Unemployment Risk, Uncertainty, and the Business Cycle

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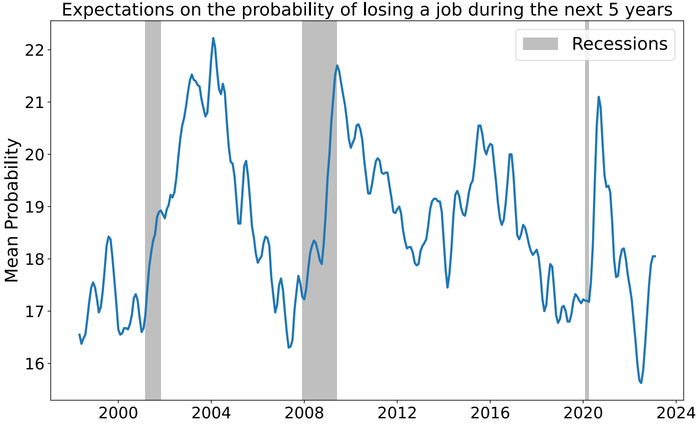
Unemployment risk could worsen recessions

"... the fear of unemployment could well lead to further increases in the saving rate that would damp consumption growth in the near term."

- Minutes of the FOMC, March 2009

Households job loss expectations rise during recessions



Income risk over the business cycles?

- Large literature on countercyclical Income risk. (Guvenen et al. 2014, Storesletten et al. 2004)
- Growing literature on countercyclical Urisk as an amplifier of business cycles. (Ravn and Sterk 2017, Graves 2023,...)

This Paper

Research Questions:

- What mechanisms drive the precautionary response to Urisk?
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What I do:

- Build structural model of countercyclical Urisk with rich distribution of wealth
- Quantify the underlying mechanisms of Urisk
- Compare UI policies in their effectiveness at mitigating Urisk

Contributions

- Response to Urisk largely stems from fear of exhausting UI.
  - i.e. Households fear ending up in a state with no income.
- Fear of exhausting UI benefits captured by income uncertainty (higher moments)
  - Households have little fear of a fall in expected income.
- Fear of exhausting UI can amplify business cycles.
- UI extensions are more effective than front loading replacement rate
  - b/c they reduce the probability of ending up with no income.

Related Literature

- **Unemployment Risk:** Ravn and Sterk (2017,2020), Den Haan, et al. (2017), Graves (2021), Gornemann et al. (2021), Bardoczy (2021), Broer et al. (2021), Harmenberg and Oberg (2021)
- **Uncertainty:** Bloom et al. (2018), Salgado, Guvenen, and Bloom (2019), Bayer et al.(2019), Schaab (2020)
- **Unemployment Insurance:** Mckay and Reis (2016), Kekre (2022)

Road Map

- Model
- Calibration and micro-estimation
- Quantitative Results (Work in progress)

Model: "HANK and SAM" per Ravn and Sterk (2017)

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  - Consumption saving problem, one asset
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  - Stochastic transitions between employment and unemployment

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- Standard **New Keynesian** Supply side
- **Search and Matching** Frictions (Diamond-Mortensen-Pissarides)

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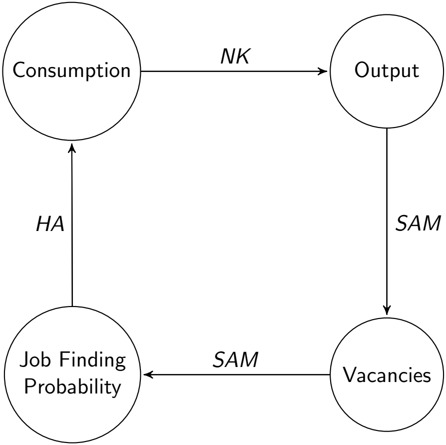
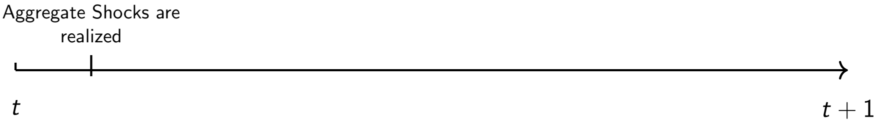
- Standard **New Keynesian** Supply side
- **Search and Matching** Frictions (Diamond-Mortensen-Pissarides)
- Policy
  - Fiscal rule that adjusts tax rate to stabilize debt to GDP
  - Monetary policy follows standard inertial Taylor rule

HANK and SAM ingredients



NK: New Keynesian
HA: Heterogenous Agents
SAM: Search and Matching

Household Timeline



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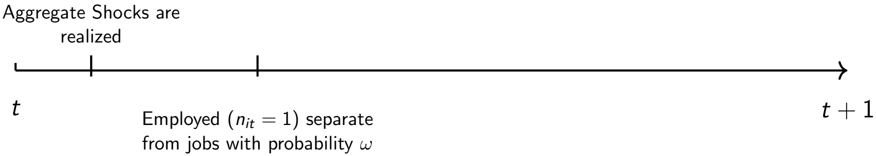

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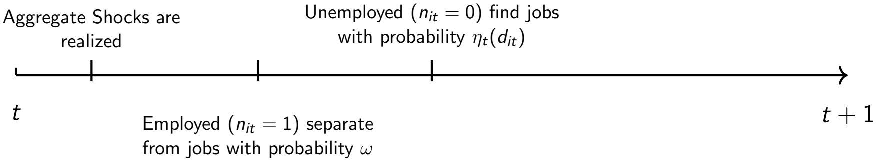

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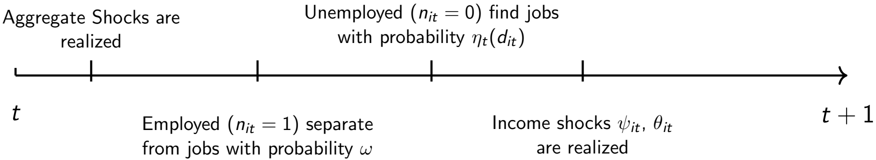

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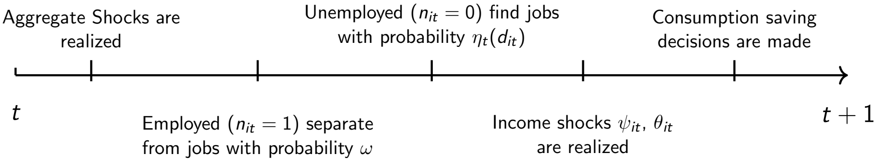

Household problem

Households choose consumption c_{it} to maximize their expected lifetime utility.

$$\max_{\{c_{it+s}\}_{s=0}^{\infty}} \mathrm{E_t}\left[\sum_{s=0}^{\infty}(\not{D}\beta_i)^{t+s}\frac{c_{it}^{1-\rho}}{1-\rho}\right]$$

s.t.

$$c_{it} + a_{it} = z_{it} + (1 + r_t^a)a_{it-1}$$

$$a_{it} \geq 0$$

$r_t^a = \frac{1+i_t}{1+\mathrm{E_t}[\pi_{t+1}]}$ is the real interest rate
z_{it} labor income
a_{it} assets
$\not{D}$ probability of death

Labor Income

Labor income is composed of permanent income p_{it} and transitory income $\theta_{it}\zeta_{it}$.

$$z_{it} = p_{it}\theta_{it}\zeta_{it}$$

θ_{it} is a transitory income shock and ζ_{it} is (un)employment income

$$\zeta_{it} = \overbrace{(1-\tau_t)w_t n_{it}}^{\text{After tax income if employed}} + \overbrace{UI_t(1-n_{it})\left(\mathbb{1}(d_{it}=1)+\mathbb{1}(d_{it}=2)\right)}^{\text{Income if unemployed for 2 quarters or less}}$$

Permanent income is subject to shocks ψ_{it+1}

$$p_{it+1} = p_{it}\psi_{it+1}$$

$$log(\psi_{it}) \sim N\left(-\frac{\sigma_\psi^2}{2}, \sigma_\psi^2\right)$$
$$log(\theta_{it}) \sim N\left(-\frac{\sigma_\theta^2}{2}, \sigma_\theta^2\right)$$

Supply Side

Standard New Keynesian Setup (Christiano et al. (2005)):

- Final Goods Producers
- Intermediate Goods Producers facing sticky prices

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Assume all intermediate good producer holds all profits b/c:

- With sticky prices can get countercyclical profits
- With high MPC households this can be unrealistic/problematic

Phillips Curve

Solution to the intermediate goods producers problem yields Phillips Curve equation:

$$\pi_t(1+\pi_t) = \frac{\epsilon_p}{\varphi}(mc_t - mc_{ss}) + \frac{1}{1+r_t^a}\mathrm{E_t}\left[\pi_{t+1}(1+\pi_{t+1})\frac{Y_{t+1}}{Y_t}\right]$$

where $mc_t = \frac{hc_t}{Z_t}$

Representative Labor Agency

Perfectly competitive

Hires labor N_t from households by posting vacancies v_t.

Sells labor demanded N_t from intermediate good producers at price hc_t to maximize profit.

$$J_t(N_{t-1}) = \max_{N_t, v_t} \{(hc_t - w_t)N_t - \kappa v_t + \frac{1}{1 + r_t^a} \mathrm{E_t} \left[J_{t+1}(N_t) \right] \}$$

s.t.

$$N_t = (1 - \omega)N_{t-1} + \phi_t v_t$$

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s.t.

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F.O.C.

$$hc_t = \left(w_t + \frac{\kappa}{\phi_t} - \frac{1}{1 + r_t^a}(1 - \omega)\mathrm{E}_t \left[\frac{\kappa}{\phi_{t+1}} \right] \right)$$

Wages

Following Graves (2021), wages follow the hiring cost with elasticity ϵ_w

$$w_t = w_{ss} \left(\frac{hc_t}{hc_{ss}} \right)^{\epsilon_w}$$

Labor Market

Job searchers e_t match with the representative labor agency.

Cobb Douglas matching function:

$$m_t = \chi e_t^{\alpha} v_t^{1-\alpha}$$

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Defining labor market tightness $\Theta_t = \frac{v_t}{e_t}$

Job Finding probabilities : $\eta_t(d) = q(d)\chi\Theta_t^{1-\alpha}$

Vacancy filling probability : $\phi_t = \chi\Theta_t^{-\alpha}$

$q(d)$ captures the duration dependence of the job finding probability.

Government

Issues long term bonds B_t at price q_t^b in period t that pays δ^s in period $t+s+1$ for $s = 0, 1, 2, ..$

The bond price satisfies the no arbitrage condition:

$$q_t^b = \frac{1 + \delta \mathrm{E}_t[q_{t+1}^b]}{1 + r_t^a}$$

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Government Budget Constraint:

$$\tau_t w_t N_t + q_t^b B_t = (1 + \delta q_t^b) B_{t-1} + G + UI_t(U_{1,t} + U_{2,t})$$

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Following Auclert et al. (2021), the tax rate adjusts to stabilize the debt to GDP ratio:

$$\tau_t - \tau_{ss} = \phi_B q_{ss}^b \frac{B_{t-1} - B_{ss}}{Y_{ss}}$$

ϕ_B governs the speed of adjustment

Monetary Policy

As in Auclert et al. (2021), monetary policy follows a standard inertial Taylor rule:

$$i_t = \rho_r i_{t-1} + (1 - \rho_r)\phi_\pi \pi_t + \epsilon_v$$

ρ is the persistence of the policy rate
ϵ_v is a monetary policy shock

Market Clearing

Asset Clearing: private saving equals the value of government debt

$$A_t = q_t^b B_t$$

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Goods Clearing:

$$C_t + G = w_t N_t$$

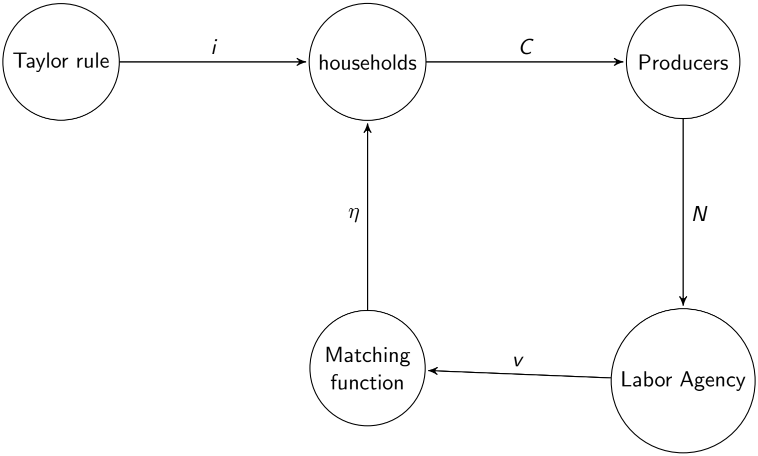
where

$C_t = \int c_{it}\, di$

$A_t = \int a_{it}\, di$

How does the model work? A high level overview

Consider a monetary policy shock:



Bringing data to model

- Model is calibrated to a quarterly frequency.
- Calibrate all parameters except discount factors
- Following Carroll et al. (2019), discount factors estimated to match the distribution of liquid wealth from 2004 SCF.

Household Calibration

Description	Parameter	Value	Source/Target
CRRA	ρ	2	Standard
Real Interest Rate	r^a	$1.03^{.25} - 1$	3% annual
Death Probability	$\not{D}$	.00625	40 year work life
Tax rate	τ	.3	
Real Wage	w_t	1.0	Normalized
UI replacement rate	UI	50%	Graves (2022)
Job Separation probability	ω	.1	JOLTS
Std Dev of Log Transitory Shock	σ_θ	.2	Carroll et al. (2017)
Std Dev of Log permanent Shock	σ_ψ	.06	Carroll et al. (2017)

Calibrating job finding probabilities

Job Finding probabilities : $\eta_t(d) = q(d)\chi\Theta_t^{1-\alpha}$

For $d = 0$ calibrate $\eta(d)$ separately to target:

- let $\eta(0) = .677$ to target EU probability $= .032$ (CPS)

For $d = 1, 2, 3, 4, 5$, following Kekre (2022):

$$q(d) = exp(-\lambda d)$$

Let $\lambda = .066$
$=>$ proportion of unemployed with unemp spells longer than 6 months is 17%

Calibrated job finding probabilites

Resulting job finding probabilities:

$\eta(0)$	$\eta(1)$	$\eta(2)$	$\eta(3)$	$\eta(4)$	$\eta(5)$
.677	.63	.59	.55	.52	.48

Overall, this results in a steady state unemployment rate of 5%

Calibration for the rest of the economy

Description	Parameter	Value	Source/Target
Elasticity of Substitution	ϵ_p	6	Ravn and Sterk (2017)
Price Adjustment Cost	φ	60	Slope of Phillips Curve = .1
Elasticity of wages	ϵ_w	.45	Graves (2021)
Vacancy Filling Rate	ϕ	.71	Graves (2021)
Matching Elasticity	α	.65	Ravn and Sterk (2017)
Vacancy Cost	κ	.05	hiring cost 7% of quarterly wage
Government Spending	G	.24	Gov. Budget Constraint
Response of Tax rate to debt	ϕ_b	.1	Auclert et al. (2021)
Decay rate of government coupon	δ	.95	5 years debt maturity
Taylor Rule inflation coefficient	ϕ_π	1.5	Standard
Persistence of nominal rate	ρ_r	.8	Bardoczy (2022)

Micro-estimation: Matching the distribution of wealth

Assume discount factors are uniformly distributed across households in the range $[\beta - \nabla, \beta + \nabla]$.

Approximate distribution with five points.

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Estimate:

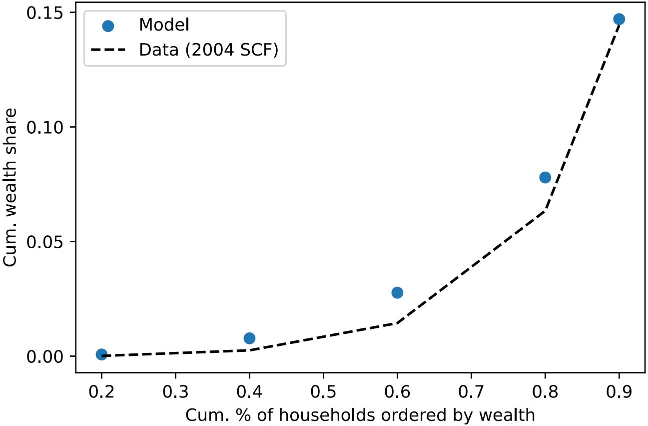
- β to match $\frac{\text{Mean Liquid Wealth}}{\text{Mean quarterly permanent income}}$
- ∇ to match 20th, 40th, 60th, 80th, and 90th percentiles of the lorenz curve for liquid wealth.

Liquid wealth as defined in Kaplan, Violante, and Weidner (2014):

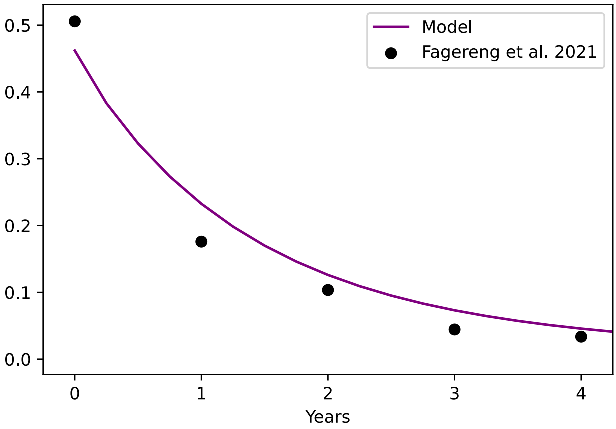
Estimated discount factors

Discount Factor Estimates ($\hat{\beta} = .0.947$, $\hat{\nabla} = .0.057$)				
.900	.924	.947	.969	.993

Distribution of liquid wealth: Model vs Data



IMPCs: Model vs Data



Decomposing the effects of unemployment risk

Consumption response to heightened Urisk can be decomposed into:

$$\text{Urisk Channel} = \underbrace{\text{Expected Income Channel}}_{\text{Consumption Smoothing}} + \underbrace{\text{Income Uncertainty Channel}}_{\text{Precautionary Saving}}$$

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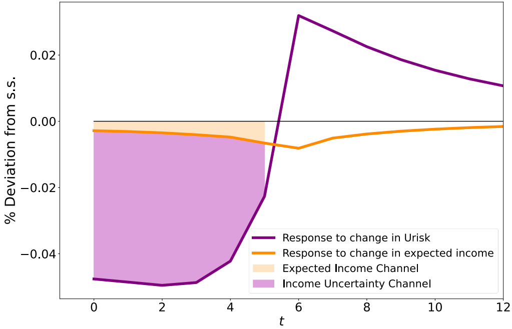
Quantifying labor income uncertainty

How to quantify each channel? Consider the following experiment:

- Consider only households(**hh**(partial equilibrium))
- In period $t = 0$, **hh** learn that the job finding prob. will fall by .01 in $t = 6$.
- Sim agg consumption response from $t = 0$ onwards.
- Sim agg consumption response but instead hh only believe their expected income falls.

Quantifying income uncertainty

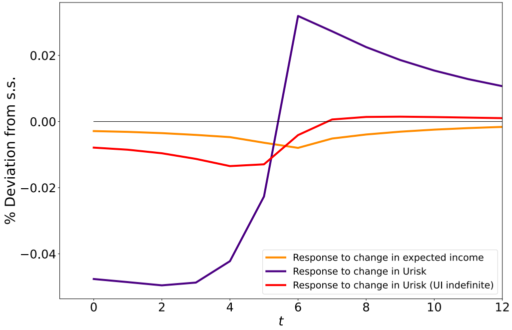
Consumption response to 1 p.p decline in the job finding probability at $t = 6$



- C response to Urisk largely explained by increased income uncertainty

Why is income uncertainty so large?

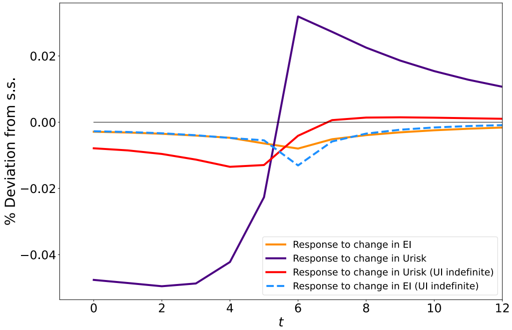
Consider the same model however UI benefits do not expire.



- Precautionary response much larger when UI expires.
- How much of the additional precautionary response is due to income uncertainty?

Why is income uncertainty so large?

Need to know the expected income effect in the model with indefinite UI.



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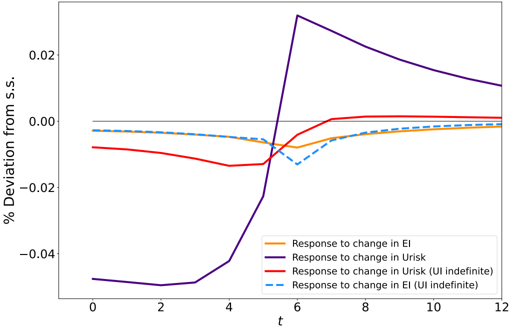

- Large proportion of income uncertainty from allowing UI to expire.

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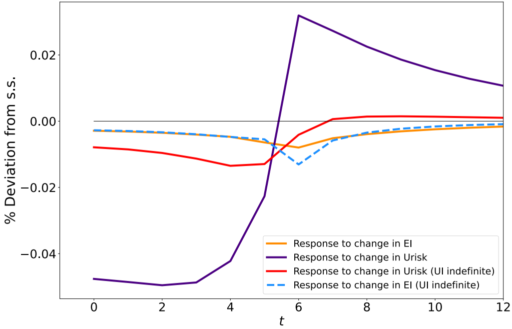

- Large proportion of income uncertainty from allowing UI to expire.
- **Precautionary response largely driven by fear of ending up in a state where UI has been exhausted.**

Precautionary responses to discretionary UI policies

Q: How do UI extensions compare to raising the rr in mitigating fears of exhausting UI?

Precautionary responses to discretionary UI policies

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Consider two separate experiments in partial equilibrium.

- a 2Q extension of UI
- an increase in the rr of equal cost to the 2Q extension

Suppose both UI policys are in effect for the same duration.

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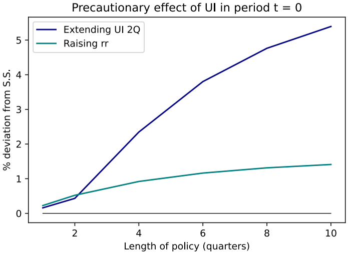
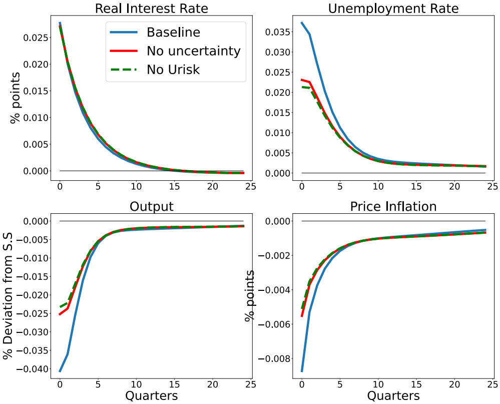


Extensions become more effective at mitigating fears than raising rr with the duration of policy.

Does this matter over the business cycle?

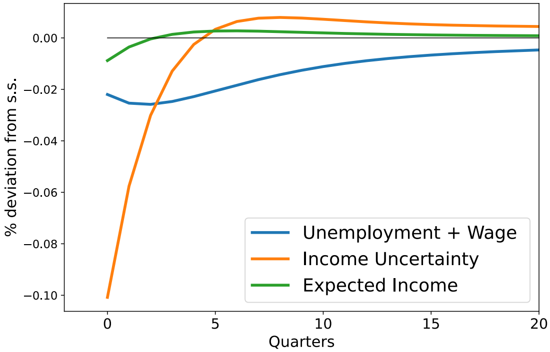
Income uncertainty over the business cycle

Impulse responses to 10 basis point (annualized) increase in the nominal rate



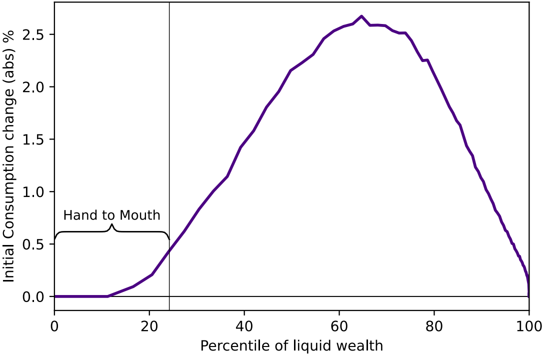
- Fear of exhausting UI can generate large fluctuations!

Decomposing the consumption response: Uncertainty vs Income Effects



- Income uncertainty much larger than indirect income effects

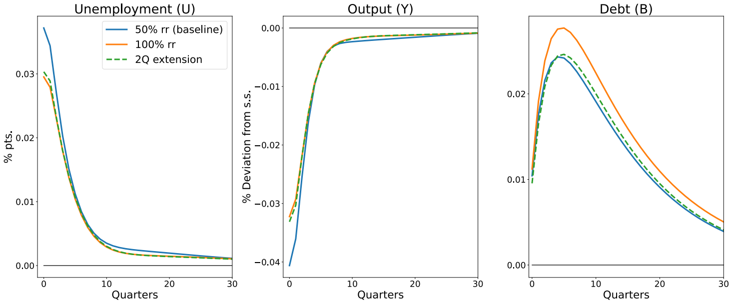
Effect of Urisk across the distribution



- Middle of the distribution largely explains C response to Urisk
- HtM are mostly liquidity constrained and do not save

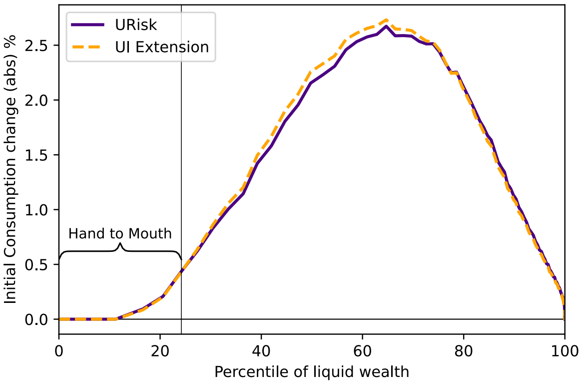
UI as an automatic stabilizer: Extensions vs raising the replacement rate (rr)

IPRs to a monetary policy shock under different UI policies



- Extending UI is a more effective automatic stabilizer than increasing rr

Precautionary effect of UI extensions across the distribution



- Precautionary Effect of UI largely explained by middle of the distribution
- Urisk and UI are two sides of the same coin

Conclusion

- Next steps:
  - Bayesian estimation of Keynesian parameters
  - Extend the model to incorporate search for moral hazard effects of UI.

Appendix

Final Goods Producer

Purchases intermediate goods Y_{jt} at price P_{jt} to produce final good Y_t

Sells final good at price P_t

$$Y_t = \left(\int_0^1 Y_{jt}^{\frac{\epsilon_p - 1}{\epsilon_p}} \, dj \right)^{\frac{\epsilon_p}{\epsilon_p - 1}}$$

Profit maximization implies demand for good j

$$Y_{jt} = \left(\frac{P_{jt}}{P_t} \right)^{-\epsilon_p} Y_t$$

Intermediate Goods Producers

Monopolistically competitive producers indexed by j

Purchases labor from a labor agency at price h_t

Produce Y_{jt} with production function linear in labor N_{jt}

$$Y_{jt} = Z_t N_{jt}$$

Intermediate Goods Producers

Monopolistically competitive producers indexed by j

Purchases labor from a labor agency at price h_t

Produce Y_{jt} with production function linear in labor N_{jt}

$$Y_{jt} = Z_t N_{jt}$$

Choose P_{jt} to maximize its profit facing price stickiness a la Rotemberg (1982)

$$F_t\left(P_{jt}\right) = \max_{\{P_{jt}\}} \left\{ \left(\frac{P_{jt} Y_{jt}}{P_t} - MC_t - \frac{\varphi}{2} \left(\frac{P_{jt} - P_{jt-1}}{P_{jt-1}} \right)^2 Y_t \right) + \frac{1}{1 + r_t^a} \mathrm{E}_t \left[F_{t+1}\left(P_{jt+1}\right) \right] \right\}$$

s.t.

$$Y_{jt} = \left(\frac{P_{jt}}{P_t} \right)^{-\epsilon_p} Y_t$$