Demographics, Redistribution, and Optimal Inflation

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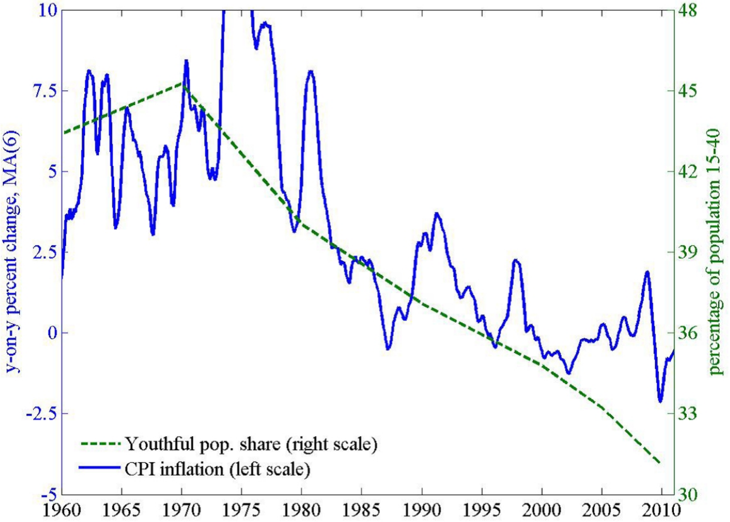
Demographic Changes and Macroeconomic Performance

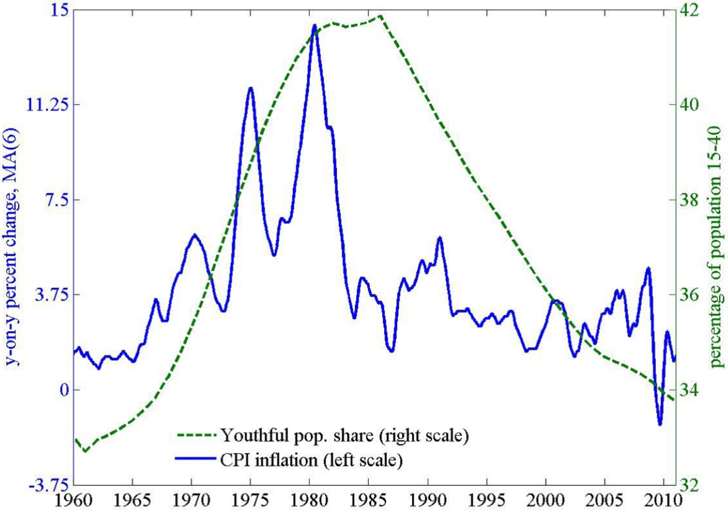
Inflation and Demography

- Can observed low inflation outcomes be related to demographic factors such as an aging population?
- A basic "back-of-the-envelop" suggests NO
- Consider an economy were capital and money are perfect substitutes
$$r = \delta + n = \frac{1}{1+\pi}$$
- The effect of a permanent increase in $n' > n$ increases the return of capital $r' > r$ and inflation decreases to π'.
- Countries with relatively young (old) populations would have relatively low (high) inflation rates, all else equal.

Inflation and Demography: Japan



Inflation and Demography: USA



Objective

- Understand the determination of central bank objectives when population aging shifts the social preferences for redistribution and its implications for inflation.
- The intergenerational redistribution tension is intrinsic in life-cycle models.
  - Young cohorts do not have any assets and wages are the main source of income.
  - Old generations cannot work and prefer a high rate of return from their savings.
- When the old have more (less) influence over redistributive policy, the rate of return of money is high (low).

Objective

- Approach: Based on Bullard and Waller (2004) but with dynamics
- Use a direct mechanism to decide the allocations. A baby boom corresponds to putting more weight on the young of a particular generation relative to past and future generations.
- This mechanism can replicate any *steady state* allocation arising from a political economy model with population growth or decline.

Outline Presentation

- Efficient economy and intergenerational redistribution
- Constrained efficiency and redistribution
- Optimal Wedges: Capital taxes=Inflation
- Numerical examples
  - Transitory demographics
  - Persistent demographic changes

Model

Environment

- Two-period OLG model with capital.
- Discrete time $t = ..., -2, -1, 0, 1, 2, ...$
- Population growth $N_t = (1+n)N_{t-1}$ where $N_0 = 1$
- Preferences: $U(c_{1,t}, c_{2,t+1}) = u(c_{1,t}) + \beta u(c_{2,t+1})$
- Neoclassical production $F(K_t, N_t)$ and constant depreciation δ
- Per capital resource constraint

$$c_{1,t} + \frac{1}{1+n} c_{1,t-1} + (1+n)\, k_{t+1} = f(k_t) + (1-\delta)\, k_t.$$

Social Preferences and Optimal Allocations

- The objective function weights current and future generations according to

$$V(k_0) = max\{\beta\lambda_{-1}u(c_{2,0}) + \sum_{t=0}^{\infty}\lambda_t\left[u(c_{1,t}) + \beta u(c_{2,t+1})\right]\}.$$

subject to the resource constraint.

- Optimality conditions imply

$$\frac{u'(c_{1,t})}{u'(c_{2,t})} = \frac{\lambda_{t-1}}{\lambda_t}\beta(1+n)$$

and

$$(1+n)\frac{u'(c_{1,t})}{u'(c_{1,t+1})} = \frac{\lambda_{t+1}}{\lambda_t}\left[1-\delta+f'(k_{t+1})\right].$$

Steady State

- Efficient production: the steady state stock of capital k^s is determined by

$$f'(k^s) = (1+n)\lambda^{-1} + \delta - 1,$$

  For $\lambda < 1$, the economy is dynamically efficient. When $\lambda = 1$, the economy satisfies the golden rule $f'(k^*) = n + \delta$.

- Efficient consumption c_1^s and c_2^s solve

$$u'(c_1^s) = \beta(1+n)u'(c_2^s)$$

$$c_1^s + \frac{c_2^s}{1+n} + (\delta + n)k^s = f(k^s).$$

Market Implementation: Intergenerational Redistribution

- Consumers: Representative newborn solves

$$max\ u(c_{1,t}) + \beta u(c_{2,t+1})$$

$$s.t. \quad c_{1,t} + s_t = w_t l_t + T_{1,t},$$

$$c_{2,t+1} = (1 - \delta + r_{t+1}) s_t + T_{2,t+1}.$$

The optimality condition

$$u'(w_t l_t - s_t + T_{1t}) = \beta u' \left[(1 - \delta + r_{t+1}) s_t + T_{2,t+1} \right] (1 + r_{t+1}).$$

- Intergenerational redistribution:

$$T_{1,t} + \frac{T_{2,t}}{1+n} = 0.$$

No Intergenerational Redistribution (Ramsey)

- In the absence of intergenerational redistribution

$$V(k_0) = max\{\beta\lambda_{-1}u(c_{2,0}) + \sum_{t=0}^{\infty}\lambda_t\left[u(c_{1,t}) + \beta u(c_{2,t+1})\right]\}$$

$$s.t. \quad c_{1,t} = f_l\left(k_t\right)l - (1+n)k_{t+1},$$

$$c_{2,t} = \left[1 - \delta + f_k\left(k_t\right)\right]k_t,$$

- Optimality conditions (endogenous multipliers $\gamma_{1,t}, \gamma_{2,t}$)

$$\frac{u'(c_{1,t})}{u'(c_{2,t})} = \frac{\lambda_{t-1}}{\lambda_t}\beta(1+n)\frac{\gamma_{1,t}}{\gamma_{2,t}}$$

Markets Redistribute: Capital taxes/inflation

- The intergenerational decision of savings (capital) is more complicated:

$$(1+n)\underbrace{u'(c_{1,t})}_{\uparrow\text{savings}} = \frac{\lambda_{t+1}}{\lambda_t}u'(c_{1,t+1})\underbrace{f_{l,k}\frac{l}{1+n}}_{\uparrow\text{wage rate}}$$

$$+\beta u'(c_{2,t+1})[1-\delta+f_k+\underbrace{f_{k,k}\frac{s_t}{1+n}}_{\downarrow\text{return all savings}}]$$

- Efficient wedges

$$\frac{u'(c_{1,t})}{\beta u'(c_{2,t+1})} = \frac{\left[1-\delta+f_k\left(\frac{s_{t-1}}{1+n}\right)(1+\phi^k_{t+1})\right]}{(1+\phi^\lambda_{t+1})}.$$

where

$$\phi^k = \frac{kf_{k,k}}{f_k} < 1; \quad \phi^\lambda_{t+1} = \lambda\frac{u'(c_{1,t+1})}{u'(c_{1,t})}f_{k,k}\left(\frac{s_{t-1}}{1+n}\right)\frac{l}{1+n} < 1$$

Money and Capital

- The optimal intergenerational redistribution determines the equilibrium interest rate.
- These parameters determine inflation when capital and money are perfect substitutes.
- Per capita money growth rate evolves

$$M_{t+1}(1+n) = (1+z_t)M_t$$

- Arbitrage then implies that

$$f_k(k_t) = \frac{1}{1+\pi_t} = \frac{1+n}{1+z_t}.$$

- Money is priced as an asset that is held in zero net supply (Woodford's (2003) "cashless" economy).

Quantitative Illustration

Functional Forms

- Preferences:

$$U(c_{1,t}, c_{2,t+1}) = \frac{c_{1,t}^{1-\sigma}}{1-\sigma} + \beta \frac{c_{2,t+1}^{1-\sigma}}{1-\sigma},$$

- Technology:

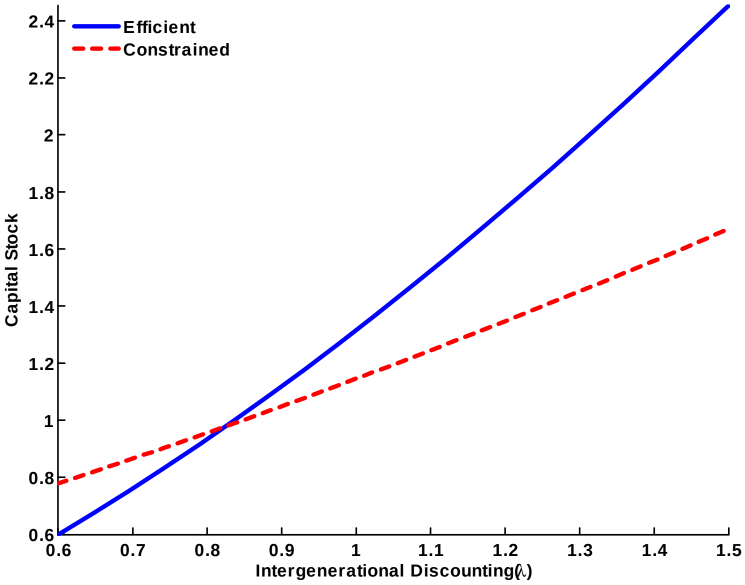
$$f(k) = Ak^{\alpha}$$

Parameterization

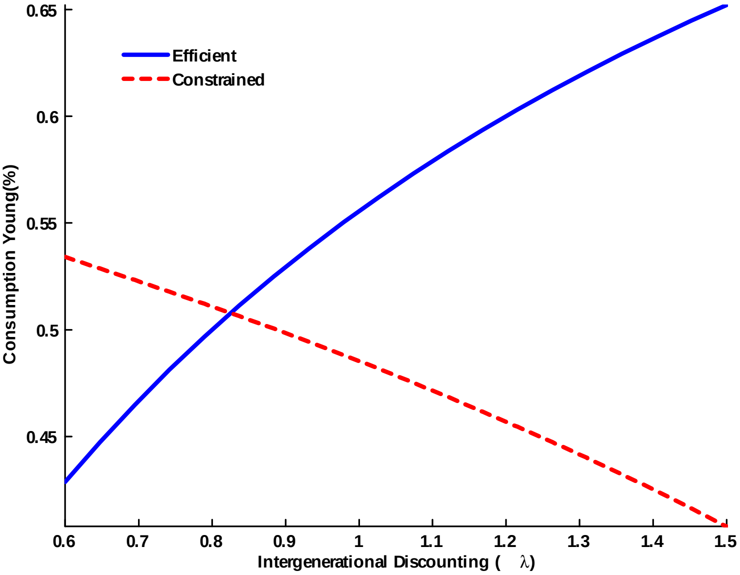
Parameter	**Value**
α	0.35
A	10
$I = \delta$	1
σ	2
n	0.996^{30}
β	0.979^{30}

Steady State

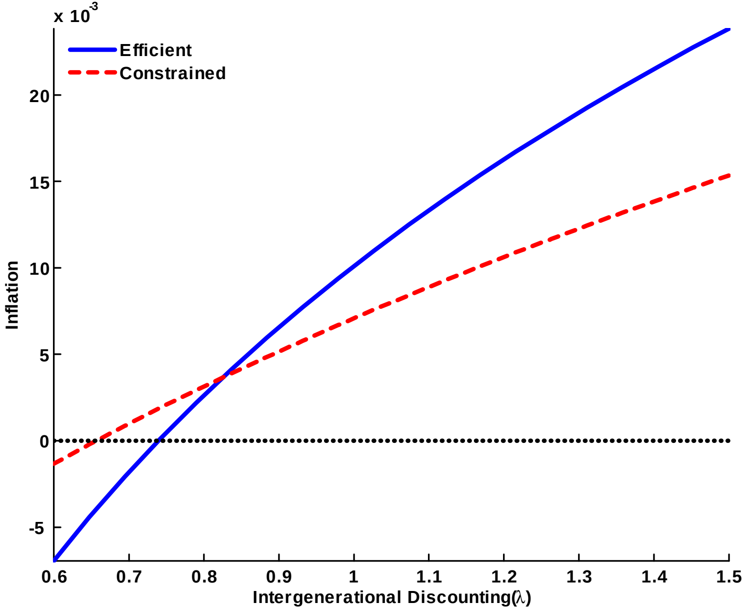
Capital Stock



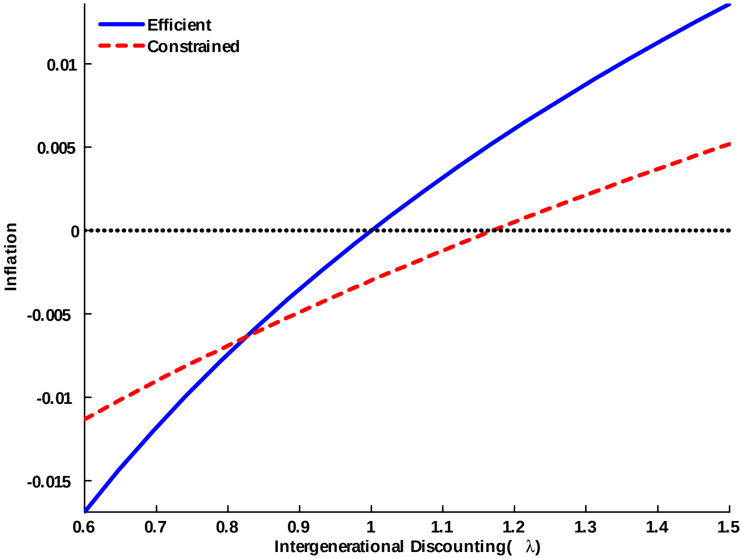
Consumption Young



Inflation (n<0)

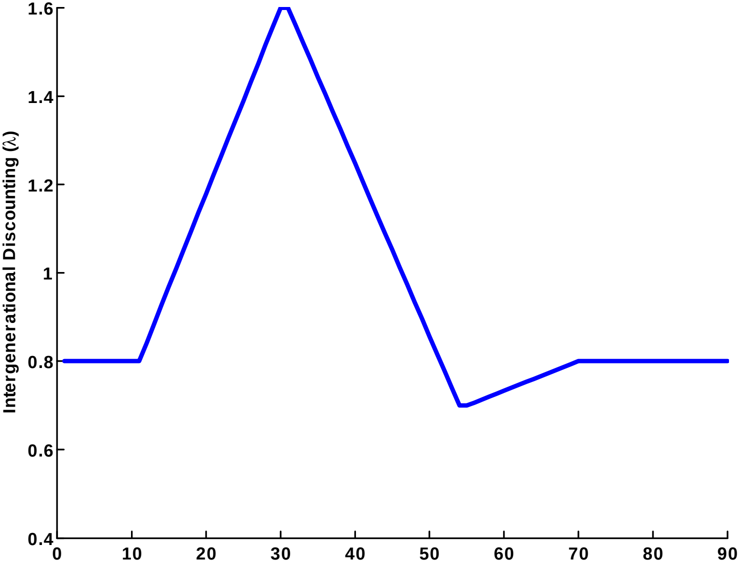


Inflation (n=0)

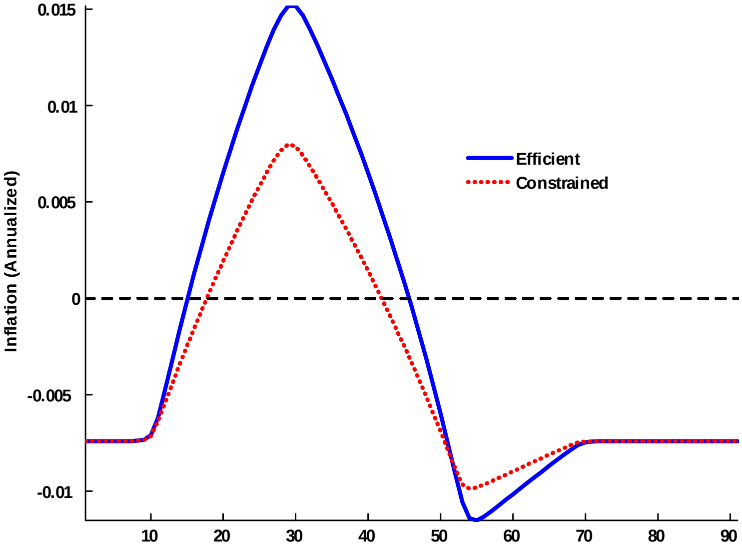


Transitional Dynamics: Demographics and Inflation

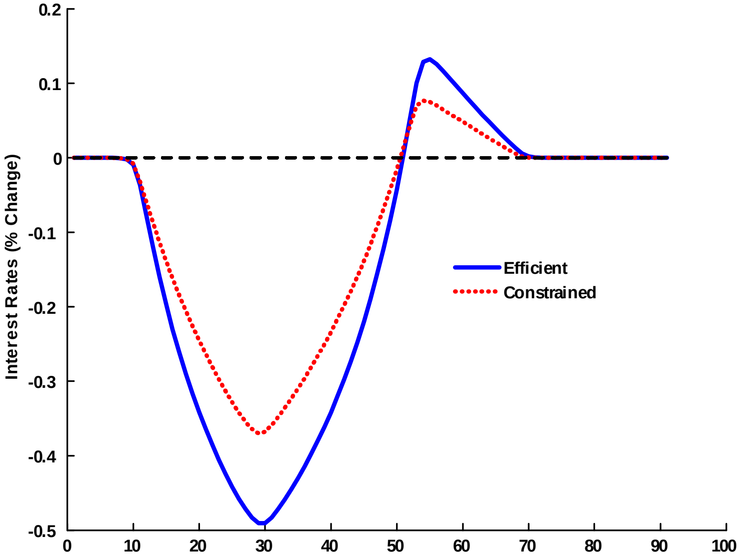
Intergenerational Redistribution: Transitory



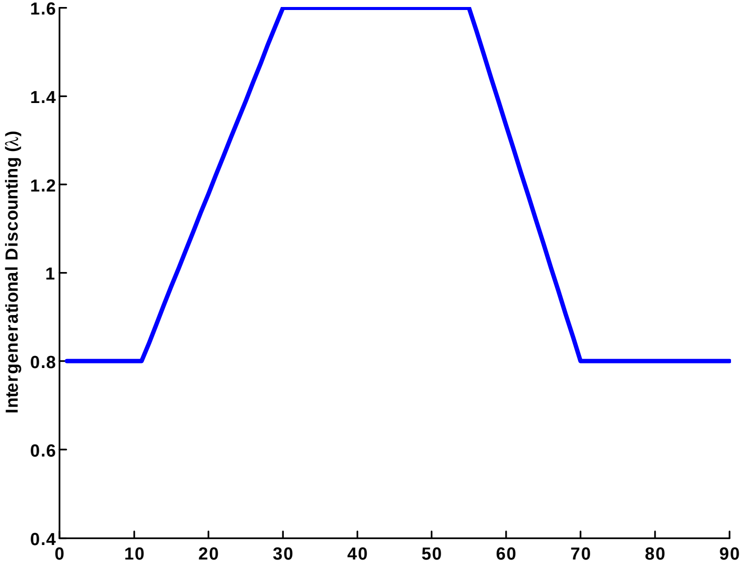
Inflation and Demographics: Transitory



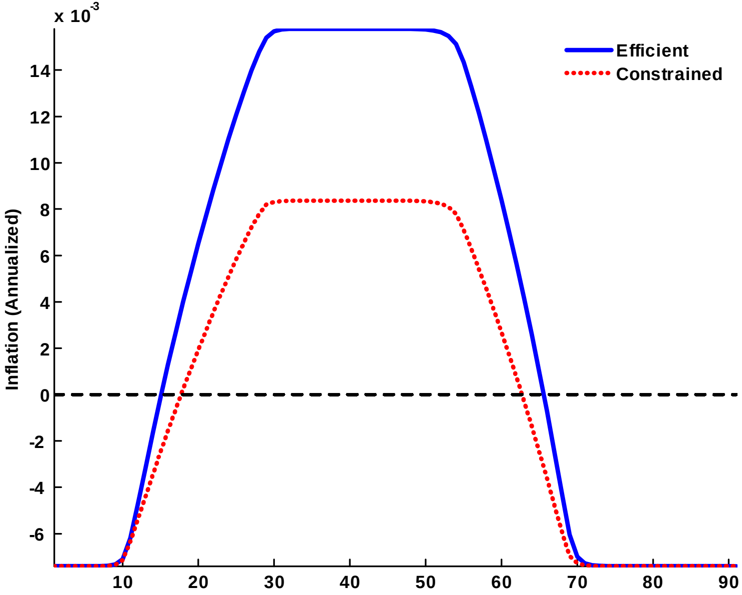
Interest Rates and Demographics: Transitory



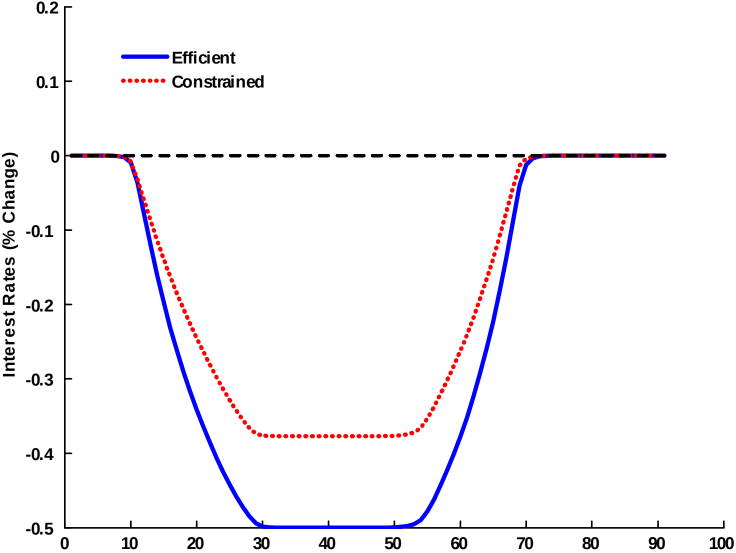
Intergenerational Redistribution: Permanent



Inflation and Demographics: Permanent



Interest Rates and Demographics: Permanent



Conclusions

- Study the interaction between population demographics, the desire for redistribution in the economy, and the optimal inflation rate.
- The intergenerational redistribution tension is intrinsic in life-cycle models.
  - Young cohorts do not have any assets and wages are the main source of income.
  - Old generations cannot work and prefer a high rate of return from their savings.
- When the old have more (less) influence over redistributive policy, the rate of return of money is high (high).