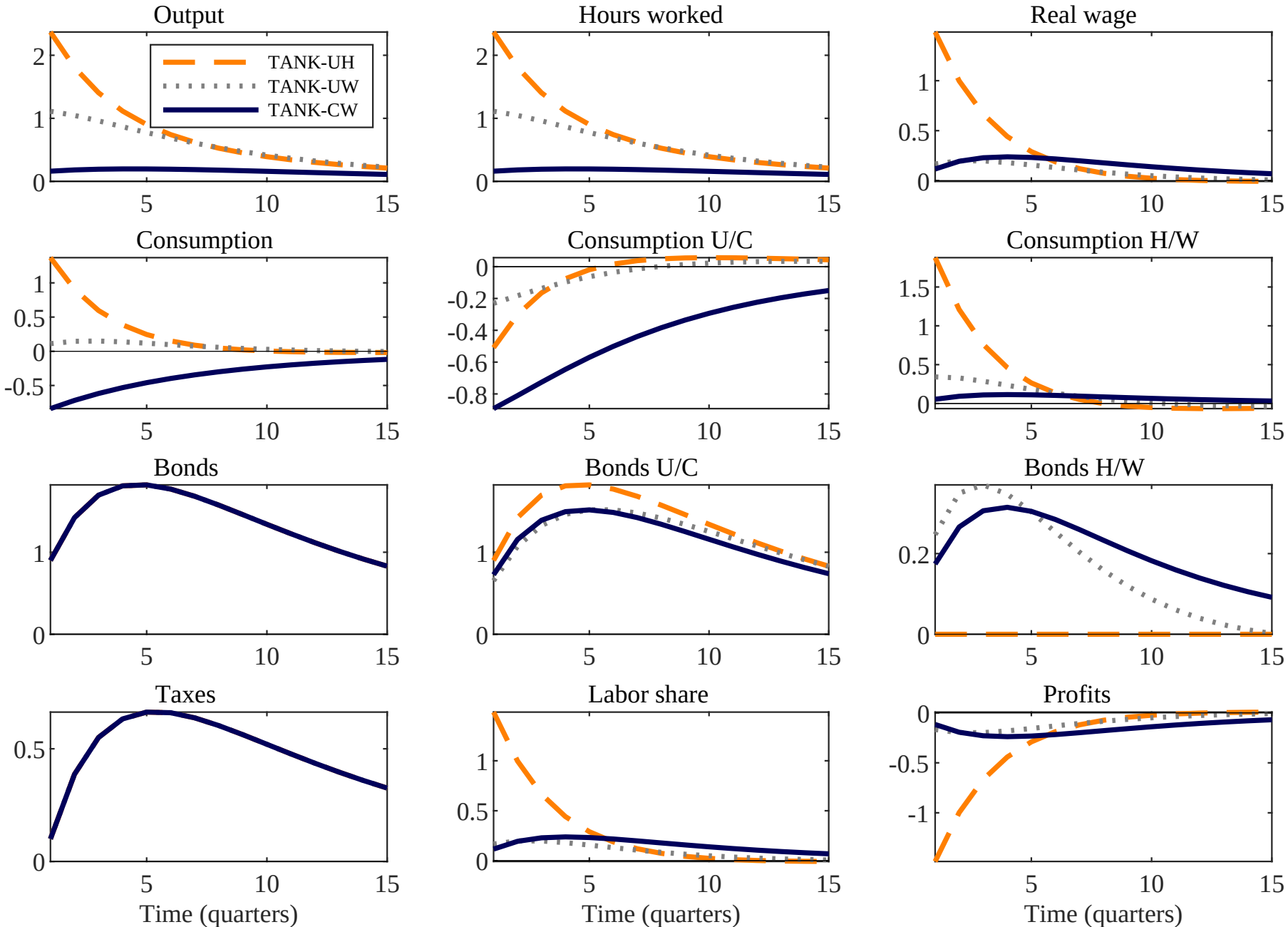
TANK-UW

Calibration



TANK-CW

▸ Calibration ▸ ψ^W Sensitivity ▸ λ Sensitivity



TANK-CW

- In the paper:
  1. The role of sticky wages and investment
  2. Medium scale model
  3. Couterfactual exercises on fiscal stimulus design
  4. Extensive appendix with derivations and sensitivity checks
- Not in the paper:
  - time varying **precautionary savings**

HANK

- Seminal paper is [Kaplan et al., 2018], see [Kaplan and Violante, 2018] for a review.
- Quantitative HANK models explicitly take into account **income risk heterogeneity** and the feedback effects from equilibrium distributions to aggregates that depend on asset and labor market characteristics.
- These models require quite sophisticated numerical methods.
- [Bilbiie, 2019b] proposes a way to think graphically and analytically about the properties of HANKs.
  - I will now follow his notation which is not always the same as before!

The New Keynesian Cross: Analytical HANK

- Main difference from TANK is that in HANK the transmission is driven by **those who face the risk of becoming constrained**, not merely about those who are so.
- Analytical HANK model that incorporates self-insurance in face of idiosyncratic uncertainty.
- The difference with TANK is captured through only one new parameter δ,[1] the coefficient in front of future consumption in the log-linearized aggregate Euler equation.
- This depends in a transparent and intuitive way on the interaction of idiosyncratic and aggregate uncertainty, the latter summarized by the TANK key parameters λ and χ.
- The NK cross that he presents for RANK/TANK now extends intertemporally, to amplification/dampening of future news and persistent shocks.

[1] Note that this is different from the δ we saw before.

The New Keynesian Cross: Analytical HANK

- Self-insurance magnifies the cyclical-inequality channel: when inequality is procyclical and there is dampening ($\chi < 1$), it implies more of it through **discounting** in the aggregate Euler equation ($\delta < 1$).

- While when countercyclical inequality implies amplification, self-insurance magnifies that too through **compounding** (the inverse of discounting) in the aggregate Euler equation ($\delta > 1$): with $\chi > 1$ good news about future aggregate income mean disproportionately good news in the hand-to-mouth state, less demand for self-insurance and, with zero equilibrium savings, higher consumption and income.

- The self-insurance and cyclical-inequality channels are complementary: the former is the larger, the more the latter is expected to matter, i.e. the longer the expected hand-to-mouth spell.

The New Keynesian Cross: Analytical HANK

- 4 assumptions.

  1. an exogenous stochastic change of status between constrained H and unconstrained S (**idiosyncratic uncertainty**);

  2. insurance is **full within type** (after idiosyncratic uncertainty is revealed), but **limited across types**;

  3. different **asset liquidity**: bonds are liquid (can be used to self-insure, before idiosyncratic uncertainty is revealed), while stocks are completely illiquid (cannot be used to self-insure);

  4. no bond trading (no equilibrium liquidity)

The New Keynesian Cross: Analytical HANK

- Two assets and two states. Agents switch between S and H; that the former may become constrained can thus be interpreted as **risk**, against which only one of the assets (bonds) can be used to insure, i.e. is liquid;
- the other asset (shares) is entirely illiquid: agents who become H cannot access it and do not receive any of its payout (profits) when in the H state - but will eventually receive again profits once they return to the S state.
- The exogenous change of state follows a Markov chain: the probability to stay type S is s, and to stay type H is h (with transition probabilities $1 - s$ and $1 - h$ respectively).
- λ becomes time varying and follows $\lambda_{t+1} = h\lambda_t + (1 - s)(1 - \lambda_t)$.
- Stationary equilibria gives $\lambda = \frac{1-s}{2-s-h}$ with $s \geq 1 - h$.

The New Keynesian Cross: Analytical HANK

- Every period, those who happen to be H would like to borrow, but we assume that they cannot (for instance they face a borrowing limit of 0).
- Since the stock is illiquid, they cannot access that portfolio (owned entirely by S, whoever they happen to be in that period).
- We therefore focus on an equilibrium where they are constrained hand-to-mouth and consume all their (endogenous) income, like in TANK $C_t^H = Y_t^H$.
- because transition probabilities are independent of history and we assumed perfect insurance within type, all agents who are H in a given period have the same income and consumption.

The New Keynesian Cross: Analytical HANK

- S are also perfectly insured among themselves in every period by assumption, and would like to save in order to self-insure against the risk of becoming H.

- Because shares are illiquid, they can only use (liquid) bonds to do that. But since H cannot borrow and there is no government-provided liquidity, bonds are in zero supply.

- An Euler equation prices these bonds even though they are not traded (just like in RANK, the aggregate Euler equation prices the possibly non-traded bond).

- But now the bond- pricing Euler equation takes into account the possible transition to the constrained H state unlike in TANK, nested when idiosyncratic shocks are permanent, where there is no transition and no self-insurance.

- The only equation that change is

$$\left(C_t^S\right)^{-\frac{1}{\sigma}} = \beta E_t \left\{ (1 + r_t) \left[s \left(C_{t+1}^S\right)^{-\frac{1}{\sigma}} + (1 - s) \left(C_{t+1}^H\right)^{-\frac{1}{\sigma}} \right] \right\}. \tag{5}$$

The New Keynesian Cross: Analytical HANK

- Log-linearizing 5 around the same symmetric steady state as in TANK, we obtain: $c_t^S = sE_t c_{t+1}^S + (1-s)E_t c_{t+1}^H - \sigma r_t$.

- Replacing the (same as in TANK) consumption function of H, we obtain the aggregate Euler:

$$\begin{aligned} c_t &= \delta E_t c_{t+1} - \sigma \tfrac{1-\lambda}{1-\lambda\chi} r_t \\ \text{where } \delta &\equiv 1 + (\chi - 1)\tfrac{1-s}{1-\lambda\chi} \end{aligned} \tag{6}$$

- With idiosyncratic uncertainty $s < 1$ this is characterized by:
  - **discounting**: $\delta < 1$ iff $\chi < 1$ (procyclical inequality)
  - **compounding**: $\delta > 1$ iff $\chi > 1$ (countercyclical inequality).

The New Keynesian Cross: Analytical HANK

- In RANK, where good news about future income imply a one-to-one increase in aggregate demand today as the household wants to substitute consumption towards the present and (with no assets) income adjusts to deliver this.

- The same also holds in the TANK limit: with permanent idiosyncratic shocks ($s = h = 1$), $\delta = 1$.

- Consider **discounting**: When good news about future aggregate income/consumption arrive, households recognize that in some states of the world they will be constrained and (because $\chi < 1$) not benefit fully from it. They self-insure against this and increase their consumption less than they would if they were alone in the economy.

- Like in RANK and TANK, this (now: ”precautionary”) increase in saving demand cannot be accommodated (there is no asset), so the household consumes less today and income adjusts accordingly to deliver this allocation.

The New Keynesian Cross: Analytical HANK

- The interaction of idiosyncratic $(1 - s)$ and aggregate uncertainty (news about y_t, and how they translate into individual income through $\chi - 1$) thus determines the self-insurance channel.
- The self-insurance channel is strengthened and the discounting is faster: the higher the risk $(1 - s)$, the lower the χ, and the longer the expected hand-to-mouth spell (higher λ at given s implies higher h);
- these intuitive results follow by calculating the respective derivatives of δ and noticing they are all proportional to $(\chi - 1)$.

The New Keynesian Cross: Analytical HANK

- The opposite holds with $\chi > 1$: there is **compounding** instead of discounting.
- The endogenous amplification through the Keynesian cross now holds not only contemporaneously (TANK), but also intertemporally: good news about future aggregate income boost today's demand because they imply less need for self-insurance.
- Since future consumption in states where the constraint binds over-reacts to good aggregate news, households internalize this by demanding less "saving".
- But savings still need to be zero in equilibrium, so households consume more that one-to-one—while income increases more than it would without risk.
- Furthermore, the self-insurance channel is **complementary** with the (TANK) hand-to-mouth channel: compounding (discounting) is increasing with idiosyncratic risk at a higher rate when there are more λ.

The New Keynesian Cross: Analytical HANK

- **TANK and analytical HANK are only different when it comes to shocks that are about the future** in some way (persistent, or news shocks); this is natural, since self-insurance is about future shocks.

Analytical HANK and the Forward Guidance Puzzle

- This model can be applied to revisit the **Forward Guidance Puzzle**: *standard medium-scale DSGE models tend to grossly overestimate the impact of forward guidance on the macroeconomy* [Negro et al., 2012]
- in T(H)ANK the multiplier of a future interest rate cut is decreasing with its date in the **discounting** case, thus resolving the puzzle as a generalization of [McKay et al., 2016].
- But in the **compounding** case, the power of Forward Guidance increases with its horizon and the Forward Guidance puzzle is instead aggravated.

Codes for this session

- Main folder
  - **tank_uh.mod** code for model in Table 1
  - **tank_uw.mod** code for model TANK-UW
  - **tank_cw.mod** code for model in Table 2
  - **DynareIrfCompare.m** compares IRFs of the three .mod files.

- Stability folder: reproduces 2D and 3D stability figures for the UH model.

- As an exercise you can modify the stability graphs to replicate the figures for TANK-UW.

Appendix

Baseline Calibration

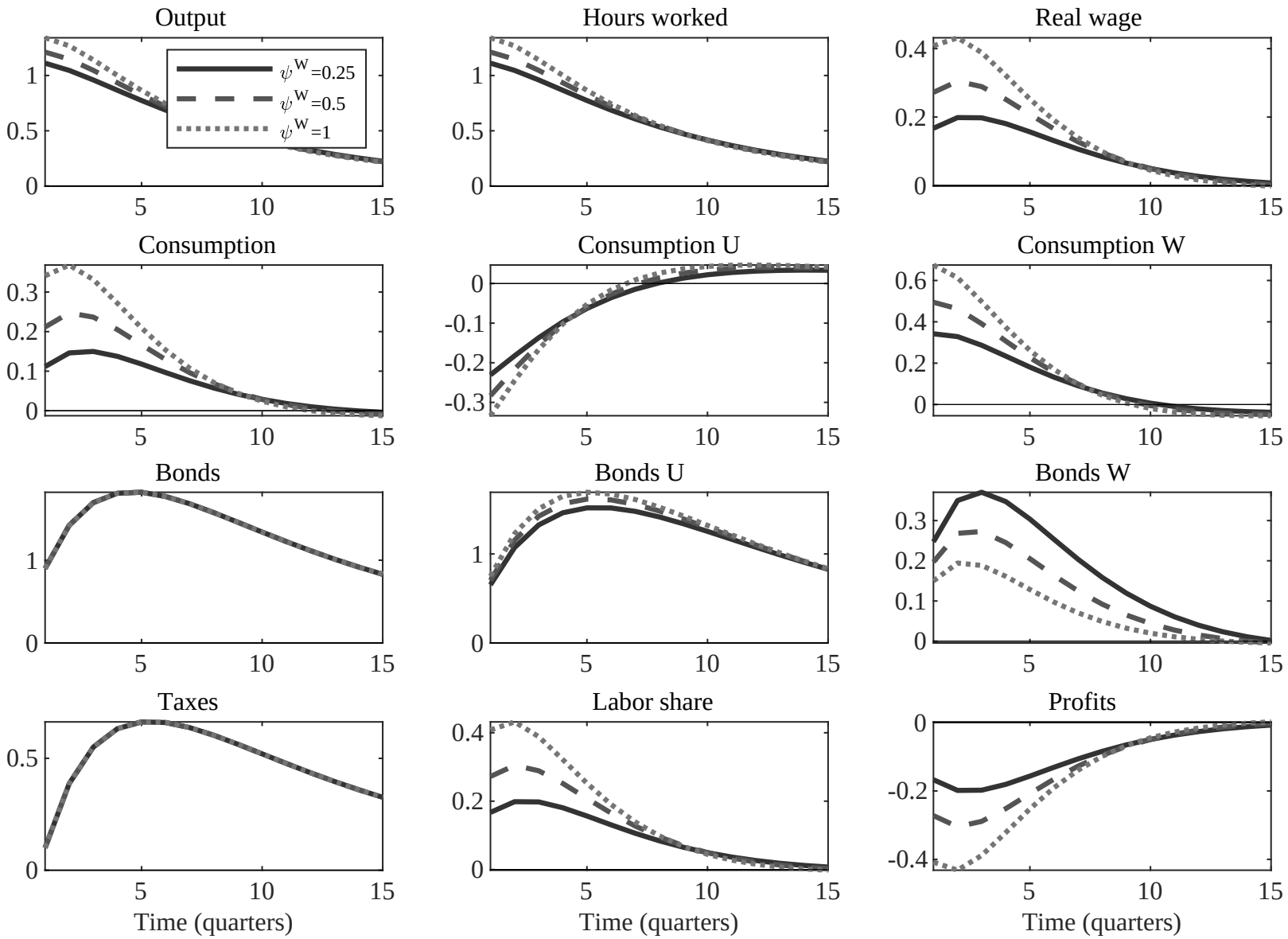
Main

Parameter	Interpretation	Value (H — W)	Source
β	Discount factor	0.99	Annual real interest rate of 4%
φ	Inverse Frisch elasticity	0.05	Determinacy of UH
ρ^G	AR1 Government spending shock	0.9	Benchmark
ψ^W	Portfolio adjustment cost	∞ — 0.25	Definition — iMPC evidence
λ	% of U/W	0.5	[Galí et al., 2007]
b^W	Workers' steady-state bond holdings	0	Comparability of models
θ	Calvo price stickiness	0.71	Average price duration 3.5q
η	Int. goods elasticity of substitution	6	Steady-state profits excl. subsidy
ϕ^π	Interest rate response to inflation	1.5	[Galí et al., 2007]
$\phi^{\tau,t}$	Tax smoothing	0	[Galí et al., 2007]
$\phi^{\tau,g}$	Tax response to government spending	0.1	[Galí et al., 2007]
$\phi^{\tau,b}$	Tax response to debt	0.33	[Galí et al., 2007]
τ^S	Production subsidy	$(\eta - 1)^{-1}$	Marginal cost pricing
Π	Steady-state inflation rate	1	Benchmark

- Steady state lump sum transfers/taxes s.t. $C^{U,C} = C^{H,W}$

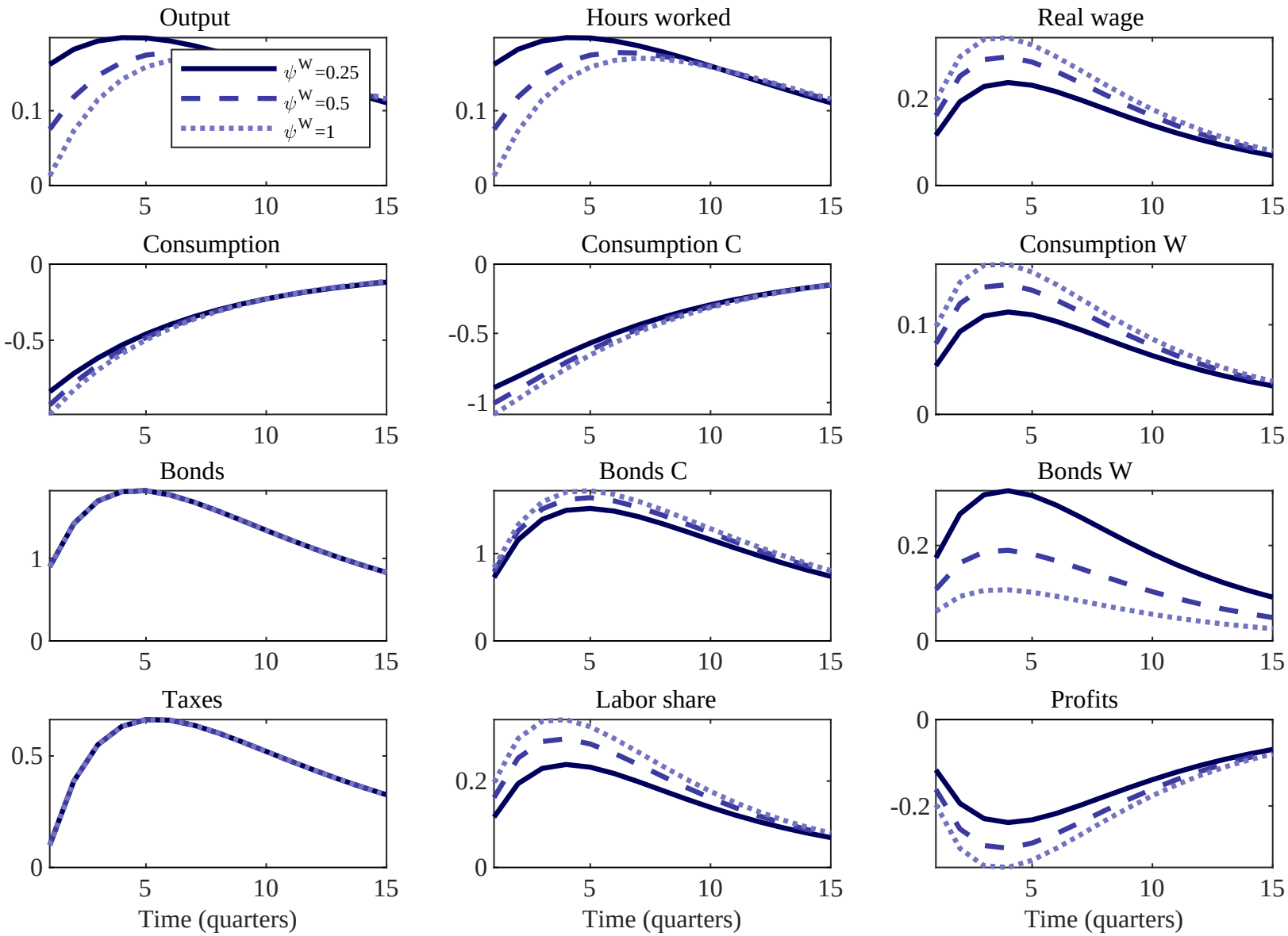
UW: Sensitivity to ψ^W

Main



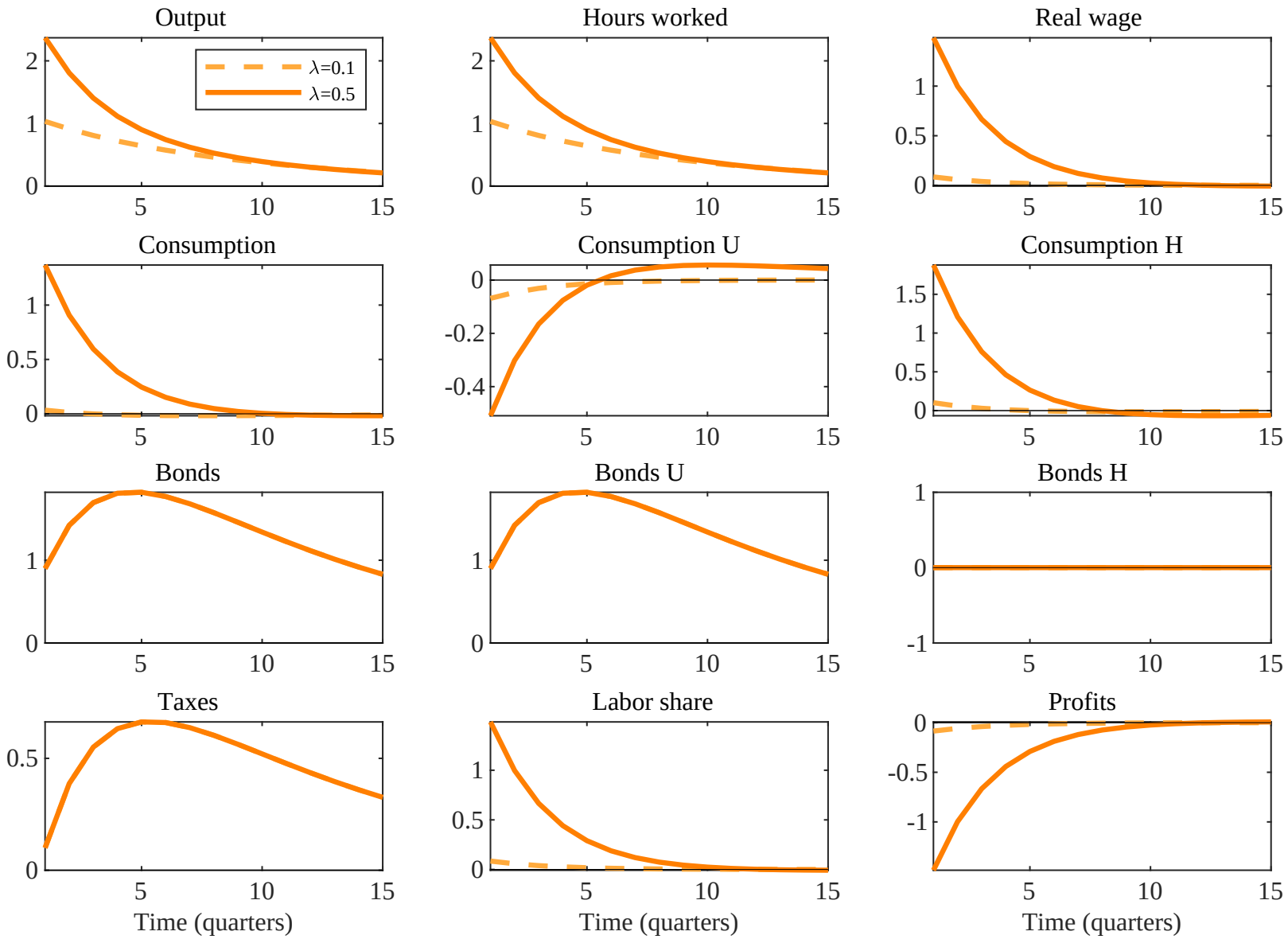
CW: Sensitivity to ψ^W

Main



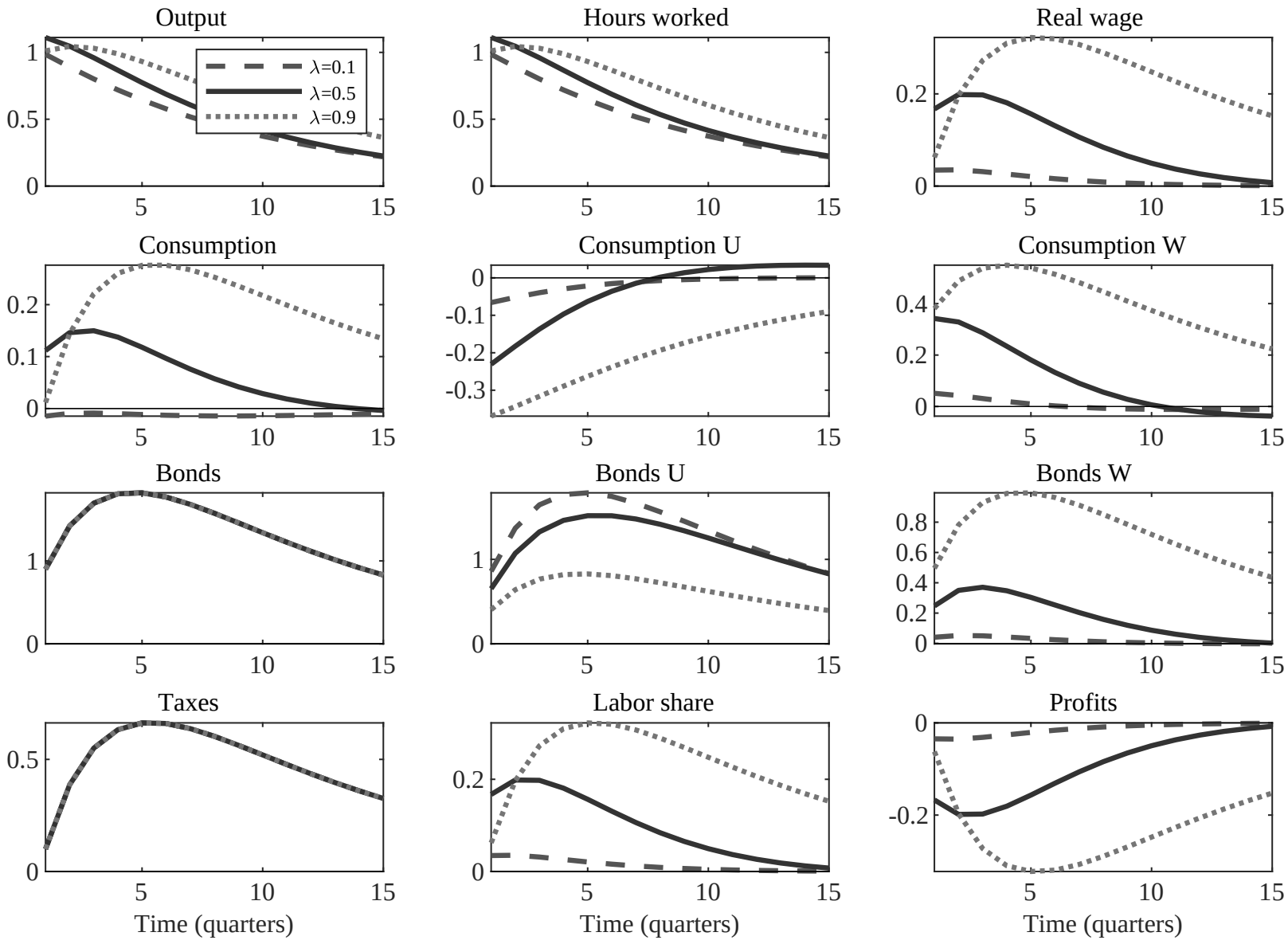
UH: Sensitivity to λ

Main



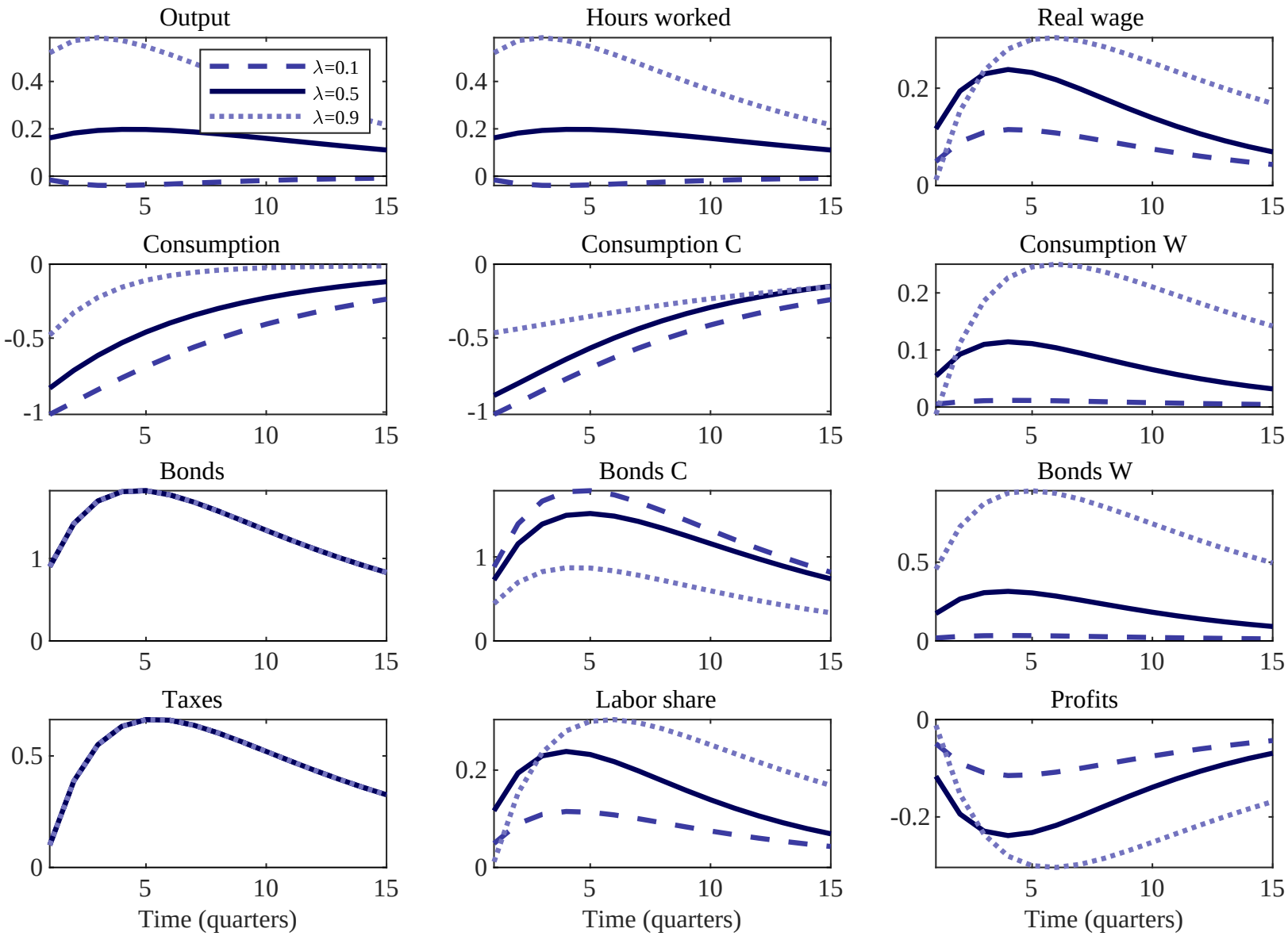
UW: Sensitivity to λ

Main



CW: Sensitivity to λ

Main



Auclert, A., Rognlie, M., and Straub, L. (2018).
The intertemporal keynesian cross.
Working Paper 25020, National Bureau of Economic Research.

Bilbiie, F. (2019a).
Monetary Policy and Heterogeneity: An Analytical Framework.
2019 Meeting Papers 178, Society for Economic Dynamics.

Bilbiie, F. O. (2008).
Limited asset markets participation, monetary policy and (inverted) aggregate demand logic.
Journal of Economic Theory.

Bilbiie, F. O. (2019b).
The New Keynesian cross.
Journal of Monetary Economics, (January).

Bilbiie, F. O., Känzig, D. R., and Surico, P. (2020).
Capital, Income Inequality, and Consumption.
CEPR Discussion Papers 14118, C.E.P.R. Discussion Papers.

Broer, T., Harbo Hansen, N.-J., Krusell, P., and Öberg, E. (2019).
The New Keynesian Transmission Mechanism: A Heterogeneous-Agent Perspective .
The Review of Economic Studies.

Cantore, C. and Freund, L. B. (2021).

Workers, capitalists, and the government: fiscal policy and income (re)distribution.
Journal of Monetary Economics, 119:58–74.

Colciago, A. (2011).
Rule-of-Thumb Consumers Meet Sticky Wages.
Journal of Money, Credit and Banking, 43(2/3):325–353.

Debortoli, D. and Galí, J. (2018).
Monetary Policy with Heterogeneous Agents: Insights from TANK models.
Working Paper.

Fagereng, A., Holm, M. B., and Natvik, G. J. J. (2018).
MPC Heterogeneity and Household Balance Sheets.
SSRN Scholarly Paper ID 2861053, Social Science Research Network, Rochester, NY.

Galí, J., David, J., and Vallés, J. (2004).
Rule-of-Thumb Consumers and the Design of Interest Rate Rules.
Technical Report 4.

Galí, J., López-Salido, J. D., and Vallés, J. (2007).
Understanding the Effects of Government Spending on Consumption.
Journal of the European Economic Association, 5(1):227–270.

Hagedorn, M., Manovskii, I., and Mitman, K. (2019).
The Fiscal Multiplier.
Technical report.

Jappelli, T. and Pistaferri, L. (2014).
Fiscal Policy and MPC Heterogeneity.
American Economic Journal: Macroeconomics, 6(4):107–136.

Kaplan, G., Moll, B., and Violante, G. L. (2018).
Monetary Policy According to HANK.
American Economic Review, 108(3):697–743.

Kaplan, G. and Violante, G. L. (2018).
Microeconomic Heterogeneity and Macroeconomic Shocks.
Journal of Economic Perspectives.

McKay, A., Nakamura, E., and Steinsson, J. (2016).
The power of forward guidance revisited.
American Economic Review, 106(10):3133–58.

Negro, M. D., Giannoni, M., and Patterson, C. (2012).
The forward guidance puzzle.
Staff Reports 574, Federal Reserve Bank of New York.

Neumeyer, P. A. and Perri, F. (2005).
Business cycles in emerging economies: The role of interest rates.
Journal of Monetary Economics, 52(2):345–380.

Schmitt-Grohe, S. and Uribe, M. (2003).
Closing small open economy models.
Journal of International Economics, 61(1):163–185.