

# Fiscal Management of Aggregate Demand: Using New Fiscal Instruments

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- Design of counter-cyclical policies
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  - Not commonly used in practice
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- A policy-driven approach
  - Quantitative HANK model
  - Effectiveness of various fiscal stabilization packages after a negative demand shock

# Framework

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- Standard HANK model with three additional components
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⇒ Relevant framework to quantify fiscal stabilization packages

- Demand-driven recession
  - Negative shock to marginal utility: unexpected, deterministic, transitory

# Fiscal Stabilization Packages

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  - Targeted-Transfer (**TT**) Package: a transfer targeted to **low-income** households
  - Unemployment Insurance (**UI**) Package: a transfer to **unemployed** households

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  - Tax Credit (TC) Package: a tax credit to low-income working households

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### ■ Robustness and implementability

- Comparison to Government Spending (G) Package and Consumption Tax Cut (G) Package

# Literature

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- Effects of **monetary policy** and **government spending** in HANK models

Kaplan, Moll, and Violante (2018), Hagedorn, Manovskii, and Mitman (2019), Bilbiie (2020), Auclert, Rognlie, and Straub (2023), Ferriere and Navarro (2024), Alves and Violante (2023)

- Quantitative effects of **UI extensions** in recessions

Mitman and Rabinovich (2015), Kekre (2022), Gorn and Trigari (2024), Bardoczy and Guerreiro (2023)

- **Optimal** fiscal and monetary policy in HANK

Bhandari, Evans, Golosov, and Sargent (2021), Le Grand and Ragot (2024), McKay and Wolf (2023)

- Stabilization and **labor taxes** in HANK

Broer, Druedahl, Harmenberg, and Oberg (2025), Le Grand, Ragot and Bourany (2025)

Environment

# A HANK model with some twists

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## ■ Households

- Bond economy with borrowing constraint
- Stochastic discount factors
- Indivisible labor choice
- Idiosyncratic labor productivity shocks + unemployment shocks



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## ■ NK block with sticky prices

- Linear technology in labor
- Monetary authority implements a standard Taylor rule

## ■ Government

- Finances spending, transfers, and UI benefits with debt, labor taxes, and capital taxes

# Households

## Working households

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- Individual **state**: asset  $a$ , discount factor  $\beta$ , productivity  $x$ , and employment  $\eta \in \{\ell, u\}$

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- Value function when employment “island”  $\eta = \ell$

$$V_t(a, x, \ell, \beta) = \max_{c, h, a'} \{ \log c - Bh + \beta \mathbb{E}_t [V_{t+1}(a', x', \eta', \beta') | x, \beta, \ell] \} \quad \text{s.t.}$$

$$c + a' = a + y^\ell + y^k - \mathcal{T}_t(y^\ell, y^k) + T_t + d_t^h(x),$$

$$y^\ell = w_t x h, \quad y^k = r_t a, \quad h \in \{0, \bar{h}\}, \quad a' \geq 0.$$

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+  $\rho_h \geq 0$  calibrated to discipline labor elasticities

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+  $\rho_h \geq 0$  calibrated to discipline labor elasticities
- AR(1) process for **discount factor**, **productivity** and **employment** status
- Flat capital tax  $\tau^k$ , **progressive** loglinear **labor** tax  $(\lambda_t, \tau^\ell)$

Heathcote, Storesletten, and Violante (2017)

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## Unemployed households

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- Unemployment benefits function of hourly wage

Kekre (2022)

$$\mathcal{B}_t(w_t x) = \zeta \min(\mathcal{R} w_t x \bar{h}, \overline{ui}) + \chi w_t x \bar{h}$$

+  $\zeta$  to match fraction of recipients,  $\mathcal{R}$  the replacement rate,  $\overline{ui}$  the UI cap

+  $\chi$  to capture household labor income received while in unemployment

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- AR(1) process for discount factors, productivity and employment status



# Firms

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  - Sticky prices a la Rotemberg

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$$G_t + (1 + r_t)D_t + T_t + \int \mathcal{B}_t(w_t x) d\mu_t = D_{t+1} + \int \mathcal{T}_t(y_t^\ell, y_t^k) d\mu_t$$

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- Fiscal rule with parameter  $\Phi_D$  for public debt,  $\lambda_t$  clears the budget constraint

Uhlig (2010)

- $\Phi_D = 0$  for constant debt, all adjustment in tax level
- $\Phi_D \rightarrow 1$  for constant taxes, all adjustment in debt

# Calibration

# Steady State Households

---

- Quarterly model calibrated to liquid wealth
- Stochastic  $\beta \in \{\bar{\beta} - \Delta, \bar{\beta}, \bar{\beta} + \Delta\}$ , duration of 50 years  
Krusell and Smith (1998)
  - $\bar{\beta}$  s.t.  $r \equiv 3.5\%$  annually
  - $\Delta$  s.t. top-quintile liquid wealth  $\approx 90\%$  (SCF)

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- Productivity  $(\rho_x, \sigma_x) = (0.989, 0.287)$   
Chang and Kim (2007)
- Labor supply decisions
  - $B$  to match employment  $\approx 78\%$   
Jang, Sunakawa, and Yum (2023)
  - $\rho_h$  to match average annual labor elasticity of  $\approx 0.3$   
Ferriere and Navarro (2024)

# Steady State

## Firm and government

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- Technology:  $\varepsilon = 7$ ,  $\Theta = 200 \rightsquigarrow$  Phillips curve slope  $\varepsilon/\Theta = 0.035$

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- Dividends redistributed linearly in  $x$ :  $d_t(x) = \bar{d}_t x$

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- Government

- Capital tax  $\tau_k = 35\%$ , labor income tax progressivity  $\tau_\ell = 0.1$

Chen, Imrohoroglu, and Imrohoroglu (2007), Heathcote, Storesletten, and Violante (2017), Ferriere, Grübener, Navarro, and Vardishvili (2023)

- Spending  $G/Y = 10\%$ , transfers  $T/Y = 8\%$ , debt  $D/Y = 100\%$

- Unemployment benefits:  $\zeta = 0.4$ ,  $\mathcal{R} = 0.5$ ,  $\overline{ui} = 60\% \bar{y}$   
 $\chi = 0.15$  to match  $C_u/C_e \approx 75\%$

Kekre (2022), Gorn and Trigari (2024)

- Automatic responses of inflation and debt:  $\Phi_\Pi = 1.5$ ,  $\Phi_D = 0.75$

## Steady State Unemployment

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- Job finding rates and separation rates across hourly wage distribution

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- Job finding rates are constant in the distribution

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- Monthly finding rate of 0.32  $\Rightarrow \pi_{\eta}(\ell|u) = 0.691$

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- Separation rates are falling in hourly wage/productivity  $x$

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- Monthly separation rates of  $\approx 1.4\%$  and  $0.7\%$  below and above median, respectively

$$\Rightarrow \pi_{\eta}(u|\ell, x) = \phi_0 x^{\phi_1}, \text{ with } \phi_0 = 0.029 \text{ and } \phi_1 = -0.446$$

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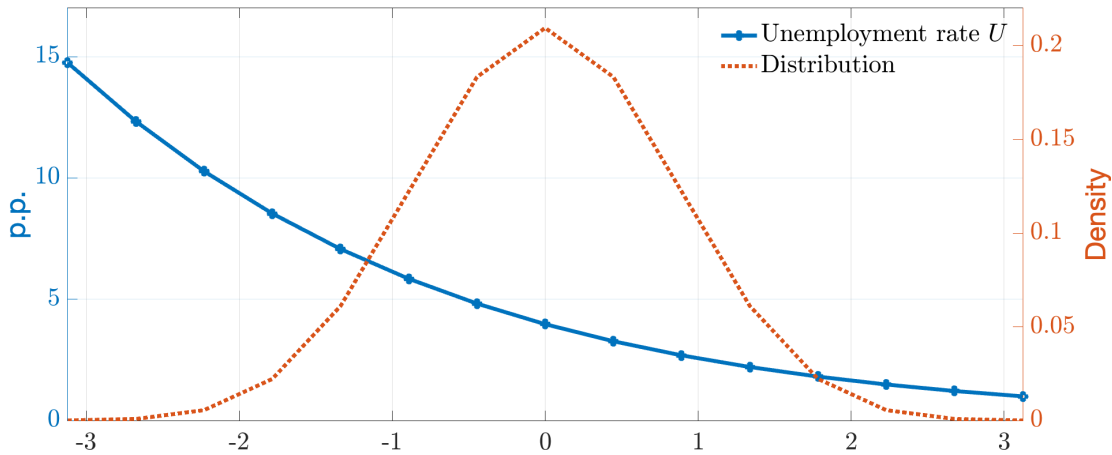
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- Average unemployment rate at 4.3% with unequal incidence in the distribution

# Steady State Unemployment in the Distribution



# Unemployment and the Business Cycle

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- **Okun's law** type of relation between output and unemployment
  - Okun coefficient  $c^{OK} = 0.5$   
Ball, Leigh, and Loungani (2017)

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  - **Elasticity** of job finding rates to aggregate unemployment of  $-0.6$   
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  - + Homogeneous increase in job finding rates



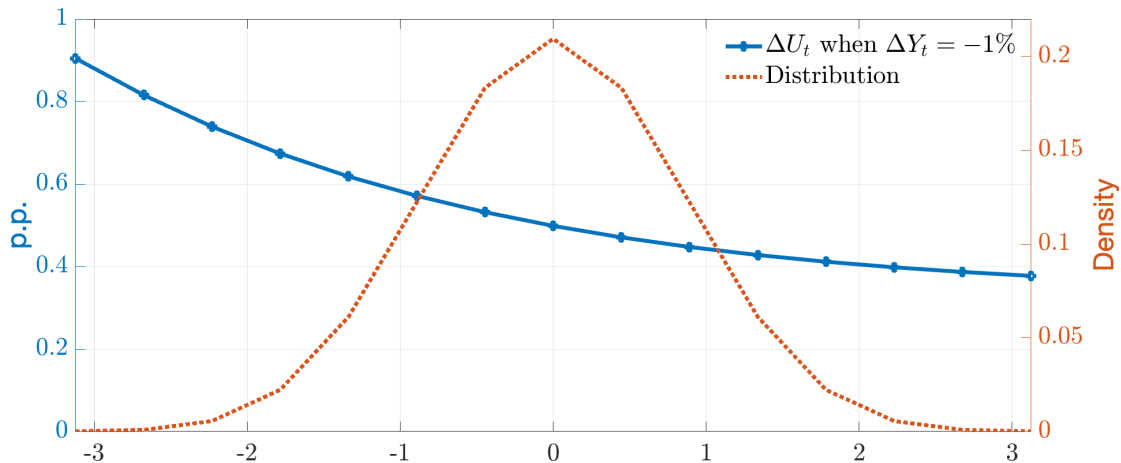
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  - + Homogeneous increase in job finding rates
- **Job separation rates** decrease with  $\Delta Y_t$ 
  - **Elasticity** of separation rates to aggregate unemployment **larger for above-median workers**  
Mueller (2017)
  - + Homogeneous additive increase in separation rates

# Unemployment and the Business Cycle

Okun's law



# Investigating the Calibration

## Household responses

---

- **Marginal propensities to consume (mpc)** Parker, Souleles, Johnson, and McClelland (2013), Kaplan and Violante (2014), ...
  - Compute mpc out of a \$500 rebate: **average** quarterly **mpc** at **0.13**
  - **Decline with wealth**: from 0.20 to 0.03 from 1st to 4th wealth quartile
  - Larger for **unemployed** at **0.32**, consumption drops by 10% when falling into unemployment  
Saporta-Eksten (2014), Ganong and Noel (2019)

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- **Labor elasticities** decline with income  
Triest (1990), Eissa and Liebman (1996), Kleven and Kreiner (2006), Meghir and Phillips (2010), ...
  - Compute labor responses to a 1% change in after-tax rate: **average** annual **elasticity** at **0.30**  
Erosa, Fuster, and Kambourov (2016)

Income quartile	1	2	3	4
<b>Labor elasticity</b>	0.44	0.34	0.25	0.22

# Investigating the Calibration Tax shocks

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- Further investigate aggregate effects of tax shocks
- Compute tax multipliers as in Mertens and Ravn (2013)
  - Tax multiplier at about  $\approx 0.7$  in the model, vs.  $\approx 2$  in the data
- Replicate a tax shock on bottom-90 vs. top-10 as in Zidar (2019)
  - Tax cut on bottom-90 increases employment by 1% in the model vs. above 3% in the data
  - Tax cut on the top-10 has no effects

⇒ Conservative calibration regarding tax responses

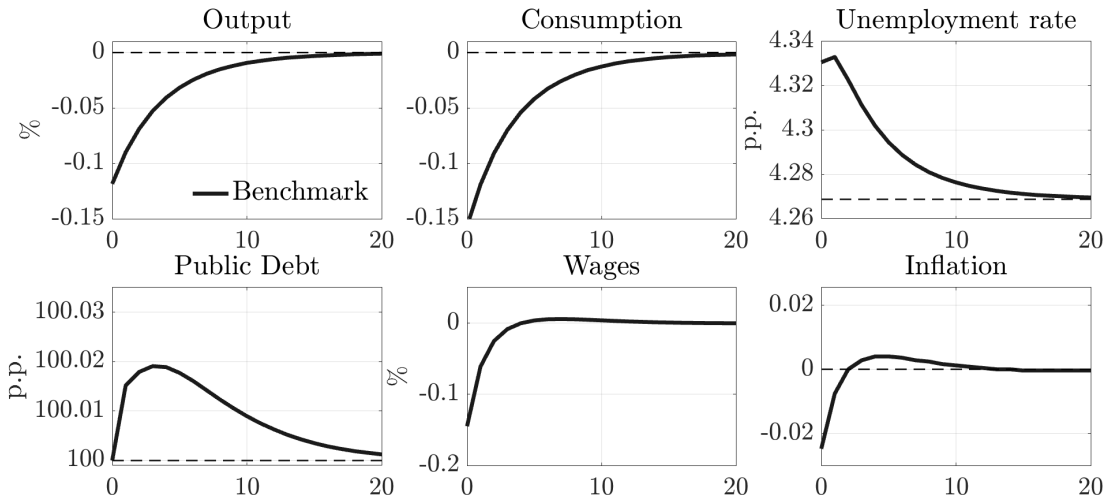
Recession

## Benchmark No Fiscal Stabilization

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- Recession induced by a negative demand shock:  $(1 - \omega_t)u(c_t, n_t)$ 
  - $\omega_0$  such that  $\Delta Y_t = -0.1\%$  on impact
  - Reverts to  $\omega = 0$  with persistence  $\rho_\omega = 0.75$  at the quarterly level
- Unexpected, transitory, perfect foresight: a 'MIT' shock

# Benchmark No Fiscal Stabilization





# Three Fiscal Stabilization Packages

## TT Package

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### ■ A Targeted Transfer (TT) Package

- Design to mimic checks sent in 2008: For all **low-income** households, based on **last-year** income
- An “automatic stabilizer” flavor: Phase out over time with persistence  $\rho_\omega$

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- Temporary transfer modeled as a **logistic** function

Ferriere, Grübener, Navarro, and Vardishvili (2023)

$$\hat{T}_t(y) = m_t \frac{2 \exp(-\chi y / \bar{y})}{1 + \exp(-\chi y / \bar{y})}, \quad m_t \text{ the transfer at } y = 0, \chi \text{ the phasing-out speed}$$

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+ “Based on **last-year** income”:  $\tilde{y}(x, \eta, \beta)$

- **Calibration** such that *total cost* equals a one-time check of \$200 to all households
  - + Initial check at  $y = 0$  is  $m_0 = \$900$
  - + Quick phase-out at  $\chi = 12$ : only 20% households receive more than \$50 at  $t = 0$

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- A check to **working low-income** households, phase-out over time at rate  $\rho_\omega$

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  - + **Phase out** with current labor income  $w_t x \bar{h}$
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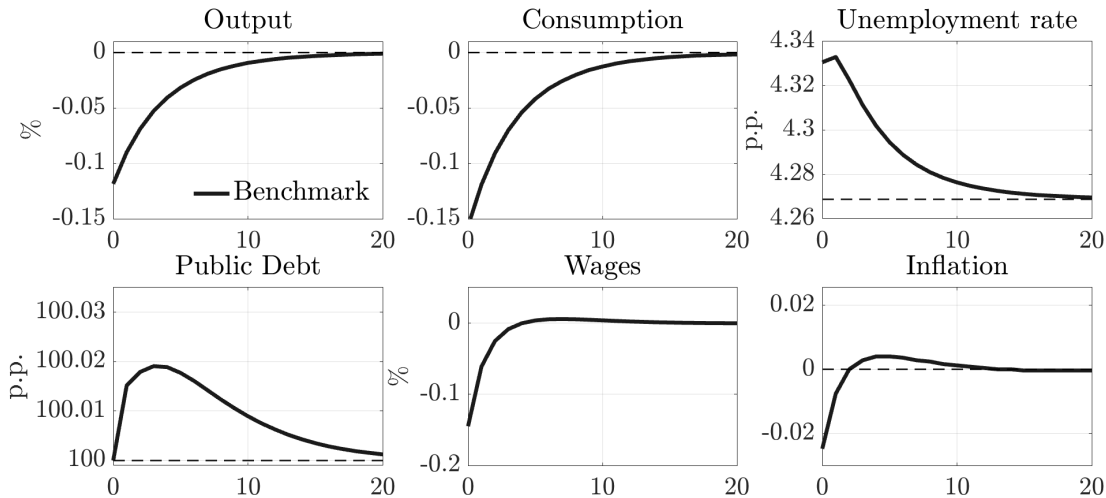
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  - + **Phase out** with current labor income  $w_t x \bar{h}$
  - + Eligible **only if**  $\eta = e$  and  $h = \bar{h}$
- **Calibration** such that equals a one-time lump-sum check of \$200
  - + Initial maximum check of \$800, slower phase-out at  $\chi = 6$

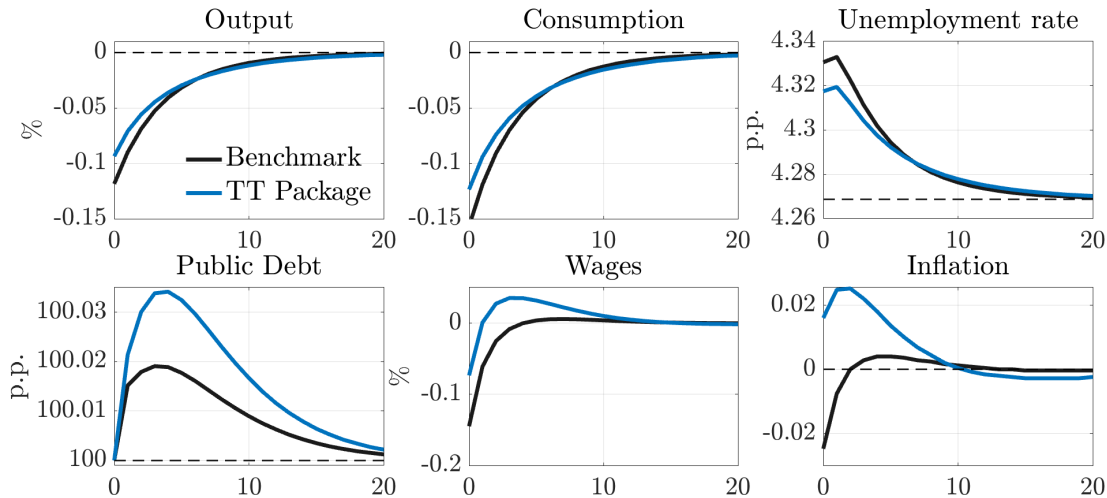
# Stabilization Packages

## Impulse Response Functions



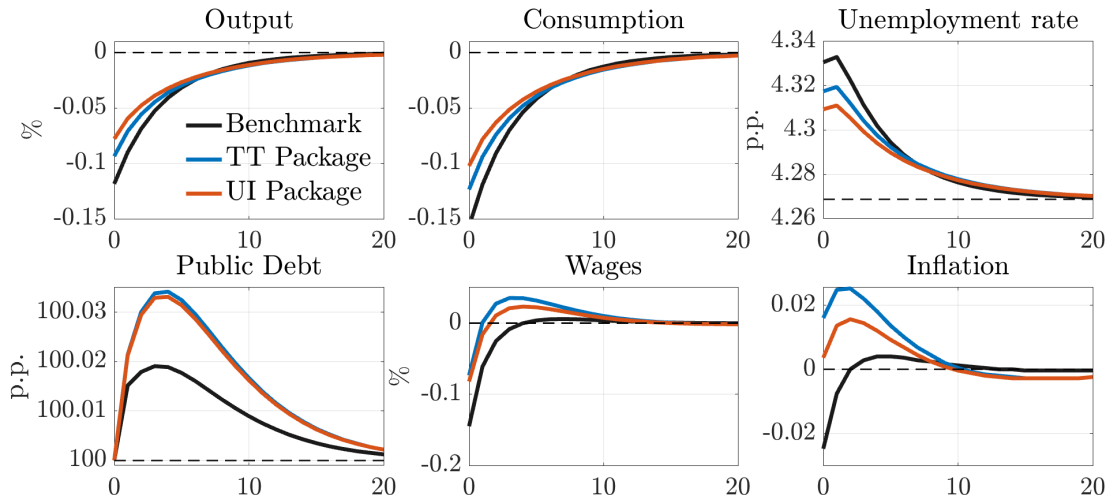
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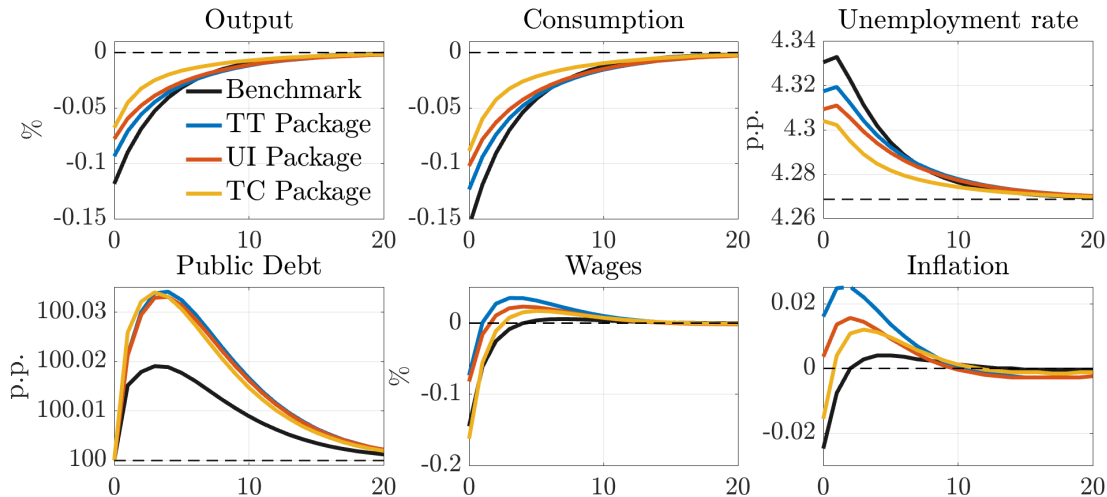
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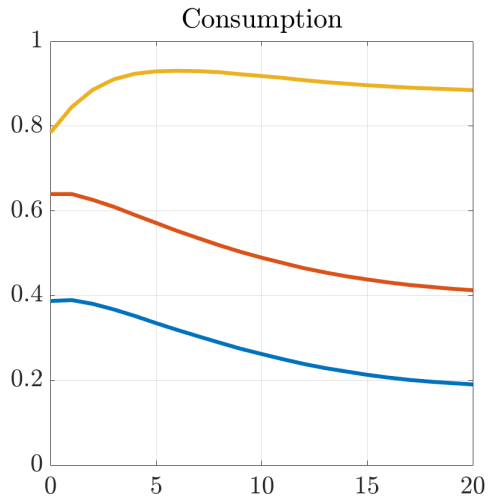
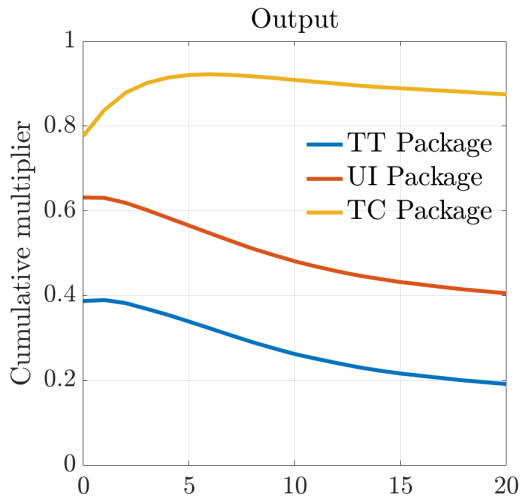


# Stabilization Packages

## Impulse Response Functions



# Stabilization Packages Multipliers



# Stabilization Packages

## Decomposition

---

- Decomposition between *consumption channel* and *labor channel*

# Stabilization Packages

## Decomposition

---

### ■ Decomposition between *consumption channel* and *labor channel*

- Use equilibrium prices and taxes and unemployment risk of the **no-stabilization** benchmark

$$\{r_t^b, w_t^b, \lambda_t^b, \pi_{\eta,t}^b, d_t^b\}$$

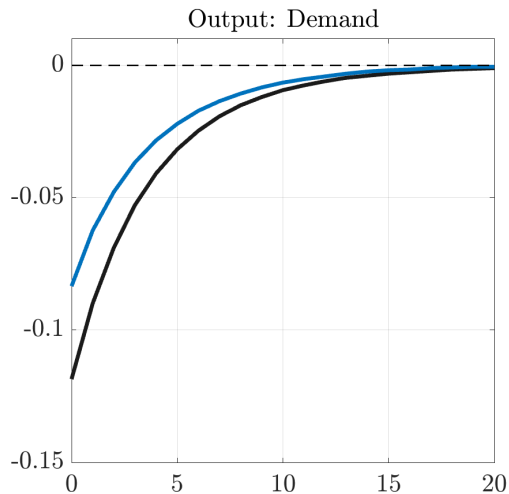
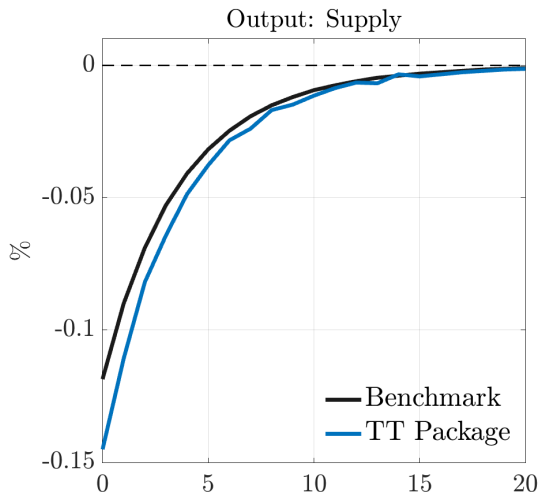
- Compute for each package TT, UI, TC

- + **Supply output**  $Y_t^s = L_t$  using households' **labor supply** policy

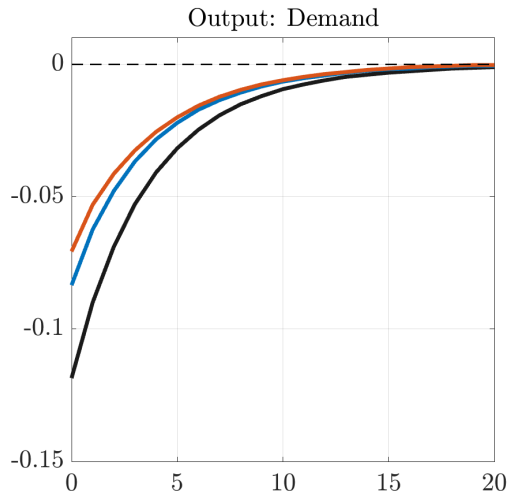
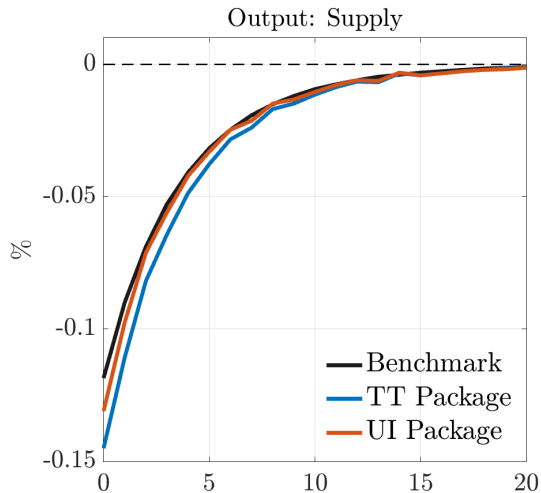
- + **Demand output**  $Y_t^d = C_t + \Theta_t + G_t + f$  using households' **consumption** policy



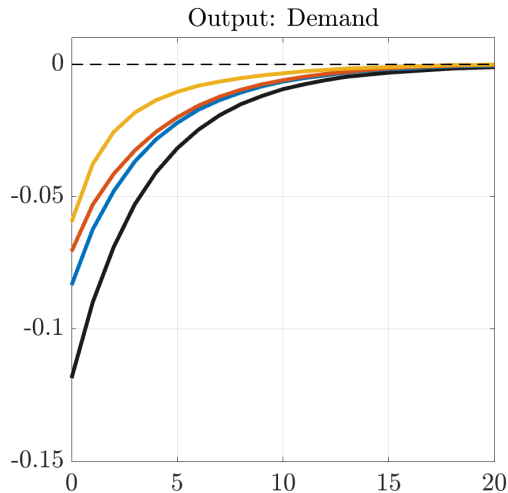
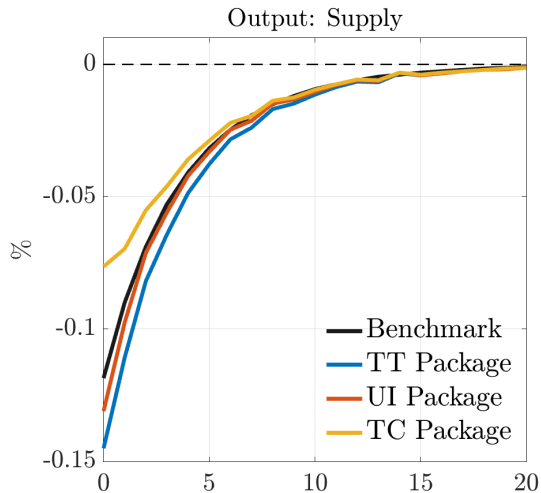
# Three Fiscal Stabilization Packages Decomposition



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# Three Fiscal Stabilization Packages Decomposition



# Taking Stock

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- Temporary tax credits are an effective fiscal stimulus
  - Implement labor tax cuts targeted to low-income workers
- Caveats on the quantification of the UI package
  - Do not internalize the negative incentive effects on job search [overestimate]
  - Abstracts from heterogeneity between recipients and non-recipients [underestimate]

# Investigating the Results

---

1. Role of public debt
2. Distributional effects across packages
3. Implementability
4. (Alternative rules for monetary policy)
5. (Deeper recessions)
6. (Steeper elasticities)

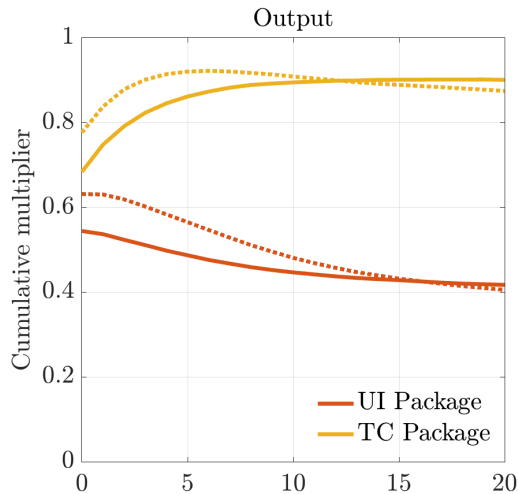
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- Compute benchmark and stabilization output paths with **constant debt**  $\Phi_D = 0$

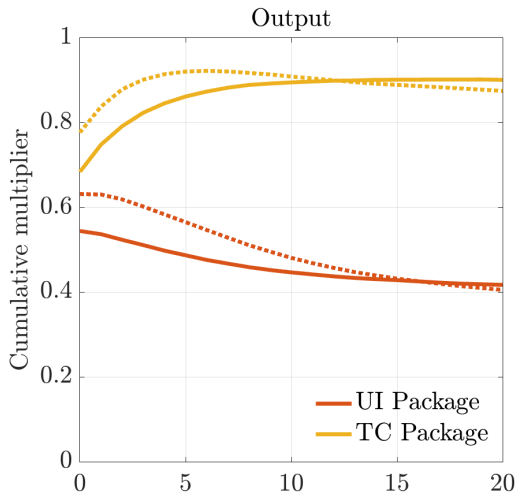
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- Public debt does help to stabilize
- TC Package No Debt  $\equiv$  temporary shock in labor tax progressivity  
 $\Rightarrow$  Stabilizes the economy





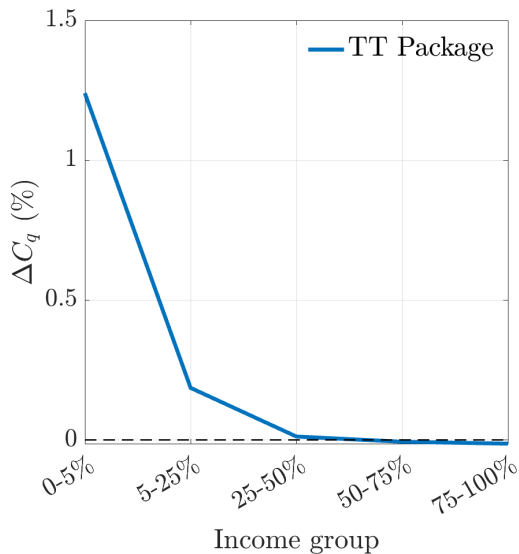
## 2. Distributional Effects

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- Consumption by income group
  - Compare with and without stabilization

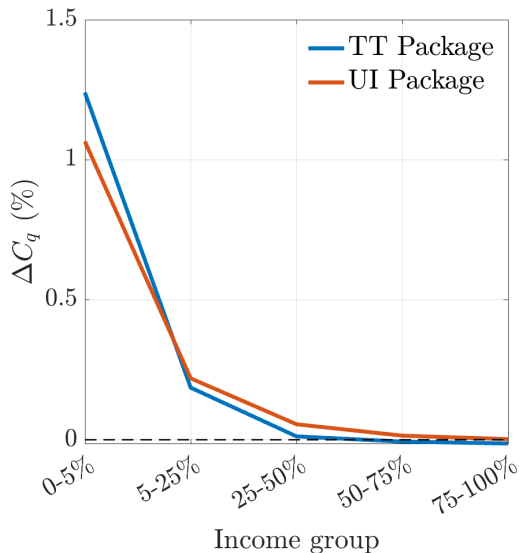
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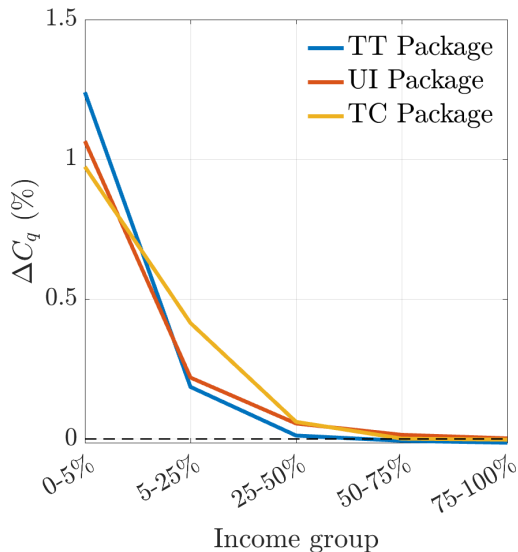
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### 3. Implementation

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- Can we actually change taxes at business cycle frequency?
- Arduous task, but we do
  - UI benefits were extended the GFC and the pandemic
  - Child tax credit expansion under the American Rescue Plan
  - Transfers are also commonly used

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- Systematic fluctuations in payroll taxes could implement the TC package
  - Easy to implement, would appear on the paycheck of workers every month

## Spending, Checks, and Consumption Taxes

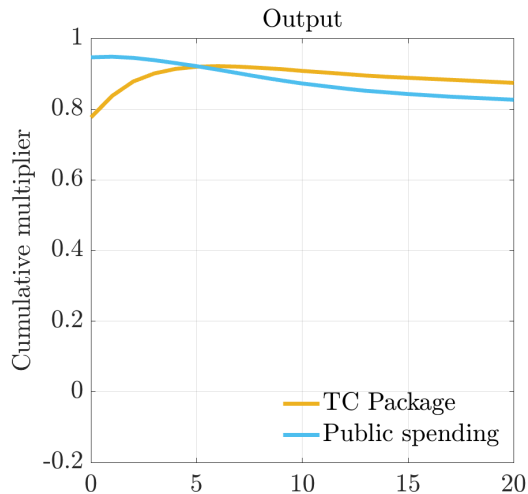


## Further Fiscal Packages $G$ and $T$ packages

---

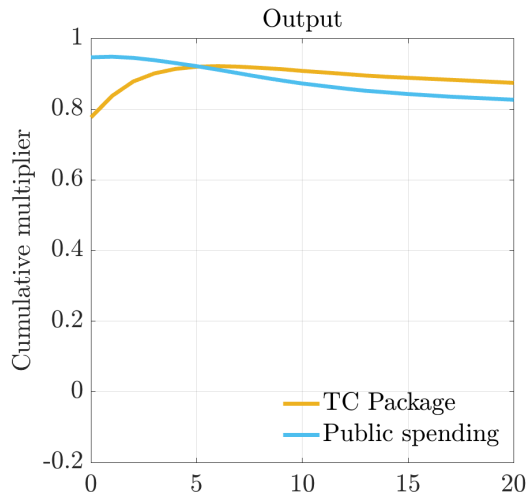
## Further Fiscal Packages $G$ and $T$ packages

- Public spending generates large output multiplier



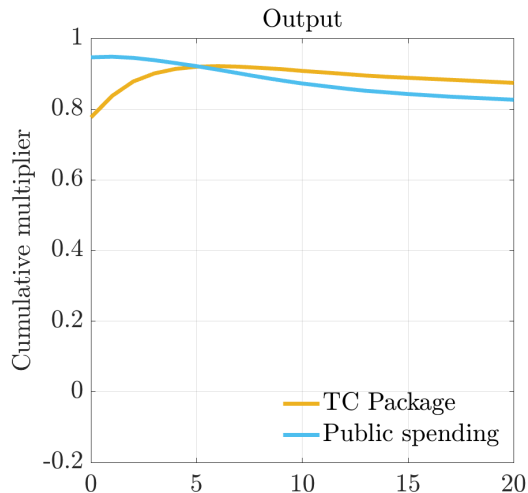
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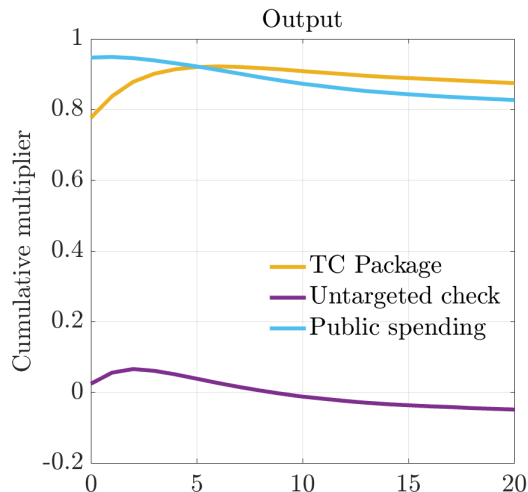
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- Public spending generates large output multiplier
  - + ... and even if labor fluctuations were entirely demand driven
  - + ... but negative consumption multiplier
- Lump-sum check has modest stabilization properties



# Fiscal Stabilization Packages Revisited

---

- Trade-off between effectiveness and welfare
  - Spending is most effective to stimulate GDP: Multiplier  $\approx 1$  on impact
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  - Transfers better for welfare, but partly (largely) saved by the households
- Should we consider Consumption Taxes?
  - Policy proposal (Blanchard, 2024)
  - Some recent examples: UK 2009, Germany 2021  
Blundell (2009), Benzarti, Carloni, Harju, & Kosonen (2020), Bachmann, Born, Goldfayn-Frank, Kocharkov, Luetticke, & Weber (2025)

## Consumption Tax Cut $\tau^c$ package

---

- Consumption taxes can bypass the trade-off between effectiveness and welfare



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    - Welfare<sup>2</sup>: Distributional effects valuable when recessions affect households unequally

- Consider two labor market arrangements

- Extensive margin labor supply decision (and flexible wages)
    - Sticky-wage model with unions and homogenous labor supply
- Auclert Rognlie and Straub (2023, 2024, 2025)

# An Equivalence Result $G$ vs. $\tau^c$

---

Consider two fiscal packages:

- A **government spending** (expansion) stimulus  $\{\hat{G}_t\}_{t=0}^T$ 
  - Fiscal cost  $\{R_t^g = \hat{G}_t^g - G\}_{t=0}^T \Rightarrow$  allocations, prices & taxes  $X^g \equiv \{Y_t^g, \pi_t^g, r_t^g, w_t^g, \lambda_t^g\}_{t=0}^T$
- A **consumption tax** (cut) stimulus  $\{\hat{\tau}_t^c\}_{t=0}^T$ 
  - Fiscal cost  $\{R_t^c = \tau^c C_t^g - \hat{\tau}_t^c C_t^c\}_{t=0}^T \Rightarrow X^c \equiv \{Y_t^c, \pi_t^c, r_t^c, w_t^c, \lambda_t^c\}_{t=0}^T$

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- **Proposition:** Assume  $U = \log c - v(n)$ , and  $R_t^c = R_t^g \forall t$ . Then:
  - **Output**, prices and taxes are **identical**:  $X^g = X^c$ ;
  - Private consumption:  $C_t^c = C_t^g + G_t^g - G \Rightarrow$  **Crowding-in** of private consumption

## An Equivalence Result Intuition

---

- Using the budget constraint to replace  $c$  in the household's problem,

$$(1 + \tau_t^c)c_t = a_t + y_t^\ell + y_t^k - \mathcal{T}_t + d_t + \dots - a' = RHS(n, a')$$
$$c_t = RHS(n, a')/(1 + \tau_t^c)$$

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with **log preferences**, delivers

$$V_t(a, x, \cdot) = \max_{n, a'} \{ \log(y_t^\ell + y_t^k - \mathcal{T}_t + d_t + \dots - a') - Bh + \beta \mathbb{E}_t V_{t+1}(a', x', \cdot) \} - \log(1 + \tau_t^c)$$

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- Consistent with **government's budget constraint** if identical cost
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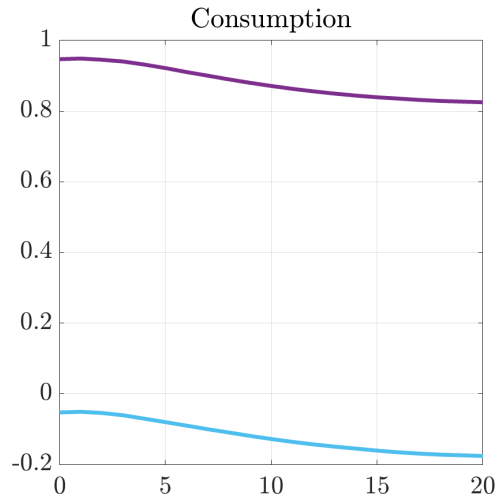
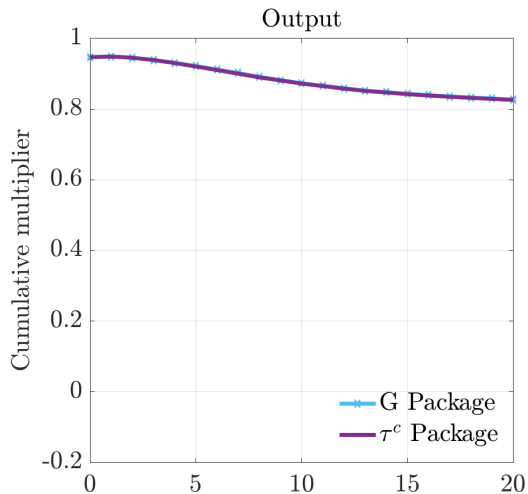
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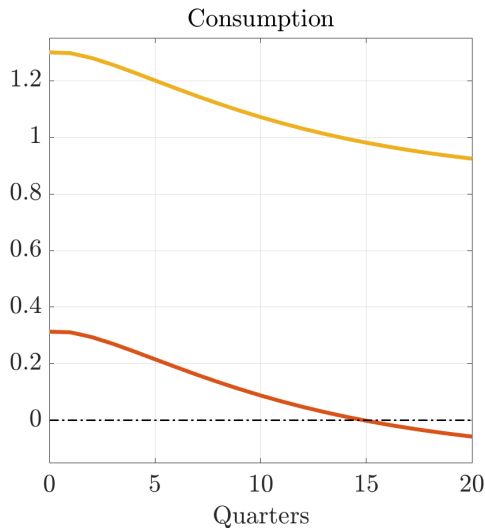
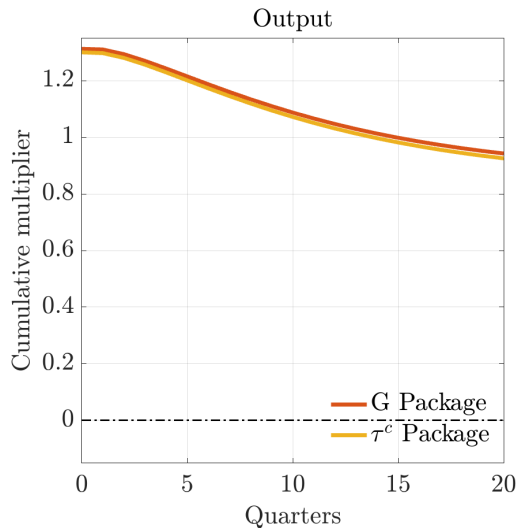
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- Robust to: capital, sticky wages, also in RANK, etc.

# Stabilization: $G$ vs. $\tau^c$ Extensive Margin Labor Supply



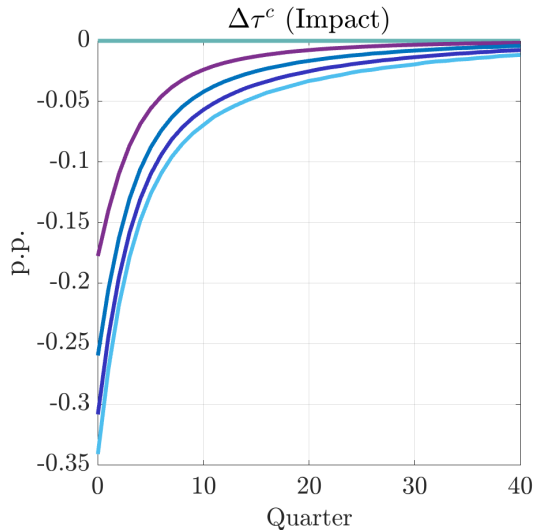
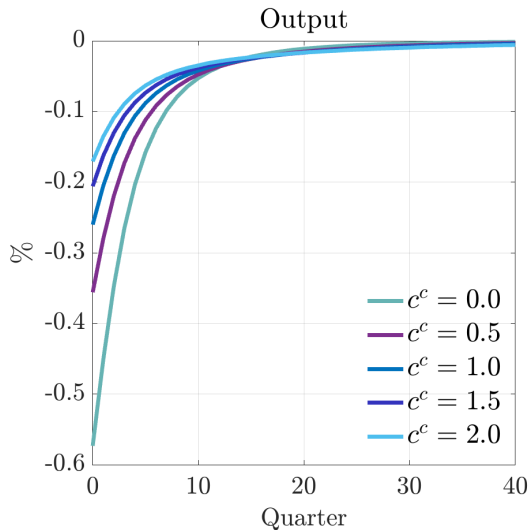
# Stabilization: $G$ vs. $\tau^c$ Sticky Wages, Unions and Homogeneous Labor Supply



## Stabilization: A Systematic Rule? $\tau_t^c = \tau^c - c^c \Delta Y_t$

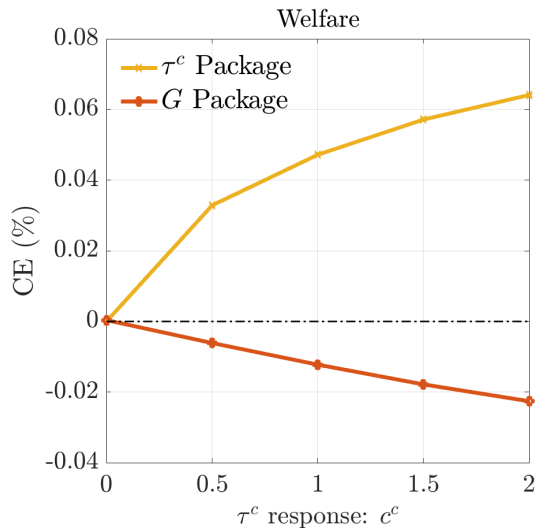
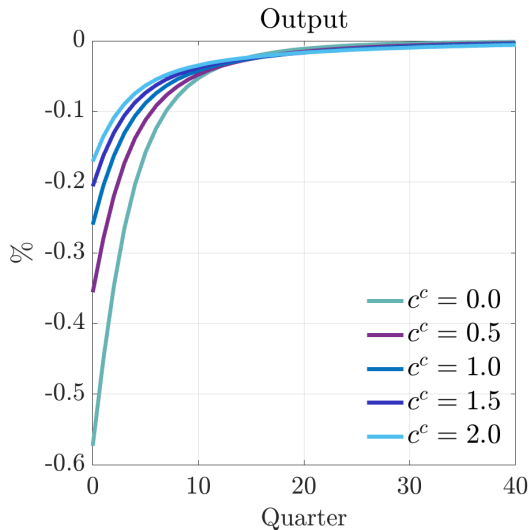
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# Stabilization: A Systematic Rule? $\tau_t^c = \tau^c - c^c \Delta Y_t$



# Stabilization: A Systematic Rule?

$$\tau_t^c = \tau^c - c^c \Delta Y_t$$



## Stabilization: $G$ vs. $\tau^c$ Taking Stock

---

- Consumption taxes as automatic stabilizers?
  - Bypass the trade-off between effectiveness and welfare
  - Easy to **implement**, high pass-through, salient



# Stabilization: $G$ vs. $\tau^c$ Taking Stock

---

- Consumption taxes as automatic stabilizers?
  - Bypass the trade-off between effectiveness and welfare
  - Easy to **implement**, high pass-through, salient
- What next?
  - **Formula** away from log case
    - + Bound  $Y_t^g - Y_t^c$  with MPE/wealth effects and labor elasticities
  - **Welfare**: larger gains when the recession falls more on the poor?
    - + Design of Okun's law

## Conclusion

# Conclusion

---

- A temporary targeted labor tax cut can stabilize the economy
  - Operates also through consumption and labor supply responses

# Conclusion

---

- A temporary targeted labor tax cut can stabilize the economy
  - Operates also through consumption and labor supply responses
- A temporary consumption tax cut may work even better?

**Thank you!**

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# Fiscal Rule

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- Public debt adjusts as a function of  $\Phi_D$

$$D_{t+1} = (1 - \phi_D)D + \phi_D \left( \hat{G}_t - \tau^k r_t A_t - \mathcal{R}_t^\ell \right), \text{ where}$$

- $\hat{G}_t$  captures total government expenditures, including debt repayments

$$\hat{G}_t = G_t + T_t + \mathcal{U}_t + (1 + r_t)D_t$$

- $\mathcal{R}_t^\ell$  captures fiscal revenues at steady-state labor tax schedule

$$\mathcal{R}_t^\ell = w_t L_t - \lambda \int (w_t x h_t(a, x, \eta, \beta))^{1-\tau^\ell} d\mu_t(a, x, \eta, \beta)$$

# Dividends

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- Assume dividends linearly distributed on  $x$

$$\delta_t = \sum_x \tilde{\delta}_t(x) \pi(x) = \sum_x \left( \frac{\delta_t}{\mathbb{E}[x]} x \right) \pi(x)$$

- Minimize wealth effects of fluctuations in dividends

Farhi and Werning (2020)

# Unemployment and the Business Cycle

Okun's law

- Finding and separation rates distribution depend on  $U_t$  Mueller (2017)

- Finding rate elasticity decreases homogeneously with  $\Delta Y_t$

$$\log \pi_{\eta,t}(\ell|u, x) = \log \pi_{\eta}(\ell|u) - \log(1 - \bar{\phi}_e \Delta Y_t)$$

- Separation rate elasticity increases with  $\Delta Y_t$

$$\pi_{\eta,t}(u|\ell, x) = \pi_{\eta}(u|\ell, x) - \bar{\phi}_u \Delta Y_t x^{-\phi_{u,x}}$$

# Unemployment and the Business Cycle Okun's law

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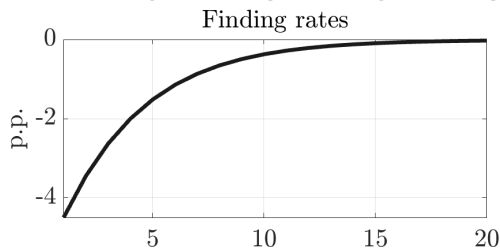
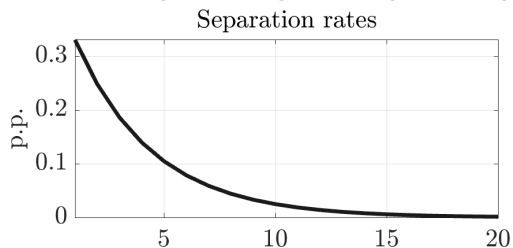
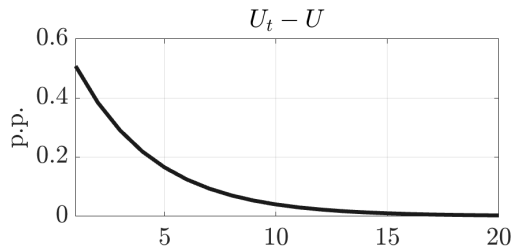
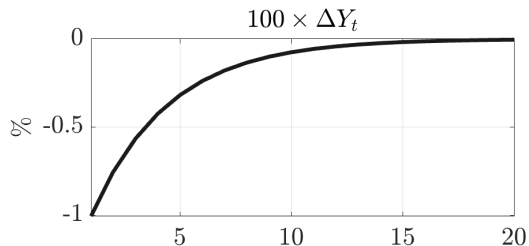
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- Joint calibration:

- +  $\bar{\phi}_e$  s.t. finding elasticity to  $U \approx -0.6$
- +  $\phi_{u,x} = 0$  elasticity of separation rates larger for above-median workers
- +  $\bar{\phi}_u = 0.33$  to get  $c_{OK} = 0.5$

# Unemployment and the Business Cycle Okun's law



Return

# Labor elasticities

## Two approaches

### ■ Labor elasticities decline with income

- Compute labor responses to a temporary tax shock

Erosa, Fuster, and Kambourov (2016)

- + Annual hours response to a 1% change in after-tax rate for one year
- + Aggregate labor elasticity is 0.30, declining with income

- Simulate steady-state model annually and run applied-micro regression

Rogerson and Wallenius (2009), Chang and Kim (2006)

- + Estimate  $b_1$  in  $\log h_{in} = b_0 + b_1 \log \tilde{w}_{in} - b_2 \log c_{in} + \varepsilon_{in}$
- + Aggregate labor elasticity is 0.45, declining with income

Income quartile	1	2	3	4
Labor elasticity: tax shock	0.44	0.34	0.25	0.22
Labor elasticity: regression	0.56	0.59	0.50	0.26



# Marginal propensities to consume

Distribution x wealth

---

- Marginal propensities to consume decline with wealth

Wealth quartile	1	2	3	4
<b>mpc</b>	0.20	0.15	0.07	0.03

## Deeper Recessions Bigger Fiscal Packages

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- Consider a recession of about 1% on impact – compared to 12bp on impact in the baseline
- Implement fiscal packages costing \$1500 per household

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- Multipliers are **similar** to the baseline

## Robustness

Monetary policy: Same real rate

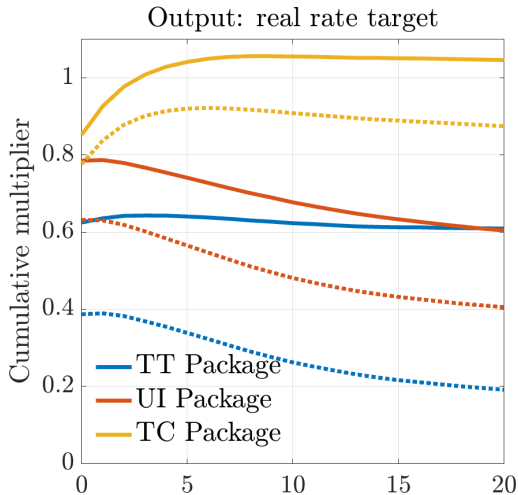
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- Fiscal packages affect inflation differently
  - Monetary policy and real rate differ
- Compare packages under benchmark real rate

# Robustness

Monetary policy: Same real rate

- Fiscal packages affect inflation differently
  - Monetary policy and real rate differ
- Compare packages under benchmark real rate
- TC package remains most effective
  - Larger multipliers than with Taylor rule
  - Especially for the TT package, less for the TC package



## Robustness More accommodative monetary policy

---

- Effectiveness of fiscal packages depend on constraints on monetary policy
- Consider a richer Taylor rule:

$$\ln \left( \frac{1 + i_{t+1}}{1 + \bar{i}} \right) = \Phi_{\Pi} \ln \left( \frac{\Pi_t}{\bar{\Pi}} \right) + \Phi_Y \ln \left( \frac{Y_t}{\bar{Y}} \right)$$

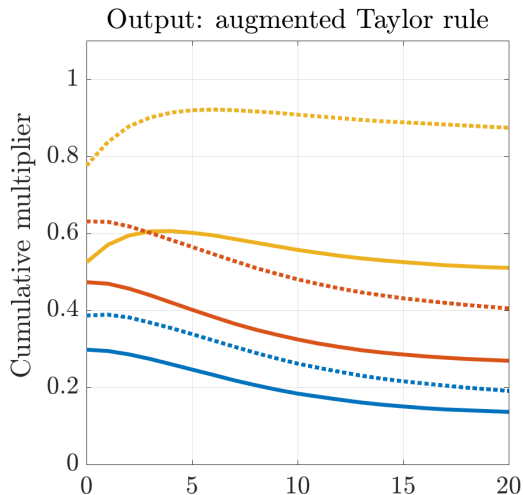
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- TC package remains **most effective**
  - **Lower multipliers** than with Taylor rule





## Robustness Steeper labor elasticities

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- Lower variance  $\rho_h$  to reach steeper labor elasticities
  - + 0.75 at Q1 (regression), 1.1 (tax shock)

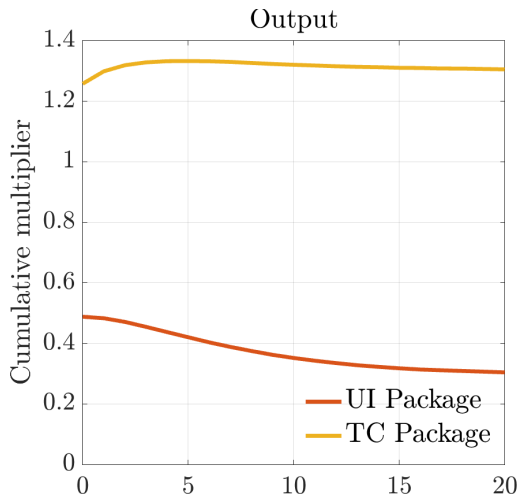
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Mertens and Ravn (2013)
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- All other targets  $\approx$  identical (**mpc** at 0.10)
- TC Package  $\Rightarrow$  **large output** multiplier



# Robustness

## Sticky wages

---

- Alternative modeling of nominal rigidities with sticky wages

Erceg, Henderson, and Levin (2000) Ferriere and Navarro (2024)

- Two-layer structure with a labor packer and labor unions

# Robustness

## Sticky wages

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### ■ Alternative modeling of nominal rigidities with sticky wages

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- Two-layer structure with a labor packer and labor unions

### ■ Competitive labor packer

- Produces a final labor bundle combining labor from unions  $N_t = \left( \int_0^1 n_{kt}^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}$

⇒ Implies labor demand  $n_{kt}^d = (W_{kt}/W_t)^{-\varepsilon} N_t$ , where  $W_t = w_t P_t$

### ■ Monopolist labor unions +

- Set wages  $w_t$  subject to adjustment cost
- Hire households labor in a competitive market at wage rate  $w_t^h$

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### ■ Theorem: Under linear labor technology, equivalence between price and wage stickiness

### ■ Labor union maximization problem

$$J_t^w(W_{kt-1}) = \max_{W_{kt}, n_{kt}} \left\{ d_{kt}^w + \frac{1}{1+r_{t+1}} J_{t+1}^w(W_{kt}) \right\} \quad \text{s.t.}$$

$$d_{kt}^w = \left( \frac{W_{kt}}{P_t} - w_t^h \right) n_{kt} - \Theta_t^w(W_{kt}, W_{kt-1}) - f_w$$

$$n_{kt} = \left( \frac{W_{kt}}{W_t} \right)^{-\varepsilon_w} N_t$$

$$\Theta_t^w(W_{kt}, W_{kt-1}) = \frac{\Theta^w}{2} \left( \frac{W_{kt}}{W_{kt-1}} - \bar{\Pi} \right)^2 N_t$$

⇒ Implies a standard **wage Philipps Curve**