The role of automatic stabilizers in the U.S. business cycle

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Fiscal automatic stabilizers

- They are rules in law that make fiscal revenues and outlays relative to total output change with business cycle.

- Popular:
  - → Friedman(1948), Solow(2004), Auerbach(2002), Blinder(2006).
  - → IMF (2009) recommends them for *every* country.

- Measured intensively:
  - → Macro level: structural deficits in time series,
  - → Micro level: Pechman measures in micro-simulations.

- Big: CBO estimates in 2012, will be \$343bn, 35% of deficit.

Are the automatic stabilizers effective?

Channels of stabilization

- Disposable income channel – e.g. income tax.
- Marginal incentives channel – e.g. progressive income tax.
- Redistribution channel – e.g. UI benefit.
- Social insurance channel – e.g. SNAP benefits.

The stabilizers in the data

Automatic stabilizers in the US budget, average 1988-2007

Revenues		**Outlays**	
Progressive income taxes		*Transfers*	
Personal Income Taxes	10.98%	Unemployment benefits	0.33%
		Safety net programs	1.02%
Proportional taxes		Supplemental nutrition assistance	0.24%
Corporate Income Taxes	2.57%	Family assistance programs	0.24%
Property Taxes	2.79%	Security income to the disabled	0.36%
Sales and excise taxes	3.85%	Others	0.19%
Budget deficits		*Budget deficits*	
Public deficit	1.87%	Government purchases	15.60%
		Net interest income	2.76%
Out of the model		*Out of the model*	
Payroll taxes	6.26%	Retirement-related transfers	7.13%
Customs taxes	0.24%	Health benefits (non-retirement)	1.56%
Licenses, fines, fees	1.69%	Others (esp. rest of the world)	1.85%
Sum	30.25%	Sum	30.25%

Notes: Each cell shows the average of a component of the budget as a ratio of GDP

A business cycle model

- Neoclassical core: Ramsey model.

- Two key imperfections or ingredients:
  - → incomplete markets for idiosyncratic income shocks a la Bewley-Aiyagari.
  - → nominal rigidities a la Calvo.

- With complete markets → 3-equation new Keynesian model

- Flexible prices → Krusell and Smith (1998)

Model preliminaries

- Infinite lives, closed economy, no life-cycle, no health.
- Population:
  - → unit-measure patient households
  - → mass ν of impatient households
- Firms:
  - → competitive final-goods firm
  - → unit-measure intermediate-good monopolists
  - → competitive capital-investment firm

Patient households

- Preferences:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\log c_t - \psi_1 \frac{n_t^{1+\psi_2}}{1+\psi_2} \right]$$

- Income:

$$x_t = (i_t/p_t) b_t + w_t \bar{s} n_t + d_t$$

- Wealth:

$$\left(\frac{\hat{p}_t}{p_t} \right) c_t + \frac{b_{t+1} - b_t}{p_t} = x_t - \bar{\tau}^x(x_t) + T_t^e$$

- Personal income tax:

$$\bar{\tau}^x(x) = \int_0^x \tau^x(x') dx'.$$

Impatient households

- Preferences: same, but less patient $\hat{\beta} \leq \beta$.

- Income:

$$x_{t,i} = \begin{cases} i_t \frac{b_{t,i}}{p_t} + w_t s_{t,i} n_{t,i} & \text{if employed;} \\ i_t \frac{b_{t,i}}{p_t} + T^u_{t,i} & \text{if unemployed;} \\ i_t \frac{b_{t,i}}{p_t} & \text{if needy.} \end{cases}$$

- Unemployment benefits:

$$T^u_{t,i} = \min \left\{ \bar{T}^u s_{t,i}, \bar{t}\bar{s}^u \right\}$$

- Wealth:

$$\left(\frac{\hat{p}_t}{p_t} \right) c_{t,i} + \frac{b_{t+1,i} - b_{t,i}}{p_t} = x_{t,i} - \bar{\tau}^x(x_{t,i}) + T^s_{t,i}$$

- SNAP payments:

$$T^s_{t,i} = \bar{T}^s \text{ if needy}$$

Final goods firm

- Technology:

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

- By cost minimization:

$$p_t = \left(\int_0^1 p_t(j)^{1/(1-\mu)} dj \right)^{1-\mu}.$$

- Sales tax:

$$\hat{p}_t = (1 + \tau^C) p_t$$

Intermediate goods firms

- Production function:

$$y_t(j) = a_t k_t(j)^{\alpha} \ell_t(j)^{1-\alpha}.$$

- Nominal rigidities a la Calvo (1983) with parameter θ.

- Maximize after-tax profits

$$\left(1 - \tau^K\right) \left[\frac{p_t(j)}{p_t} y_t(j) - w_t \ell_t(j) - \left(\upsilon r_t + \delta\right) k_t(j) - \xi \right] - (1-\upsilon) r_t k_t(j)$$

- Corporate income tax: τ_k

Capital goods firm

- Representative firm, after-tax profit:

$$d_t^k = r_t k_t - \Delta k_{t+1} - \frac{\zeta}{2}\left(\frac{\Delta k_{t+1}}{k_t}\right)^2 k_t - \tau^p v_t$$

- Value of firm is:

$$v_t = \max\left\{d_t^k + \mathbb{E}_t\left[\lambda_{t,t+1} v_{t+1}\right]\right\}$$

- Tobin's q:

$$v_t = q_t k_t$$

- Property income tax τ^p

Government

- Government budget:

$$\text{tax revenue - benefits} = g_t + \frac{i_t}{p_t} B_t - \frac{B_{t+1} - B_t}{p_t} + T_t^e$$

- Rule for paying deficits:

$$T_t^e = -\gamma \log \left(\frac{B_t/p_t}{\bar{B}} \right)$$

$$\log \left(\frac{g_t/y_t}{\bar{g}/\bar{y}} \right) = -\gamma \log \left(\frac{B_t/p_t}{\bar{B}} \right).$$

- Deficits: how fast, γ, and with what, g or T^e, are they paid.

Shocks and business cycles

- Monetary policy:

$$i_t = \bar{i} + \phi_p \Delta \log(p_t) + \phi_y \log(y_t/\bar{y}) + \varepsilon_t$$

- Shocks to productivity and monetary policy are AR(1).

- Idiosyncratic shocks are discrete-state Markov chain with aggregate shocks to employment.

- Markets clear with both households supplying labor and holding bonds, but only patient households owning the capital stock via capital firm.

Evaluation of the stabilizers

- Seven stabilizers in four groups
  - → Proportional taxes,
  - → Progressive income taxes,
  - → Safety-net transfers,
  - → Budget deficits.
- Calculate ergodic distribution and evaluate Smyth measure of effectiveness of stabilizers

$$S = \frac{\text{Var}(\log \hat{Y}_t)}{\text{Var}(\log Y_t)} - 1.$$

Three models we will consider

- Representative-agent model, with complete markets.

Proposition: If all households trade a full set of Arrow securities and are equally patient, there is a representative agent solving:

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \log(c_t) - (1 + E_t)\, \psi_1 \frac{n_t^{1+\psi_2}}{1+\psi_2} \right\},$$

$$\hat{p}_t c_t + b_{t+1} - b_t = p_t \left[x_t - \bar{\tau}(x_t) \right] + T_t^n$$

$$x_t = \frac{i_t}{p_t} b_t + w_t s_t (1 + E_t) n_t + d_t + T_t^u$$

$$s_t = \left[\frac{1}{1+E_t} \bar{s}_t^{1+1/\psi_2} + \frac{E_t}{1+E_t} \int_0^{\nu} s_{i,t}^{1+1/\psi_2} di \right]^{\frac{1}{1+1/\psi_2}},$$

where $1 + E_t$ is total employment.

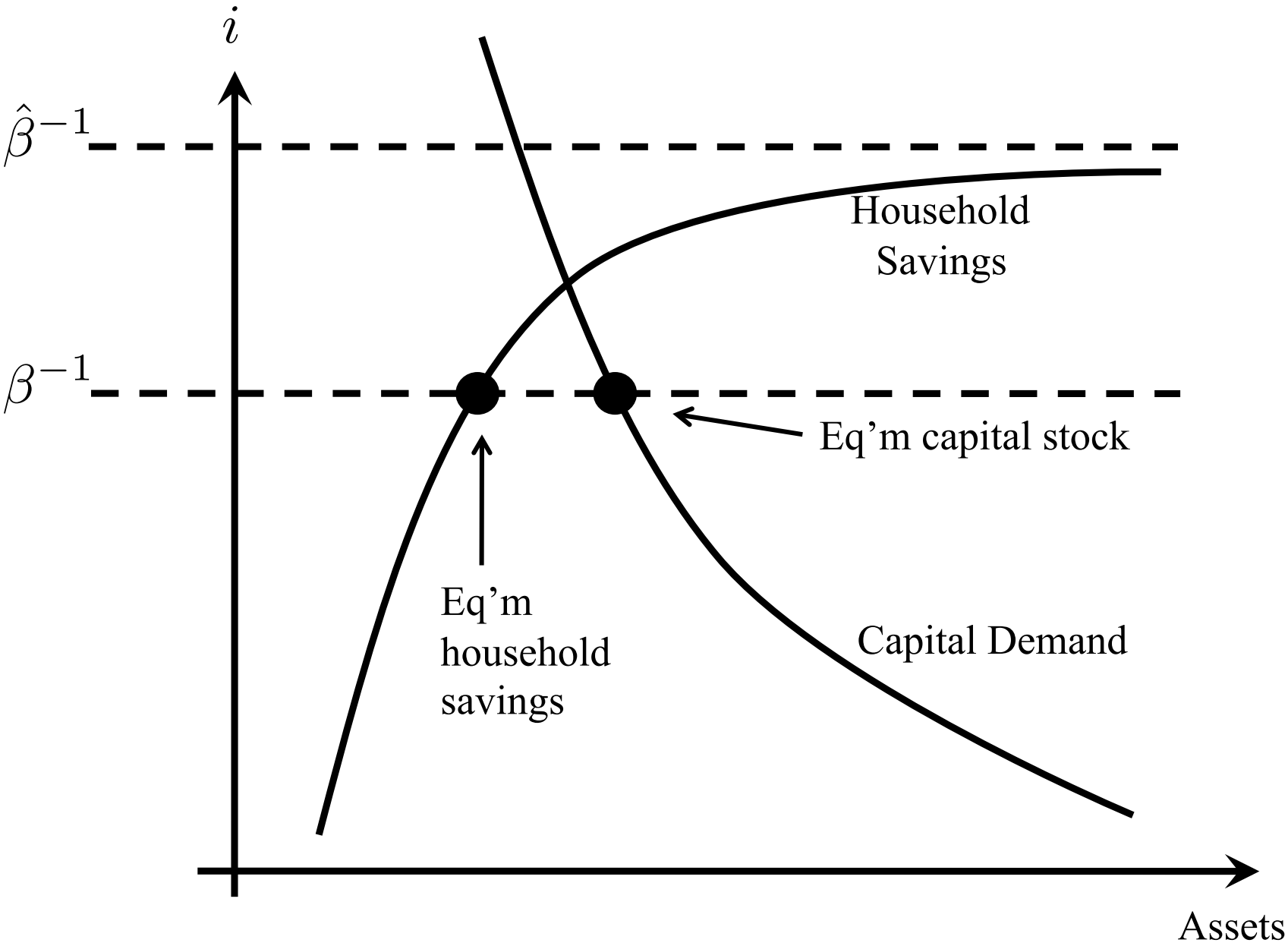
Three models we will consider

- Representative-agent model, with complete markets.
  - → The new Keynesian model with lots of distortionary taxes.
  - → Redistribution and social insurance channels are shut off.

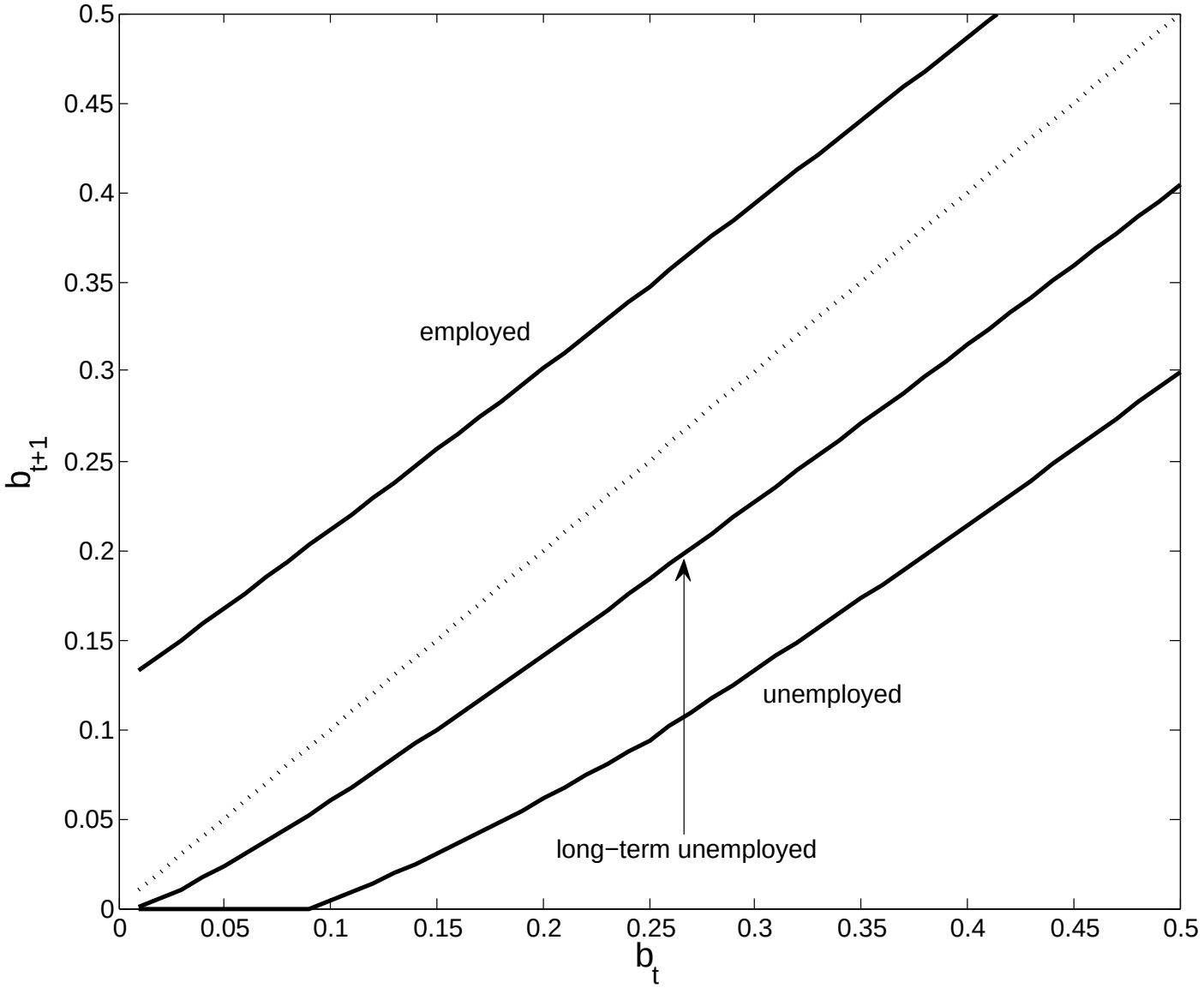
- Hand-to-mouth impatient households ($\hat{\beta} \to 1$) who choose labor supply optimally but consume all of their income:
  - → $(1+\tau^C)c_{t,i} = w_t s_{t,i} n_{t,i} + T^u_{t,i} + T^s_{t,i} - \bar{\tau}^x(.)$.
  - → The savers-spenders model
  - → Maximizes the disposable income channel.

- Our full model, with redistribution and precautionary savings.

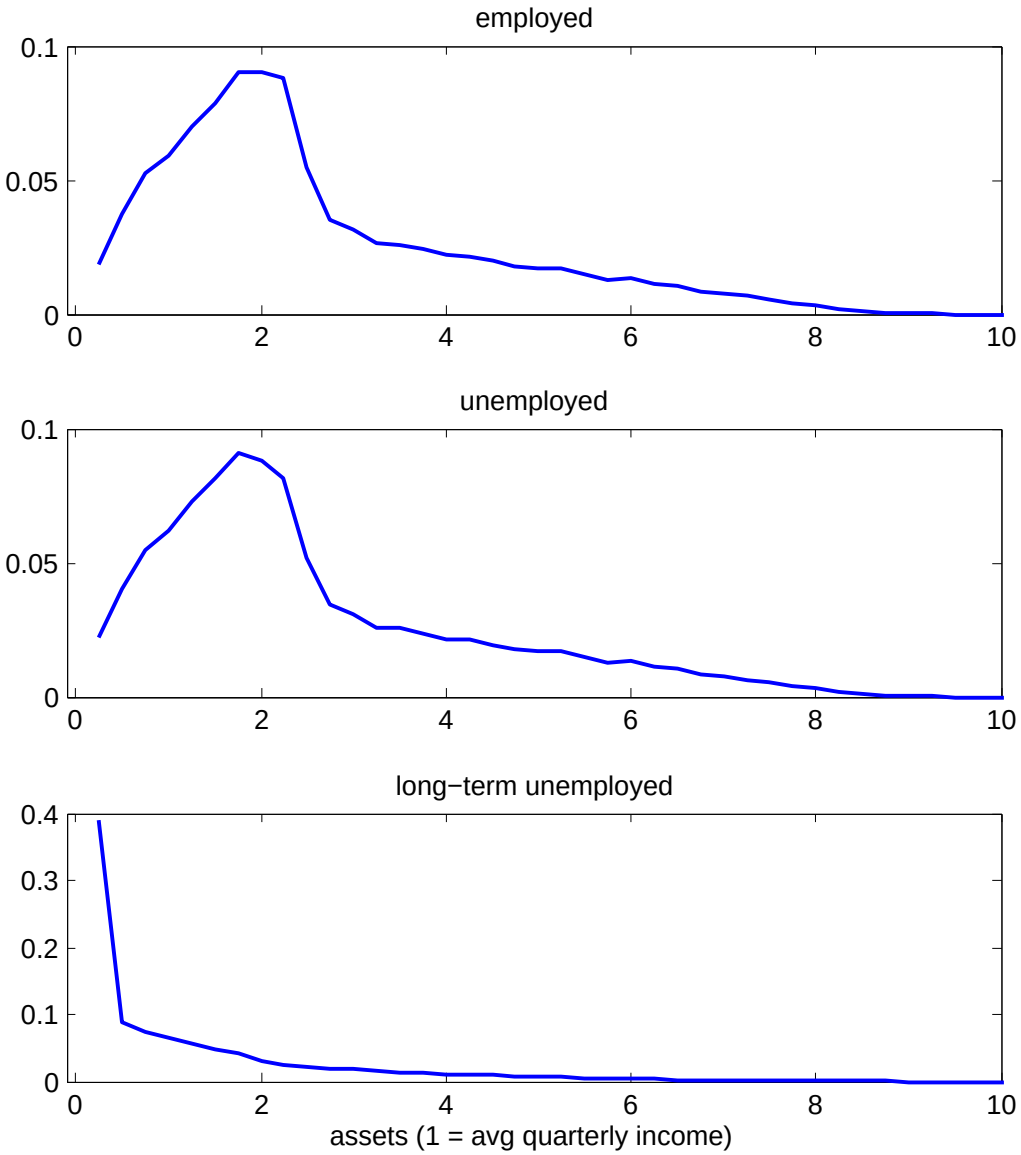
How the steady state works



Savings decisions



Wealth distribution



A benchmark with a warning

Assumptions:

- Complete markets.
- $\hat{\beta} = \beta$.
- The personal income tax is proportional.
- The probability of being employed is constant over time.
- The Calvo probability of price adjustment $\theta = 1$, so prices are flexible.
- There are infinite adjustments costs, $\gamma \to +\infty$, and no depreciation, $\delta = 0$, so capital is fixed.
- There are no fixed costs of production, $\xi = 0$.

Proposition:

$\text{Var}(\log Y_t) = \text{Var}(\log a_t) \Rightarrow S = 0$ and stabilizers are ineffective.

Solution of the full model

- Must solve for aggregate dynamics with cross-sectional distribution as a state variable *and* nominal rigidities.

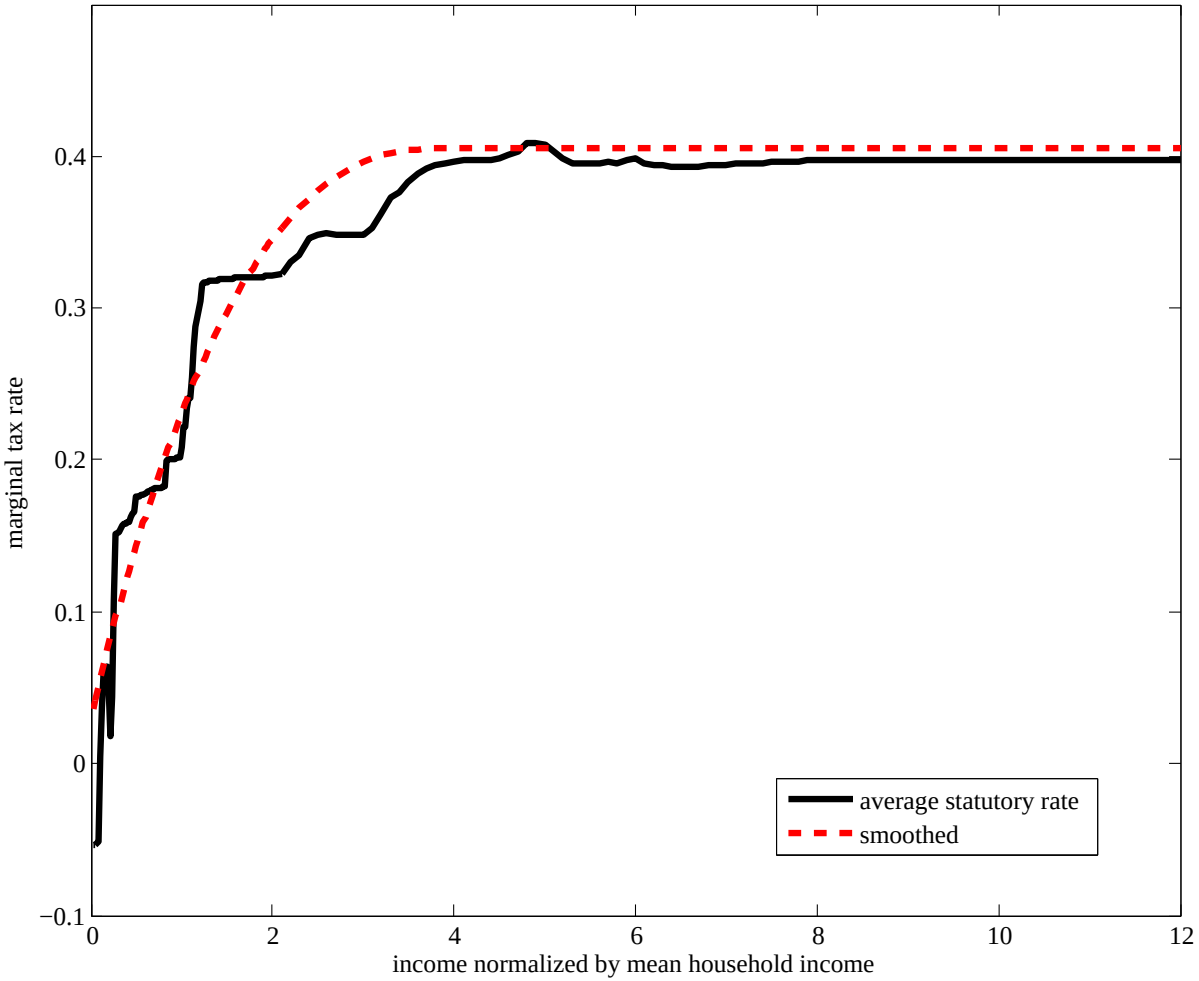
- Our approach: use method of Reiter (2008,2009)
  - → Approximate distribution with a histogram.
  - → Approximate household decision rules discretely.
  - → Number of variables and equations: 10,236.
  - → Linearize: decision rules are linear in aggregate states.
  - → Model reduction to reduce number of variables.
  - → Then apply your standard solver.

Calibration strategy

- Preference/technology parameters to match tax base.
- Tax rates to match average revenue.

Symbol	Parameter	Value	Target (Source)
Panel A. Tax bases and rates			
τ^c	Tax rate on consumption	0.054	Avg. revenue from sales taxes (Table 1)
β	Discount factor of stock owners	0.989	Consumption-income ratio = 0.689 (NIPA)
τ^p	Tax rate on property	0.003	Avg. revenue from property taxes (Table 1)
α	Coefficient on labor in production	0.296	Capital income share = 0.36 (NIPA)
τ^k	Tax rate on corporate income	0.282	Avg. revenue from corporate income tax (Table 1)
ξ	Fixed costs of production	1.32	Corporate profits / GDP = 9.13% (NIPA)
μ	Desired gross markup	1.1	Avg. U.S. markup (Basu, Fernald, 1997)
Panel B. Government outlays and debt			
$\bar{T}^u$	Unemployment benefits	0.185	Avg. outlays on unemp. benefits (Table 1)
$\bar{T}^s$	Safety-net transfers	0.169	Avg. outlays on safety-net benefits (Table 1)
G/Y	Steady-state purchases / output	0.130	Avg. outlays on purchases (Table 1)
γ	Fiscal adjustment speed	2.2	Autocorrel. net public savings / GDP = 0.966 (NIPA)
B/Y	Steady-state debt / output	1.66	Avg. interest expenses (Table 1)

Calibration: progressive income tax



- Marginal tax rates from TaxSim
- Federal and state income taxes
- Average over:
  - 1988 to 2007
  - U.S. states weighted by pop.
- Smoothed with cubic polynomial

Calibration: idiosyncratic uncertainty

- Transitions across e: government programs.
- Skill shocks and difference across agents to match wealth and income distribution and wage dynamics.

Panel C. Labor-force status			
π_{eu}	Steady-state transition prob. E-U	0.026	Avg. insured unemp. rate = 0.023 (BLS)
π_{ue}	Steady-state transition prob. U-E	0.571	Avg. UE flow quarterly = 0.813 (Shimer, 2007)
π_{up}	Steady-state transition prob. U-P	0.297	Avg. SNAP ratio = 0.077 (USDA)
π_{pu}	Steady-state transition prob. P-E	0.087	SNAP exit hazard = 0.03 monthly (Mabli et al., 2011)
π^y_{eu}	Cyclical transition prob. E-U	-1.75	St. dev. of unemp. rate = 0.009 (BLS)
π^y_{ue}	Cyclical transition prob. U-E	9.70	St. dev. of UE flows = 0.053 (Shimer)
π^y_{up}	Cyclical transition prob. U-P	0.00	St. dev. of SNAP ratio = 0.020 (USDA)
Panel D. Income and wealth distribution			
ν	Non-participants / stock owners	4	
β^h	Discount factor of households	0.983	Wealth of top 20% by wealth
$\bar{s}$	Skill level of stock owners	4.66	Income of top 20% by wealth (SCF)
$E(s)$	Mean of non-participants skill	1.08	Avg. income in economy normalized to 1

Calibration: business cycle

- Standard business cycle facts.

- Aggregate shock processes to fit inflation and output dynamics.

Panel E. Business-cycle parameters

θ	Calvo price stickiness	0.286	Avg. price spell duration = 3.5 (Klenow, Malin, 2011)
ψ_1	Labor supply	21.6	Avg. hours worked = 0.31 (Cooley, Prescott, 1995)
ψ_2	Labor supply	2	Frisch elasticity = 1/2 (Chetty, 2011)
δ	Depreciation rate	0.114	Annual depreciation expenses / GDP = 0.046 (NIPA)
ζ	Adjustment costs for investment	15.0	Corr. of Y and C = 0.88 (NIPA)
ρ_z	Autocorrelation productivity shock	0.880	Autocorrel. of log GDP = 0.864 (NIPA)
σ_z	St. dev. of productivity shock	0.004	St. dev. of log GDP = 1.539 (NIPA)
ρ_m	Autocorrelation monetary shock	0.500	Largest AR for inflation = 0.85 (Pivetta, Reis, 2006)
σ_m	St. dev. of monetary shock	0.005	Share of output variance due to shock = 0.2
ϕ_p	Interest-rate rule on inflation	1.55	St. dev. of inflation = 0.638 (NIPA)
ϕ_y	Interest-rate rule on output	0.010	Correl. of inflation with log Y = 0.198 (NIPA)

Experiments

- Cut proportional taxes by 10%
- Cut transfers by same amount of GDP
- Cut intercept of personal income tax by same amount of GDP
- Replace progressive tax by a flat tax
- Balance the budget or have purchases adjust
- All of the above

Cutting proportional taxes

Table: The effect of proportional taxes on the business cycle

	Full model		Representative agent		Hand-to-mouth	
	variance	average	variance	average	variance	average
output	-0.0074	0.0118	0.0003	0.0115	0.0030	0.0117
hours	0.0007	0.0004	0.0038	0.0015	0.0022	0.0006
consumption	-0.0077	0.0093	-0.0178	0.0090	0.0288	0.0092

Note: Proportional change caused by cutting the stabilizer

- Ineffective on cycle and harmful on average.
- Induce little change in intertemporal relative prices.

Unemployment and poverty benefits

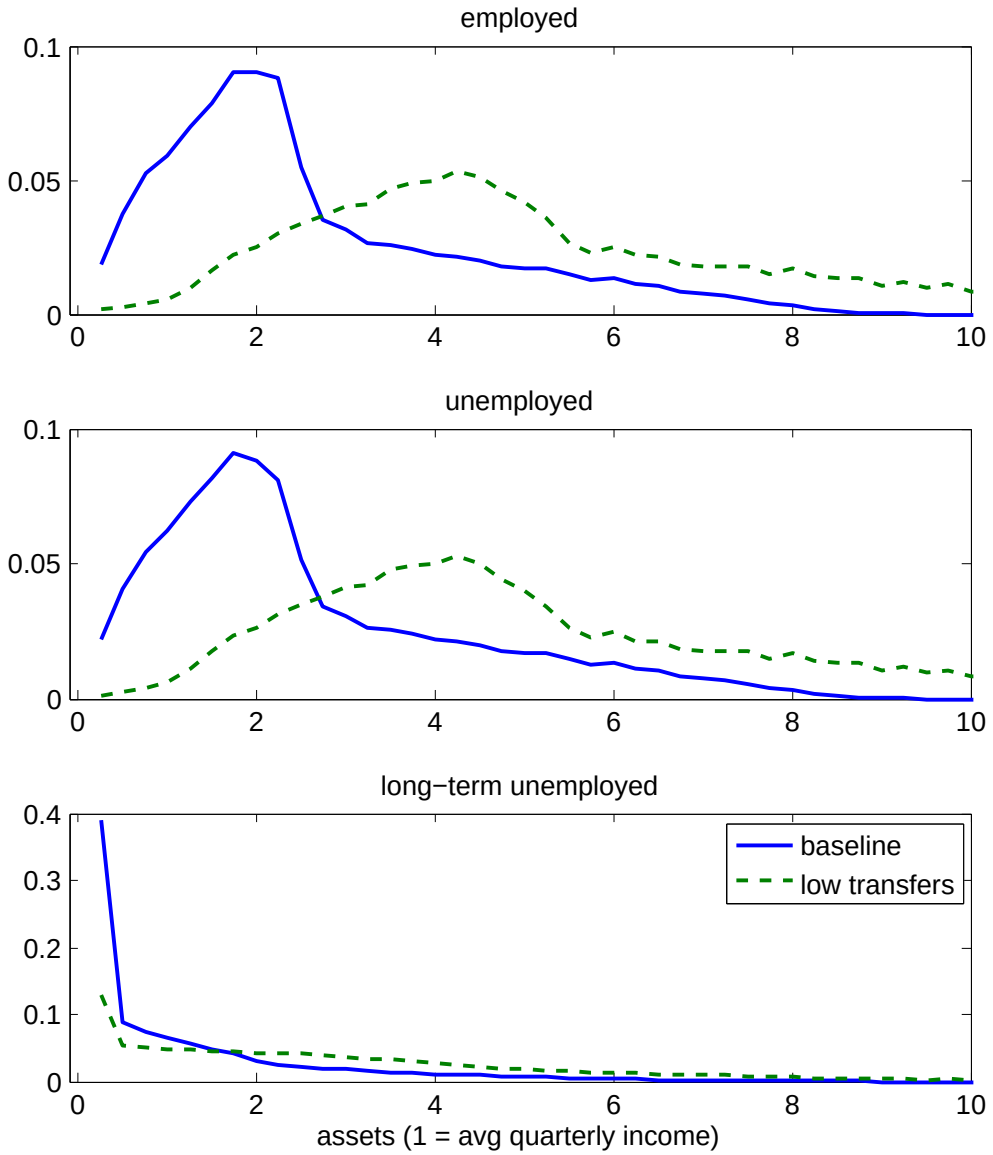
Table: The effect of transfers on the business cycle

	Full model		Representative agent		Hand-to-mouth	
	variance	average	variance	average	variance	average
output	0.0994	-0.0004	-0.0069	0.0002	-0.0095	-0.0042
hours	0.1698	-0.0097	-0.0033	0.0002	0.0051	-0.0018
consumption	-0.0743	-0.0005	-0.0133	0.0002	0.1278	-0.0048

Note: Proportional change caused by cutting the stabilizer

- Redistribution in labor supply pushes hours.
- Volatility of household consumption rises by 91%.
- No effect w/o response of precautionary savings.

Wealth distribution



Eliminating progressivity in income tax

Table: The effect of progressive taxes on the business cycle

	Full model		Representative agent		Hand-to-mouth	
	variance	average	variance	average	variance	average
output	0.0255	0.0446	-0.0457	0.0383	-0.0930	0.0500
hours	-0.0274	0.0390	-0.0161	0.0383	-0.0453	0.0330
consumption	-0.0671	0.0508	-0.0118	0.0436	0.0123	0.0570

Note: Proportional change caused by cutting the stabilizer

- Precautionary savings: volatility of household consumption increases by 70%.
- Marginal incentives channel: hours of high-skill become more pro-cyclical without countervailing rise in marginal tax rate.

The level of income tax

Table: The effect of the level of tax rates on the business cycle

	Full model		Representative agent		Hand-to-mouth	
	variance	average	variance	average	variance	average
output	0.0020	0.0078	-0.0064	0.0076	-0.0339	0.0075
hours	-0.0142	0.0037	-0.0063	0.0076	-0.0126	0.0034
consumption	-0.0207	0.0089	-0.0133	0.0087	-0.0297	0.0086

Note: Proportional change caused by cutting the stabilizer

- Across-the-board income tax cut of 2 percentage points.

Fiscal adjustment

Table: The effect of budget deficits on the business cycle

	Balanced-budget		Purchases adjust	
	variance	average	variance	average
output	-0.0022	0.0000	0.0772	0.0000
hours	-0.0010	0.0000	0.0427	0.0001
consumption	-0.0048	0.0000	-0.4587	0.0002

Note: Proportional change from altering the fiscal adjustment rule

- Close to Ricardian Equivalence with lump-sum tax.
- Purchases rule leads to amplification through multiplier.

Overall effectiveness

Table: The effect of all stabilizers on the business cycle

	Full model		Representative agent		Hand-to-mouth	
	variance	average	variance	average	variance	average
output	0.0356	0.0563	-0.0440	0.0513	-0.0843	0.0569
hours	-0.0126	0.0344	-0.0120	0.0409	-0.0316	0.0316
consumption	-0.0361	0.0598	-0.0276	0.0541	0.1905	0.0606

Note: Proportional change caused by cutting the stabilizer

Conclusion

- Proportional taxes are ineffective.
- Progressive income taxes and safety-net transfers are quite effective at lowering volatility of output.
- Progressive income taxes have potentially large negative effects on average level of economic activity.
- Safety-net transfers stabilize household consumption, but destabilize aggregate consumption.
- Redistribution and social insurance are crucial to the workings of these policies.
- Overall, great potential of automatic stabilizers, but partly unfulfilled.

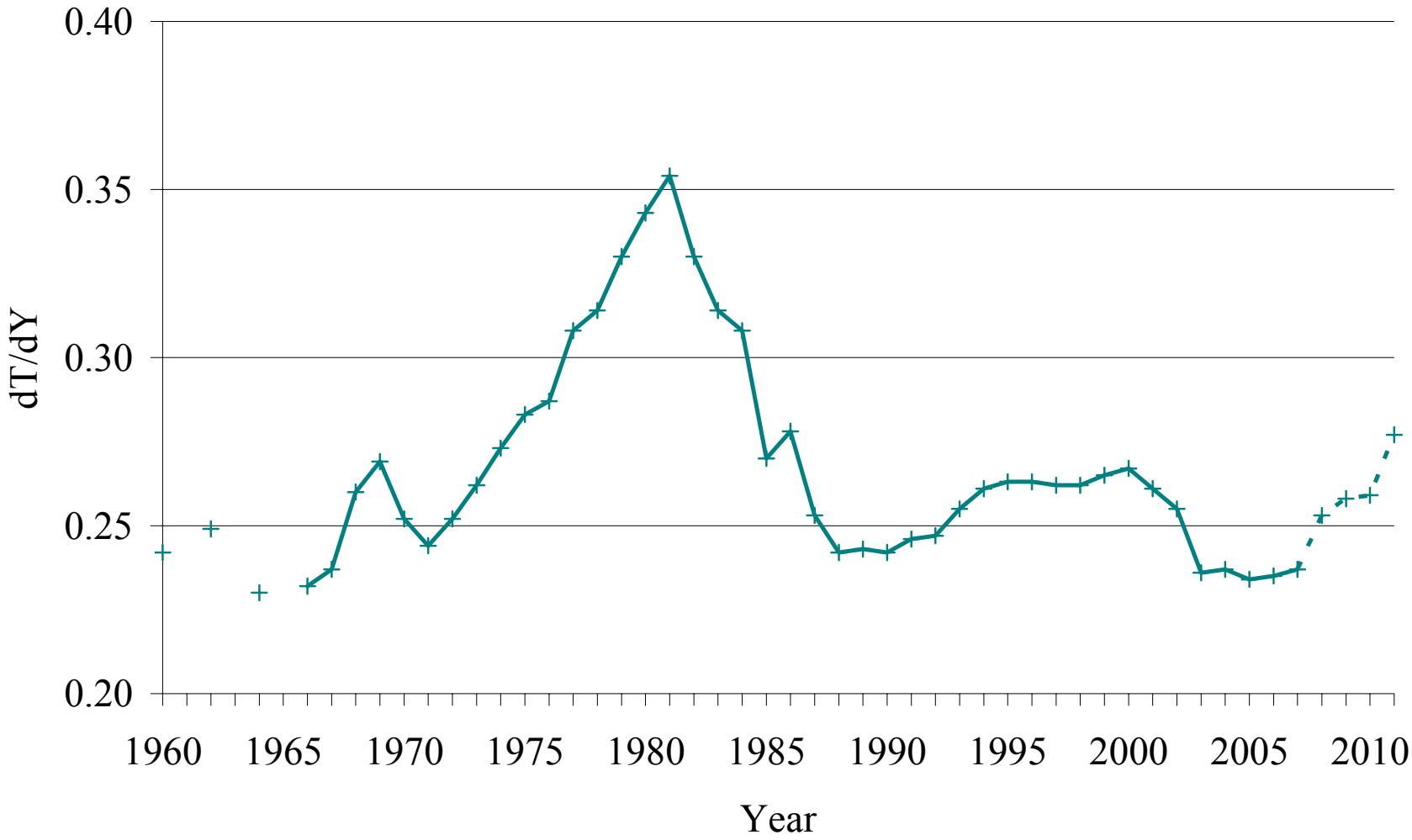
Extra–elasticity of labor supply

Table: Labor supply elasticity for all stabilizers experiment

	elasticity = 1/2		elasticity = 1/5		elasticity = 1	
	variance	average	variance	average	variance	average
output	0.0356	0.0563	0.0255	0.0326	0.0406	0.0811
hours	-0.0126	0.0344	-0.0009	0.0166	-0.0248	0.0531
consumption	-0.0361	0.0598	-0.0485	0.0331	-0.0288	0.0876

Note: Proportional change caused by cutting the stabilizer

Extra–Pechman measures



Extra–Properties of model