Tax Policy Announcement in a Heterogeneous Agents Model

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Motivation

- In models with a representative agent, (under usual assumptions) zero capital taxation, after a finite number of periods, is optimal. (e.g. Chari & Kehoe (1999)).

- Davila, Hong, Krusell & Rios-Rull (2011) in a model with heterogeneous agents and incomplete markets: "the long-run capital stock in a laissez-faire world is not only too low, but much too low".

- In a quantitative model with heterogenous agents and incomplete markets, Domeij & Heathcote (2004) show that the negative "distributional" effects associated with reducing capital taxation outweigh the benefits.

Questions

- Does announcement help alleviate the negative distributional effects associated with reducing capital taxation?

- Is the effect of announcement quantitatively significant?

Mechanism - Why Reduce Capital Tax?

Davila, Hong, Krusell & Rios-Rull (2011)

- If the fraction of labor income in total income of the poor is higher than the average in the economy, then they are benefited by a larger aggregate capital stock.
- The logic goes through prices. A higher capital stock drives interest rate down and the wage up.
- This movement in prices reduces the wealth inequality.
- Laissez-faire is equivalent to no taxes and the result implies there should be more capital in that scenario, so if capital taxes are positive we should reduce them.

Mechanism - Why Announcement?

- Replacing, without announcement, capital tax with e.g. labor tax, benefits the "rich" (with asset intensive income) but is detrimental to the "poor" (with labor intensive income).
- This redistribution has negative welfare consequences (from a utilitarian perspective).
- Announcing the tax change in advance allows the agents to adjust their asset position before having their labor income reduced.
- Actually, following the announcement the capital stock increases driving wages up.
- By the time the tax change is implemented, they can benefit more from the reduction of capital taxes.

Strategy of the Project

1. Calculate stationary equilibrium of a heterogeneous agents model with incomplete markets that is consistent with US data[1].

2. **Announce** that in t^* periods there will be a change to a specific new tax system.

3. In period t^*, in line with the announcement, set the capital tax to the new level and adjust the other taxes (consumption or labor) to balance the government's intertemporal budget constraint.

4. Compute the transition between stationary equilibria.

5. Measure the welfare impact.

- This experiment is an extension to the one run in Domeij & Heathcote (2004).

[1] Wealth distribution, income process, (average) capital, consumption and labor taxes, and debt to output ratio.

Environment - Household

- There is a measure one of households that face idiosyncratic uninsurable labor productivity risk, e_t, that follows a Markov process.

- Taking the sequences of prices and tax rates as given each household solves

$$\max_{\{c_t, a_{t+1}\}} E_0 \left[\sum_{t=0}^{\infty} \beta^t u(c_t) \right]$$

subject to, for all $t \geq 0$,

$$\begin{aligned} (1+\tau_t^c)\, c_t + a_{t+1} &= (1-\tau_t^n)\, w_t e_t \bar{n} + (1+(1-\tau_t^k) r_t) a_t, \\ a_{t+1} &\geq 0. \end{aligned}$$

Environment - Firm and Government

- Given prices, in each period, the representative firm solves

$$\max_{K_t, N_t} F\left(K_t, N_t\right) - w_t N_t - r_t K_t$$

- Government finances an exogenous stream of expenditure, $\{G_t\}$, with taxes on consumption, labor and capital or debt

$$G_t + r_t B_t = B_{t+1} - B_t + \tau_t^c C_t + \tau_t^n w_t \bar{n} + \tau_t^k r_t \left(K_t + B_t\right).$$

Equilibrium

- Given $\{G_t\}$, an equilibrium is $\{c_t, a_{t+1}, K_t, B_t\}$, prices $\{r_t, w_t\}$, taxes $\left\{\tau_t^c, \tau_t^n, \tau_t^k\right\}$, and measures $\{\mu_t\}$ over individual histories such that:

  1. $\{c_t, a_{t+1}\}$ solve the problem of the households;
  2. Factor prices are set competitively: $r_t = F_1(K_t, \bar{n})$, $w_t = F_2(K_t, \bar{n})$;
  3. $\{\mu_t\}$ is consistent with the transition probability matrix;
  4. Government budget constraint holds,

$$G_t + r_t B_t = B_{t+1} - B_t + \tau_t^c C_t + \tau_t^n w_t \bar{n} + \tau_t^k r_t \left(K_t + B_t\right),$$

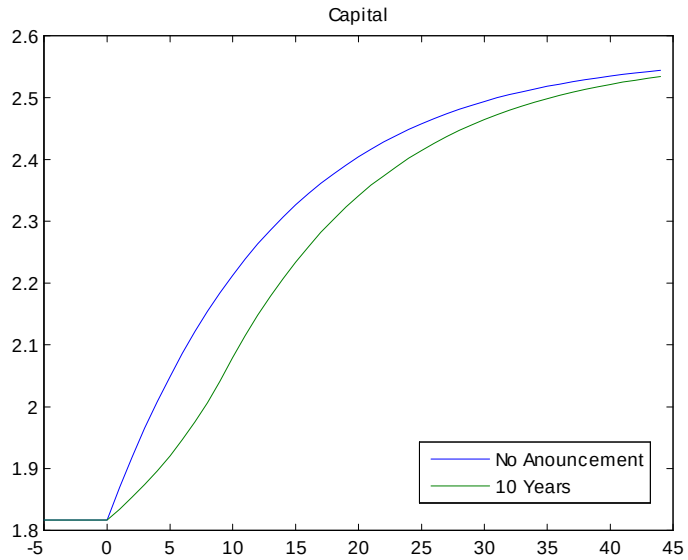
     and debt is bounded;
  5. Markets clear,

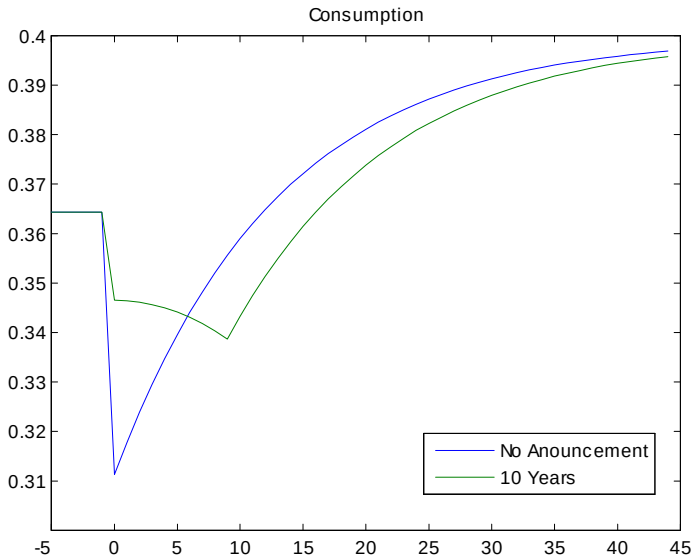
$$C_t + G_t + K_{t+1} - (1-\delta) K_t = Y_t, \quad K_t + B_t = A_t.$$

Outline of Results

1. Effect of announcement in a RA economy.
2. Effect of announcement in a heterogeneous agents economy.
3. Description of the welfare measures.
4. Results for benchmark economy.
5. Results for the economy with endogenous labor.

Announcement in an RA Economy

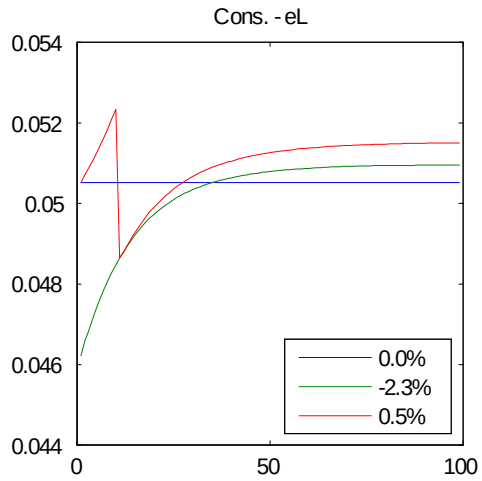


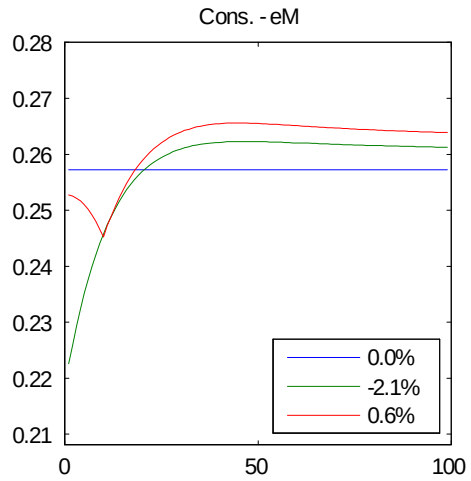


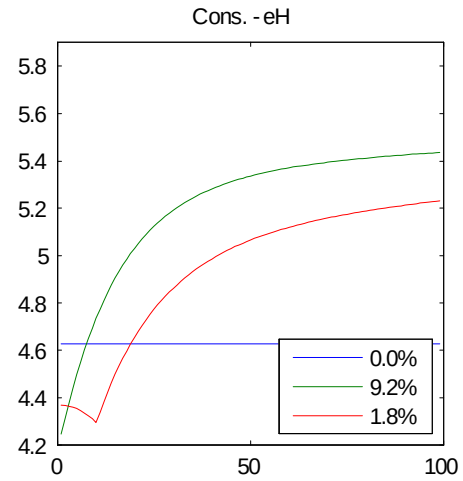
- The tax change increases (by 3%) total income. Consumption jumps down initially because the agent chooses to increase her asset position.
- The effect of the announcement is ambiguous:
  - Smoother consumption path, with a smaller initial reduction.
  - The benefit associated with the policy change are deferred.
- Welfare benefit: 1.49% without announcement and of 1.41% with it.

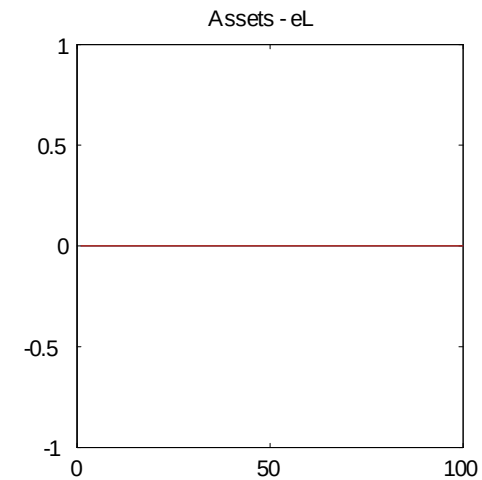
Why is Announcement Good?

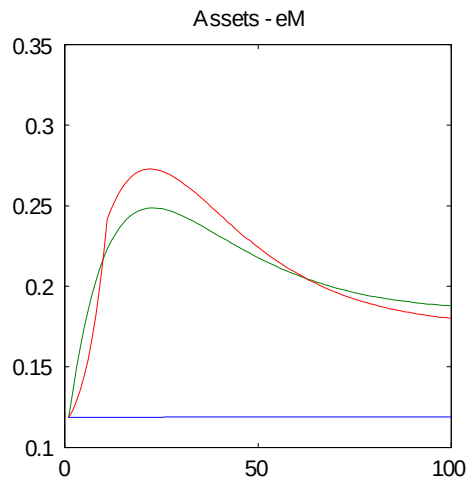
Replacing Capital Tax with **Consumption** Tax

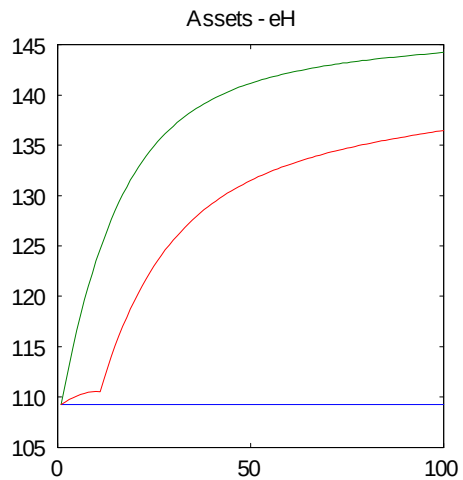






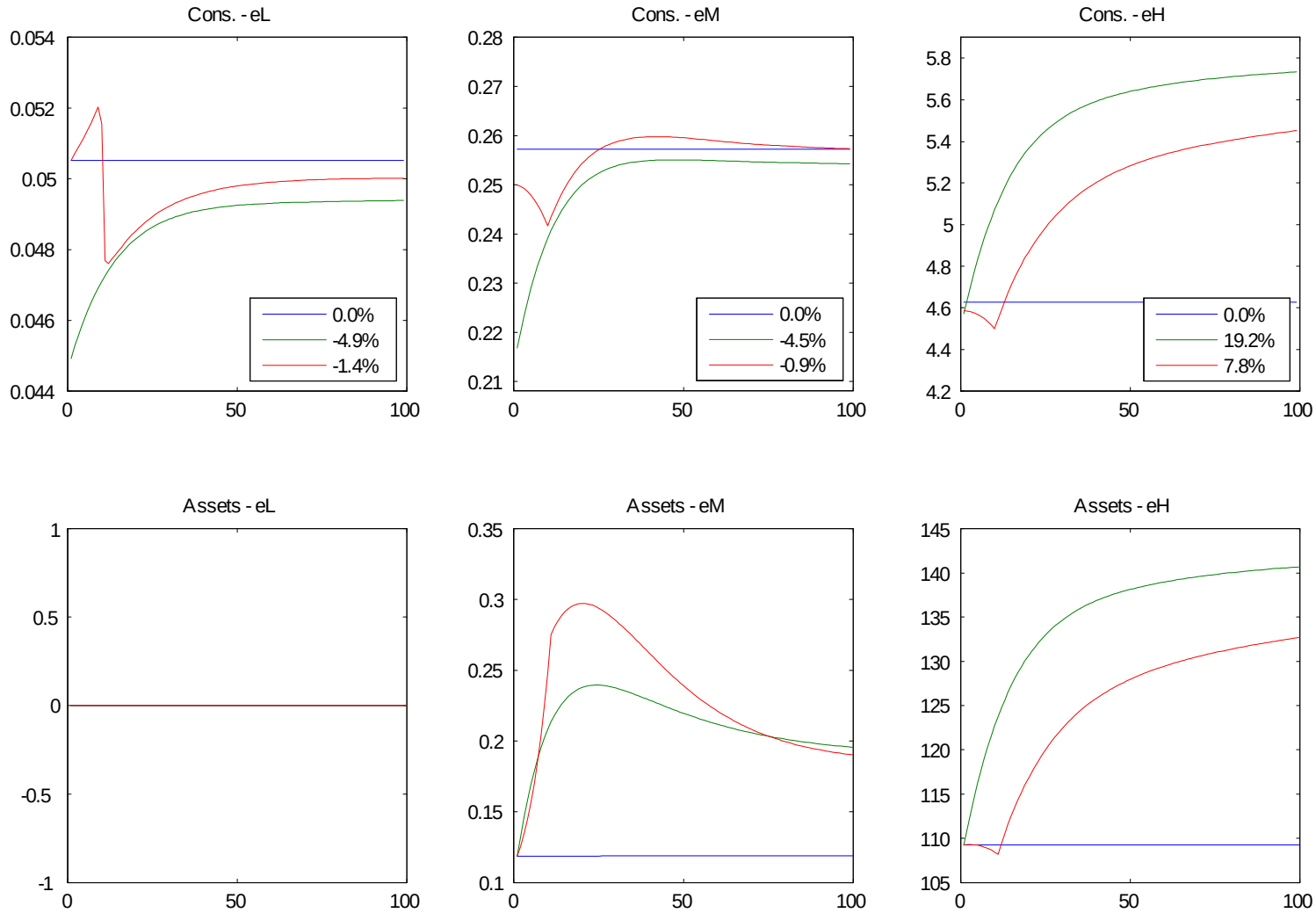






Why is Announcement Good?

Replacing Capital Tax with **Labor** Tax



Why is Consumption Tax Better then Labor Tax?

- Relative to labor taxation, with consumption taxation more tax revenue is extracted from consumption-rich agents.
- The correlation between labor income and consumption is 0.54.
- The correlation between asset income and consumption is 0.96.
- Replacing capital tax with labor tax decreases the tax burden of the consumption-rich.

Welfare Measures

- Consumption with reform: $c_t^R\left(a_0, e^t\right)$.
- Consumption without reform: $c_t^{NR}\left(a_0, e^t\right)$.
- Average welfare gain, Δ:

$$\int E_0\left[U\left(\left\{c_t^R\right\}\right)\right] d\lambda\left(x_0\right) = \int E_0\left[U\left(\left(1+\Delta\right)\left\{c_t^{NR}\right\}\right)\right] d\lambda\left(x_0\right),$$

where λ is the initial distribution of initial states $x_0 = \left(a_0, e_0\right)$.

Welfare Measures

- Level Effect, Δ_L:

$$U\left(\left\{C_t^R\right\}\right) = U\left(\left(1+\Delta_L\right)\left\{C_t^{NR}\right\}\right).$$

- Certainty equivalent consumption, $\bar{c}^j\left(x_0\right)$:

$$U\left(\left\{\bar{c}^j\right\}\right) = E_0\left[U\left(\left\{c_t^j\right\}\right)\right], \quad \text{for } j = R, NR.$$

- Aggregate certainty equivalent, $\bar{C}^j$:

$$\bar{C}^j = \int \bar{c}^j\left(x_0\right) d\lambda\left(x_0\right), \quad \text{for } j = R, NR.$$

Welfare Measures

- Uncertainty Effect, Δ_U:

$$U\left(\left(1-p_{unc}^{j}\right)\left\{C_t^j\right\}\right)=U\left(\left\{\bar{C}_t^j\right\}\right), \text{ then, } \; 1+\Delta_U=\frac{1-p_{unc}^{R}}{1-p_{unc}^{NR}}$$

- Inequality Effect, Δ_I:

$$U\left(\left(1-p_{ine}^{j}\right)\left\{\bar{C}_t^j\right\}\right)=\int U\left(\left\{\bar{c}^j\left(x_0\right)\right\}\right)d\lambda\left(x_0\right), \text{ then, } \; 1+\Delta_I=\frac{1-p_{ine}^{R}}{1-p_{ine}^{NR}}$$

- Theorem (Floden (2001)): Under assumption about the utility function it follows that

$$\left(1+\Delta\right)=\left(1+\Delta_L\right)\left(1+\Delta_U\right)\left(1+\Delta_I\right).$$

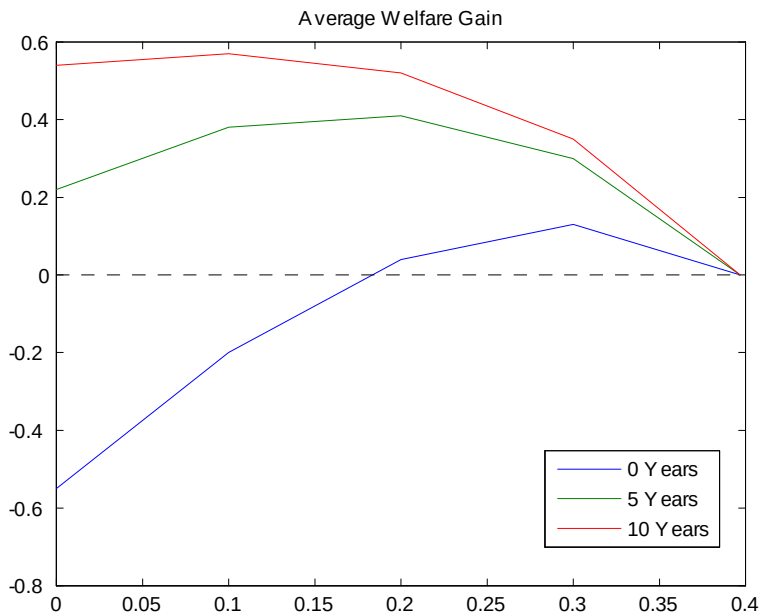
Results - Zero Capital Tax, Adjusting **Consumption** Tax

	Rep. Agent	0 Years	5 Years	10 Years
Welfare Gain	1.49	-0.46	0.18	0.61
Level Effect	1.49	0.13	0.18	0.24
Uncertainty Effect	-	0.53	0.48	0.41
Inequality Effect	-	-1.12	-0.48	-0.04
% in Favor	-	30	41	98

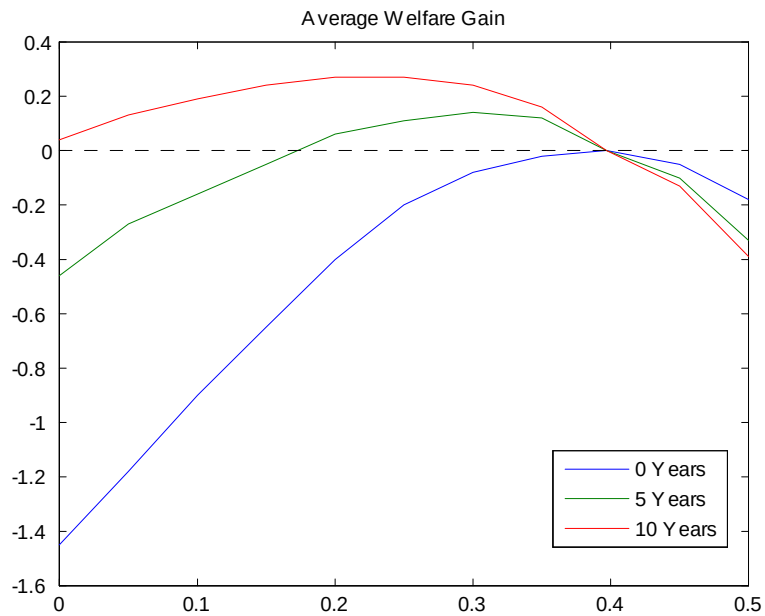
Results - Zero Capital Tax, Adjusting **Labor** Tax

	Rep. Agent	0 Years	5 Years	10 Years
Welfare Gain	1.49	-1.51	-0.52	-0.11
Level Effect	1.49	0.23	0.27	0.23
Uncertainty Effect	-	0.74	0.68	0.60
Inequality Effect	-	-2.46	-1.45	-0.94
% in Favor	-	27	32	37

Results - Different Final Capital Tax Levels



Consumption Tax



Labor Tax

Endogenous Labor

- Utility used in endogenous labor computation:

$$u(c,n) = \log\left(c - \chi\frac{n^{1+\frac{1}{\nu}}}{1+\frac{1}{\nu}}\right)$$

- Aggregate labor supply is independent of distribution of wealth: useful for computation of transition.

- With endogenous labor taxes are distortionary: welfare effects are worse.

Results - Endogenous Labor, Adjusting **Consumption** Tax

	0 Years	5 Years	10 Years
Welfare Gain	-0.54	0.21	0.41
Level Effect	0.01	0.14	0.47
Uncertainty Effect	0.49	0.43	0.56
Inequality Effect	-1.04	-0.36	-0.24
% in Favor	29	40	48

Extensions

- The codes are fast so maybe we could search for optimality on transition within a particular class of tax functions.
- Gradual vs. discrete change in policy experiment.
- Experiment with alternative calibrations.

Conclusions

- An announcement can alleviate the negative distributional effects associated with reducing capital taxation. It has quantitatively significant implications.

- Consumption tax is a better tool than labor tax to compensate for the capital tax reduction since it extracts more revenue from rich agents

Solution Algorithm

1. Solve for the initial stationary equilibrium.
2. Choose a new value for the capital tax τ^k and announcement period t^*.
3. Assume the economy converges to a new stationary equilibrium in T periods and guess a sequence $K_2, ..., K_{T-1}$.
4. Solve for the new tax on labor (or consumption) such that given $K_2, ..., K_{T-1}$ and τ^k, govt. debt is unchanged between $T-1$ and T. Compute the associated path for the government debt, $B_2, ..., B_{T-1}$.
5. Solve for the final stationary equilibrium given tax rates τ^k, τ^c, G and B_T. Compute the capital stock, K_T.
6. Solve for households savings decisions in transition.
7. Update the path of capital, i.e. take the initial stationary distribution over wealth and productivity and use the decision rules computed above to simulate the economy forward. Then, check for market clearing at each date and adjust $K_2, ..., K_{T-1}$ appropriately.
8. If the new sequence for capital is the same as the old, we have found the equilibrium path. Otherwise go back to step 5.

Calibration

Capital share	0.36	**Debt to GDP**	0.67
Depreciation rate	0.06	**Labor tax**	0.26
Risk aversion	1	**Capital tax**	0.37
		Cons. tax	0.05

		Benchmark	**Endogenous labor**
Discount factor		0.965	0.961
Individual	**eh**	5.087	4.74
productivity process	**em**	0.839	0.847
	el	0.167	0.17
Markov matrix	0.9	0.1	0
	0.005	0.99	0.005
	0	0.1	0.9