Optimal Automatic Stabilizers

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- How generous UI?
- How progressive tax system?

- Design of the social insurance system incorporating roles for:
  - $\rightarrow$ Social insurance / redistribution
  - $\rightarrow$ Incentives
  - $\rightarrow$ Macroeconomic stabilization

- Focus on automatic stabilizers:
  - $\rightarrow$ fixed UI replacement rate
  - $\rightarrow$ fixed tax progressivity

Our contributions

- A formal definition of automatic stabilizers
  - → Tractable incomplete markets model with nominal rigidities and aggregate shocks.
  - → For UI:
    - Baily-Chetty formula with macroeconomic stabilization term.
    - $\mathbb{E}_0\left[(dW_t/dM_t)(dM_t/db)\right] = E\left[\cdot\right]E\left[\cdot\right] + \text{Cov}$

- Characterization of macroeconomic stabilization term:
  - → Recessions are costly.
    - More idiosyncratic risk.
  - → Social programs stabilize cycle.
    - More idiosyncratic risk.

- Quantitative assessment in calibrated model:
  - → Unemployment benefits: replacement rate rises from 35% to 56%.
  - → Income tax progressivity: barely changes.

Why do we care?

- Growing sense that heterogeneity shapes business cycle.
  → Social insurance changes idiosyncratic risk and income distribution with macroeconomic consequences.

- In a low-interest-rate environment, larger role for fiscal policy.

2. Model

Population, preferences, endowments

- Unit continuum of households
  - → Productivity $\alpha_{i,t}$ and employment status $n_{i,t}$.
  - → Every period, δ share dies, replaced by households with $\alpha_{i,t} = 1$.

- Preferences:

$$\mathbb{E}_0 \sum_t \beta^t \left[\log(c_{i,t}) - \frac{h_{i,t}^{1+\gamma}}{1+\gamma} - \frac{q_{i,t}^{1+\kappa}}{1+\kappa} + \chi \log(G_t) - \xi \left(1 - n_{i,t}\right) \right].$$

Idiosyncratic risk 1: productivity

$$\log \alpha_i' = \log \alpha_i + \log \epsilon_i'$$
$$\epsilon_i' \sim F(\epsilon'; u)$$

- Cyclical income risk

  e.g. Storesletten et al. (2004), Davis and von Wachter (2011), Guvenen et al. (2014).

Idiosyncratic risk 2: employment

- υ searchers per period.

- Finding rate per unit of search: M_t.

- Non-employment is i.i.d. across households.

Technology

- Intermediate good: $y_{j,t} = \eta_t^A l_{j,t}$

- Final good is Dixit-Stiglitz aggregate of intermediate varieties

$$Y_t = \left(\int_0^1 y_t(j)^{1/\mu} dj \right)^\mu$$

- Using standard price index and demand for variety j:

$$Y_t = \underbrace{\frac{\eta_t^A}{S_t}}_{\equiv A_t} L_t.$$

where

$$S_t \equiv \int (p_t(j)/p_t)^{\mu/(1-\mu)} \, dj \geq 1$$

$$L_t \equiv \int h_{i,t} n_{i,t} \alpha_{i,t} di.$$

- Resource constraint: $Y_t - J_t = C_t + G_t$

Market structure 1

- Risk-free, real bond with borrowing constraint $a_{i,t} \geq 0$.
- Labor income if employed is $\alpha_{it} w_t h_{it}$
  - $\rightarrow$ Worker chooses hours given w_t
- Firms look for workers at a cost (Blanchard and Gali, 2010)
  - $\rightarrow$ Cost per hire: $\psi_1 M_t^{\psi_2}$
  - $\rightarrow$ Aggregate hiring costs: $J_t \equiv \psi_1 M_t^{\psi_2} (\upsilon - u_t)$

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- Wage rule:

$$w_t = w(\eta_t^A, u_t, b, \tau)$$

Market structure 2

- Competitive final-goods firm.
- Monopolistic competition for intermediates operating: desire constant markup over marginal cost.
- But markup fluctuates due to nominal rigidities.
- Entrepreneurial income sent to households proportional to their skills.

Social programs

- Progressive income tax
  - → pre-tax income $\equiv z_{i,t}$
  - → after-tax income $= \lambda_t z_{i,t}^{1-\tau}$
  - → $1 - \lambda_t$ determines the level of taxes.
  - → τ determines the progressivity of taxes.
- Unemployment insurance
  - → Paid in proportion to what would earn if employed: $b\lambda_t z_{i,t}^{1-\tau}$
  - → $b \in [0, 1]$ is the generosity of benefits.
- Chosen ex ante, automatic stabilizers, not state-dependent.

Other government policy

- Monetary policy:

$$I_t = \bar{I}\pi_t^{\omega_\pi} x_t^{\omega_x} \eta_t^I.$$

- Government purchases follow Samuelson (1954) rule

$$G_t = \chi C_t \eta_t^G$$

- Budget constraint

$$G_t + R_t B_t = \int n_{i,t} \left(z_{i,t} - \lambda_t z_{i,t}^{1-\tau} \right) - (1 - n_{i,t})\, b\lambda_t z_{i,t}^{1-\tau} di + B_{t+1}.$$

Vanishing liquidity equilibrium

- $B_t = 0 \ \forall t$.
- Degenerate wealth distribution: can't borrow so can't save.
- Agent with greatest willingness to save is on Euler equation, others are constrained.
- Krusell et al. (2011), Ravn and Sterk (2017), Werning (2015).
- Heterogeneity in α drops out of Euler equation due to homothetic preferences and unit root shocks. E.g. Constantinides and Duffie (1996).

$\Rightarrow$ Employed on Euler equation and unemployed constrained.

Inequality and heterogeneity

Lemma

All households choose the same asset holdings, hours worked, and search effort, so $a_{i,t} = 0, h_{i,t} = h_t$, and $q_{i,t} = q_t$ for all i.

- Distribution of wealth is not a state variable.
- Distribution of income and consumption $(z_{i,t}, c_{i,t})$ driven by $(\alpha_{i,t}, n_{i,t})$.

Aggregation for consumption dynamics

$\tilde{c}_t \equiv$ consumption of employed individual with average productivity.

Lemma

Consumption dynamics obey:

$$\frac{1}{\tilde{c}_t} = \beta R_t \, \mathbb{E}_t \left\{ \frac{1}{\tilde{c}_{t+1}} Q_{t+1} \right\}$$

$$\textit{with: } Q_{t+1} \equiv \left[(1 - u_{t+1}) + u_{t+1} b^{-1} \right] \mathbb{E} \left[\epsilon_{i,t+1}^{-(1-\tau)} \right].$$

Q_{t+1} is precautionary motive (dampened by social insurance).

Consumption distribution: $c_{i,t} = \left[\alpha_{i,t}^{1-\tau} (n_{i,t} + (1 - n_{i,t}) b) \right] \tilde{c}_t$

Policy distortions

- Labor supply and distortionary income taxation:

$$h_t = [\bar{w}(1-\tau)]^{\frac{1}{1+\gamma}} M_t^{\frac{\zeta}{1+\gamma}}$$

- Search effort and distortionary unemployment benefits:

$$q_t^{\kappa} = M_t \left[\log(1/b) - \frac{h_t^{1+\gamma}}{1+\gamma} + \xi\right].$$

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Summary

Equilibrium can be expressed as small number of endogenous variables and equations.

Structure of the labor market

Lemma

There are functions $\mathcal{H}_h$, $\mathcal{H}_q$, $\mathcal{H}_u$, $\mathcal{H}_Y$ such that:

$$
\begin{aligned}
h_t &= \mathcal{H}_h(b, \tau, M_t, \eta_t^A) \\
q_t &= \mathcal{H}_q(b, \tau, M_t, \eta_t^A) \\
u_t &= \mathcal{H}_u(b, \tau, M_t, \eta_t^A) \\
Y_t &= \mathcal{H}_Y(b, \tau, M_t, \eta_t^A)
\end{aligned}
$$

- Given M_t, can solve for other variables.
- M_t is a useful summary of the state of the business cycle.

4. Optimal choice of b and τ

Target

- Goal is to maximize utilitarian social welfare: $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t W_t$

$$\begin{aligned} W_t = & \log(C_t) - (1-u_t)\frac{h_t^{1+\gamma}}{1+\gamma} - \upsilon \frac{q_t^{1+\kappa}}{1+\kappa} + \chi \log(G_t) - \xi u_t \\ & + \mathbb{E}_i \log\left(\alpha_{i,t}^{1-\tau}\right) - \log\left(\mathbb{E}_i\left[\alpha_{i,t}^{1-\tau}\right]\right) \\ & + u_t \log b - \log\left(1 - u_t + u_t b\right). \end{aligned}$$

- Choose b and τ ex ante.

Optimal unemployment insurance

Proposition

The optimal choice of the generosity of unemployment insurance b satisfies:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \begin{array}{c} u_t \left(\frac{1}{b} - 1\right) \left.\frac{\partial \log(b\tilde{c}_t)}{\partial \log b}\right|_{M,q} \\ + \left.\frac{\partial \log \tilde{c}_t}{\partial \log u_t}\right|_M \left.\frac{\partial \log u_t}{\partial b}\right|_M + \frac{dW_t}{dM_t}\frac{dM_t}{db} \end{array} \right\} = 0.$$

- Optimal policy trades off insurance, incentives, and macro stabilization
- Larger macro-stabilization term implies more generous insurance.

▸ More

Optimal income tax progressivity

Proposition

The optimal progressivity of the tax system τ satisfies:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \begin{array}{c} \frac{\text{Cov}\left(\alpha_{i,0}^{1-\tau}, \log \alpha_{i,0}\right)}{\mathbb{E}_i\left[\alpha_{i,0}^{1-\tau}\right]} + \frac{\beta}{1-\beta} \frac{\text{Cov}\left(\epsilon_{i,t+1}^{1-\tau}, \log \epsilon_{i,t+1}\right)}{\mathbb{E}_i\left[\epsilon_{i,t+1}^{1-\tau}\right]} \\ - \left(\frac{A_t}{C_t} - h_t^{\gamma}\right)(1-u_t) \left.\frac{\partial h_t}{\partial b}\right|_M \\ + \frac{dW_t}{dM_t}\frac{dM_t}{d\tau} \end{array} \right\} = 0.$$

- Optimal policy trades off insurance, incentives, and macro stabilization
- Larger macro-stabilization term implies more progressive tax.

More

The macroeconomic stabilization term

$$\sum_{t=0}^{\infty} \beta^t \, \mathbb{E}_0 \left\{ \frac{dW_t}{dM_t} \frac{dM_t}{db} \right\} = \sum_{t=0}^{\infty} \beta^t \left\{ \mathbb{E}_0 \left[\frac{dW_t}{dM_t} \right] \mathbb{E}_0 \left[\frac{dM_t}{db} \right] + \text{Cov} \left[\frac{dW_t}{dM_t}, \frac{dM_t}{db} \right] \right\}$$

The hallmark of an automatic stabilizer: activity more sensitive to policy when activity is inefficiently low.

Activity and welfare

Proposition

The effect of macroeconomic activity on welfare can be decomposed into:

$$\frac{dW_t}{dx_t} = \underbrace{(1-u_t)\left[\frac{A_t}{C_t} - h_t^{\gamma}\right]\frac{dh_t}{dM_t}}_{\textit{labor-wedge (intensive)}} + \underbrace{\frac{1}{C_t}\left.\frac{\partial C_t}{\partial u_t}\right|_x \frac{du_t}{dM_t} - \frac{1}{C_t}\left.\frac{\partial J_t}{\partial M_t}\right|_u}_{\textit{labor-wedge (extensive)}}$$

$$- \underbrace{\frac{Y_t}{C_t S_t}\frac{dS_t}{dM_t}}_{\textit{price-dispersion}}$$

$$\underbrace{-\left(\log(1/b) - \frac{h_t^{1+\gamma}}{1+\gamma} + \xi\right)\left.\frac{\partial u_t}{\partial M_t}\right|_q + \frac{1-b}{1-u_t+u_t b}\frac{du_t}{dM_t}}_{\textit{unemployment-risk}}$$

$$+ \underbrace{\frac{\beta}{1-\beta}\frac{d}{dM_t}\int \log\left(\frac{\epsilon^{1-\tau}}{\int \epsilon^{1-\tau} dF(\epsilon, u_t)}\right) dF(\epsilon, u_t)}_{\textit{income-risk}}$$

Social programs and activity

- Social programs affect activity through two channels:
  - → Social insurance channel: dampen precautionary savings motives
  - → Redistribution channel: transfers to high-MPC agents
- Both channels become stronger in a recession
  - → More idiosyncratic risk
  - → More unemployed people receiving transfers
- General equilibrium considerations are crucial
  - → If real interest rates adjust perfectly, then no role for aggregate demand policy.

▸ Details

5. Quantitative analysis

Solving model

- Calibration:
  - $\rightarrow$ Frisch elasticity of labor supply = 1/2.
  - $\rightarrow$ Average price duration of 3.5 quarters.
  - $\rightarrow$ Micro elasticity of unemployment w.r.t. benefits = 0.5.
  - $\rightarrow$ Estimated monetary rule: $I_t = \bar{I}\pi_t^{1.66}(1-u_t)^{0.13}\eta_t^I$.
  - $\rightarrow$ Cyclical income process based on Guvenen-McKay-Ryan. ▸ Details
  - $\rightarrow$ ζ to match contribution of intensive margin to variance of hours.
  - $\rightarrow$ $b = 0.81$ to match consumption change in unemployment.
    Stephens (2004), Aguiar and Hurst (2005), Saporta-Eksten (2014), Chodorow-Reich and Karabarbounis (2016).
- Global solution method based on Maliar and Maliar (2015)

Optimal policy

(i) Compute optimal policy without aggregate shocks (deterministic steady state).

(ii) Compute optimal policy with aggregate shocks.
   → Assume steady state, but with anticipation of shocks in future.

- Comparing (i) and (ii) shows how business cycles affect optimal policy.

Optimal policy

	b	τ	Replacement rate
Without aggregate shocks	0.746	0.248	0.35

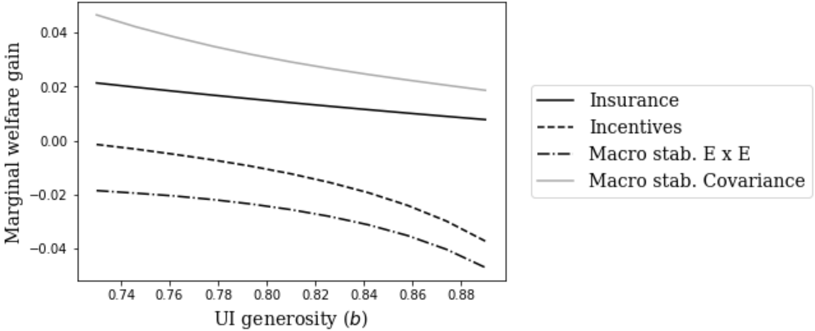
$$\left(\text{Replacement rate} \times \frac{1}{2} + \frac{1}{2}\right)^{1-\tau} = b$$

Optimal policy

	b	τ	Replacement rate
Without aggregate shocks	0.746	0.248	0.35
With	0.824	0.216	0.56

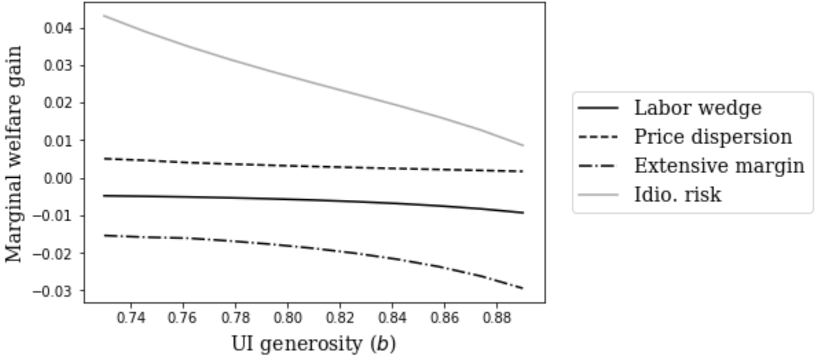
$$\left(\text{Replacement rate} \times \frac{1}{2} + \frac{1}{2}\right)^{1-\tau} = b$$

Policy trade-offs



Unpacking the macro stabilization term

$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{dW_t}{dx_t} \frac{dx_t}{db} \right\}$ in terms of components of $\frac{dW_t}{dx_t}$

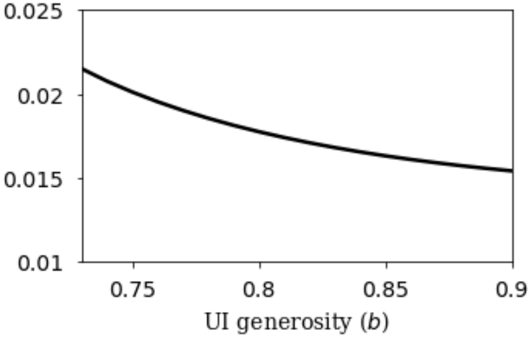


Stabilizing effect of b

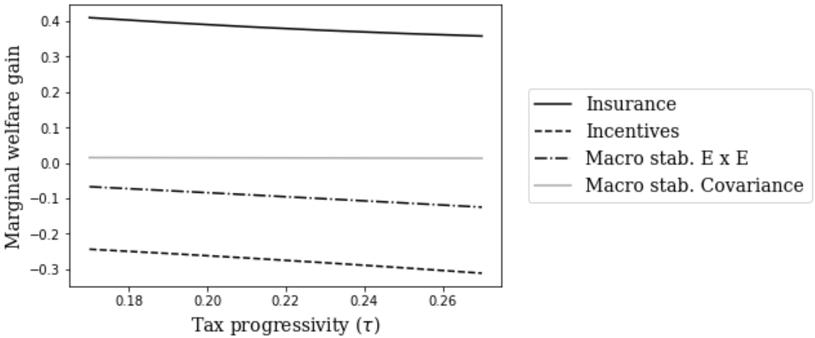
- Unemployment risk creates a powerful, cyclical precautionary savings motive. Ravn and Sterk (2015), Den Haan et al. (2015), Heathcote and Perri (2017).

- Raising benefits has a strong stabilizing effect.

Standard deviation of log output



WHY IS τ (APPROXIMATELY) UNCHANGED?



- Macro stabilization benefit is small relative cost of distortions.
- τ falls due to joint optimization over b and τ.

Conclusion: The logic of automatic stabilizers

- Automatic stabilizers increase demand through redistribution and social insurance.

- These channels are more powerful in recessions as more unemployed and more risk.

- Automatic stabilizers more useful when risks are volatile and monetary policy is unresponsive.

- Aggregate stabilization considerations can have important effects on optimal policy calculations.

Conclusion:
Outstanding issues

- Quantitative analysis with heterogeneity in unemployment risk.

- Structural determinants of cyclical earnings losses.

- Limits of rules.

Household's problem

$$V(a,n,\mathcal{S}) = \max_{c,a',h}\left\{\log c - \frac{h^{1+\gamma}}{1+\gamma} + \beta\,\mathbb{E}\left[(1-\upsilon)V(a',1,\mathcal{S}') + \upsilon V^q(a',\mathcal{S}')\right]\right\}$$

such that

$$c + a' = R(\mathcal{S})a + (n + (1-n)b)\,\lambda\left(w(\mathcal{S})h + d(\mathcal{S})\right)^{1-\tau},$$

where for an employed individual h is a choice and for an unemployed worker h should be replaced by $h(a,\mathcal{S})$, which is the equilibrium decision rule of employed workers.
The value of entering the period without a match is

$$V^q(a,\mathcal{S}) = \max_{q}\left\{M(\mathcal{S})qV(a,1,\mathcal{S}) + (1-M(\mathcal{S})q)V(a,0,\mathcal{S}) - \frac{q^{1+\kappa}}{1+\kappa}\right\}.$$

Aggregate state $\mathcal{S} \equiv (\eta^A, \eta^I, \eta^G, \mathbb{E}_i[\alpha_i^{1-\tau}], S_{-1}, \Phi]$

Back

Equilibrium definition

Let $N(a, \mathcal{S}) \equiv 1 - \upsilon + \upsilon q(a, \mathcal{S}) M(\mathcal{S})$ be the probability that a worker with assets a is employed.
Define $\mathcal{H}$ as aggregate hours worked per employed worker and $\mathcal{Q}$ as average search effort.
Aggregate quantities, are then given by

$$C = \int c(a, 1, \mathcal{S}) N(a, \mathcal{S}) + c(a, 0) \left[1 - N(a, \mathcal{S})\right] d\Phi(a) \tag{1}$$

$$\mathcal{H} = \int h(a, \mathcal{S}) N(a, \mathcal{S}) d\Phi(a) / \int N(a, \mathcal{S}) d\Phi(a) \tag{2}$$

$$\mathcal{Q} = \int q(a, \mathcal{S}) d\Phi(a). \tag{3}$$

Equilibrium: 11 variables, three exogenous processes, solution to the household's problem, distribution of wealth.
The variables are $u_t, R_t, I_t, \pi_t, Y_t, G_t, w_t, S_t, \frac{p_t^*}{p_t}, J_t, M_t$.
The exogenous processes are η_t^A, η_t^G, and η_t^I.

Back

Equilibrium definition

$$u_t = \upsilon(1 - q_t M_t)$$

$$J_t = \psi_1 M_t^{\psi_2}(\upsilon - u_t)$$

$$w_t = \bar{w} A_t (1 - J_t / Y_t) x_t^{\zeta}$$

$$\pi_t = \left[(1-\theta) / \left[1 - \theta \left(\frac{p_t^*}{p_t} \right)^{1/(1-\mu)} \right] \right]^{1-\mu}$$

$$I_t = \bar{I} \pi_t^{\omega_\pi} x_t^{\omega_x} \eta_t^I$$

$$G_t = \chi C_t \eta_t^G$$

$$S_t = (1-\theta) S_{t-1} \pi_t^{-\mu/(1-\mu)} + \theta \left(\frac{p_t^*}{p_t} \right)^{\mu/(1-\mu)}$$

$$Y_t = A_t h_t (1 - u_t)$$

$$Y_t = C_t + G_t + J_t$$

$$R_t = I_t / \mathbb{E}_t \left[\pi_{t+1} \right]$$

$$\frac{p_t^*}{p_t} = \frac{\mathbb{E}_t \sum_{s=t}^{\infty} R_{t,s}^{-1} (1-\theta)^{s-t} \left(\frac{p_t}{p_s} \right)^{\mu/(1-\mu)} Y_s \mu \left(w_s h_s + \psi_1 M_s^{\psi_2} \right) / (A_s h_s)}{\mathbb{E}_t \sum_{s=t}^{\infty} R_{t,s}^{-1} (1-\theta)^{s-t} \left(\frac{p_t}{p_s} \right)^{1/(1-\mu)} Y_s}.$$

Back

Savings

Big picture:

- Allow for self insurance.
- Focus on unemployment risk and UI.
- A given level of insurance requires less social insurance.
- Wealth is very unequally distributed.
  - → Hard to match very rich with labor market shocks.
  - → We focus on consumption impact of unemployment not aggregate savings.

Savings

Details:

- Positive stock of government debt so non-degenerate distribution of wealth.
- B_t is fixed across time and across policy changes.
- Adjust λ_t to pay interest on debt.
- Solve with Reiter (2009) method.

Wage rule

What if wages rise with social insurance (e.g. Hagedorn et al. 2016)?

- $\mathbb{E}_0\left[\frac{dW_t}{dx_t}\right]\mathbb{E}_0\left[\frac{dx_t}{db}\right] < 0.$
- Lower b without aggregate shocks.
- Still $\text{Cov}\left[\frac{dW_t}{dx_t}, \frac{dx_t}{db}\right] > 0.$
- b lower, but stabilization benefit still raises b with aggregate shocks.

Details:

- 10% elasticity of steady state wage with respect b.

Back

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- 10% elasticity of steady state wage with respect b.

	Baseline	Positive wage elasticity
b^* without aggregate shocks	0.773	0.527
b^* with aggregate shocks	0.853	0.733

Back

Wage rule

What if wages are more flexible?

- Employment volatility falls so less need to stabilize.
- Not clear this is interesting? Resulting model doesn't match:
  - → Unemployment volatility.
  - → Intensive margin hours drive the labor market.

Details:

- Double elasticity of wages with respect to x_t.

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- Employment volatility falls so less need to stabilize.
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  - → Unemployment volatility.
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Details:

- Double elasticity of wages with respect to x_t.

	Baseline	More cyclical wages
b^* without aggregate shocks	0.773	0.773
b^* with aggregate shocks	0.853	0.804

◂ Back

Budget deficits

Big picture:

- Balanced budget eliminates effect of tax progressivity on average tax rate.
- Now allow for budget deficits.
- Continue with no-trade equilibrium:
  → Government borrows from foreigners.
- Minor effect on the results.
  → Budget deficits help to stabilize C_t but not u_t.

Details:

- Borrow at world interest rate R^*.
- New fiscal rule

$$\lambda_t = \bar{\lambda}\left(\frac{\lambda_t^*}{\bar{\lambda}}\right)^{-\ell_\lambda} - \ell_B \frac{B_t}{\bar{Y}},$$

- ℓ_λ calibrated to match volatility of budget deficits.
- ℓ_B close to zero to match high persistence of public debt.

Back

Budget deficits

	Baseline	Budget deficits
b^* without aggregate shocks	0.773	0.773
b^* with aggregate shocks	0.853	0.852
τ^* without aggregate shocks	0.267	0.267
τ^* with aggregate shocks	0.260	0.263

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Unemployment benefits and activity

Proposition

Under the assumptions of this section:

$$\frac{d\log x_0}{d\log b} = \Lambda^{-1}\left[\frac{u_0 b}{1-u_0+u_0 b} + \frac{u_1 b^{-1}}{1-u_1(1-b^{-1})} - \frac{u_1 b}{1-u_1(1-b)}\right]$$

where Λ is defined below.

- Redistribution: unemployed have higher MPC, effect of benefits on AD increasing in u_0.

- Savings effects: higher UI lowers precautionary savings motive, but raises future taxes. Effect of benefits on AD increasing in u_1 (for $u_1 \in [0, 1/2]$).

◂ Back

Slopes

Lemma

Under the assumptions of this section :

$$\Lambda = \frac{d\log R_0}{d\log x_0} + (1-\tau)^2\sigma_\epsilon^2(x_0)\frac{d\log\sigma_\epsilon^2(x_0)}{d\log x_0} + \frac{1-b}{1-u_0+u_0 b}u_0\frac{d\log u_0}{d\log x_0} - \frac{d\log S_0}{d\log\tau} + \frac{d\log(1-u_0)}{d\log x_0} + \frac{d\log(1-J_0/Y_0)}{d\log x_0}$$

- Elasticities are lower with strong response of real interest rate to activity. E.g. flexible prices or aggressive monetary policy.
- Elasticities are larger with precautionary savings response and consumption multiplier.

Back

Tax progressivity and activity

Proposition

Under the assumptions of this section:

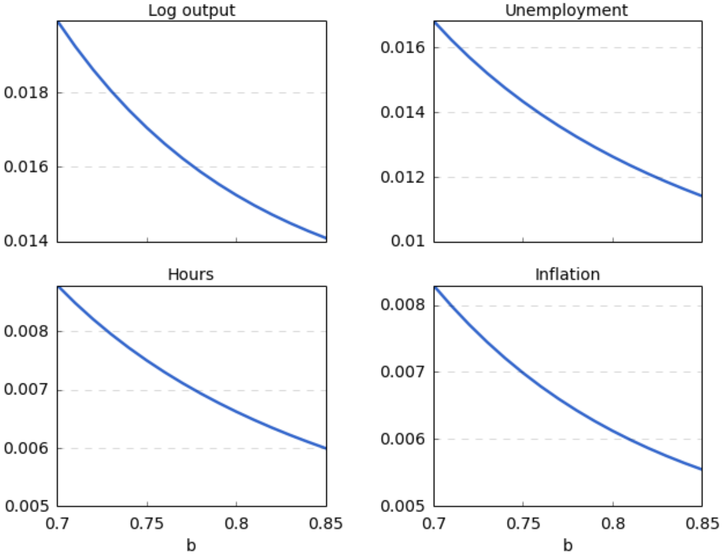
$$\frac{d \log x_0}{d \log \tau} = \Lambda^{-1} 2\sigma_\epsilon^2(x_0)\,(1-\tau)\,\tau$$

where Λ is defined below.

- Progressive taxes dampen precautionary motive, more so when risk is high.

◂ Back

Standard deviations



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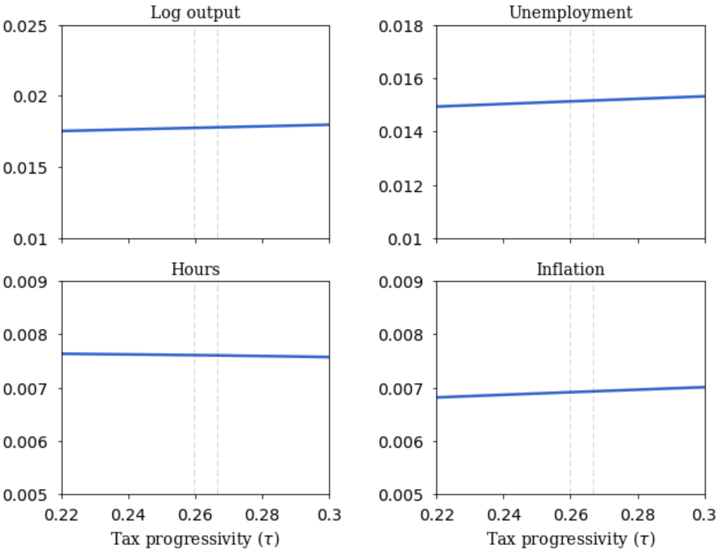

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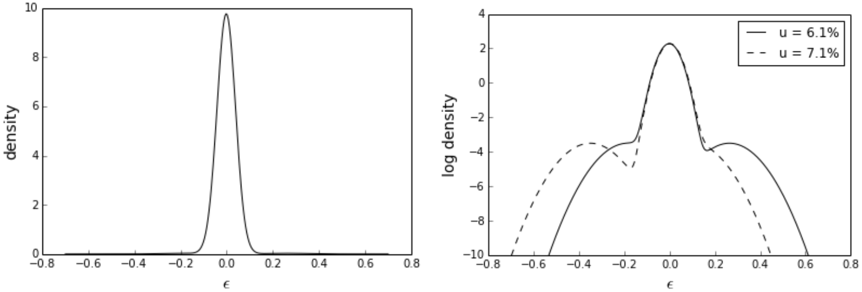
Time-varying mixture of normals



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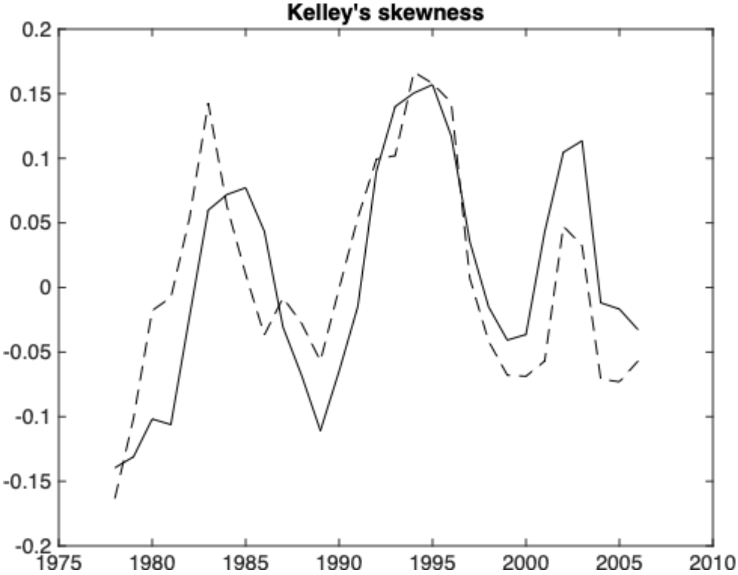
Skewness of five-year earnings growth rates



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Propositions with general wage rule

- Wage given by general mechanism: $w(\eta_t^A, x_t, b, \tau)$. E.g. Nash bargaining.

- Hours per worker:

$$h_t = \left\{ (1-\tau) \left[\frac{\eta_t^A}{S(x_t)} \left(1 - \frac{J_t}{Y_t} \right) \right]^{-1} w(\eta_t^A, x_t, b, \tau) \right\}^{1/(1+\gamma)}$$

$$h_t = \left\{ (1-\tau) H(\eta_t^A, x_t, b, \tau) \right\}^{1/(1+\gamma)}.$$

- For optimal b, additional term:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t (1-u_t) \left[\frac{A_t}{C_t} - h_t^\gamma \right] \frac{dh_t}{dH_t} \left. \frac{\partial H_t}{db} \right|_x .$$

- Similar term for optimal τ.

- Intuition: wage has two effects:
  - → Incentives for job creation—already captured by dx_t/db.
  - → Incentives for intensive hours—our wage rule only has effect through x_t, but could be others.

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Why is τ (approximately) unchanged?