

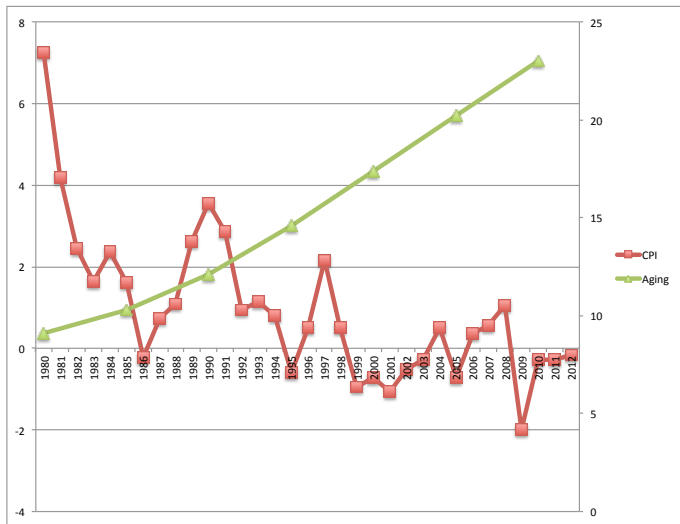
Aging and Deflation from a Fiscal Perspective

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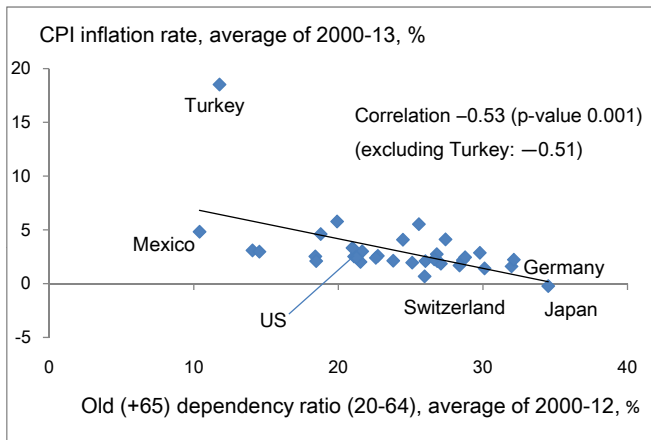
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Negative Correlation bw Aging and Inflation in Japan



Negative Correlation bw Aging and Inflation in OECD Countries



Motivations

We aim to analyze

- the reason for the concurrent population aging and deflation and
- the impact of price changes on income distribution across generations.

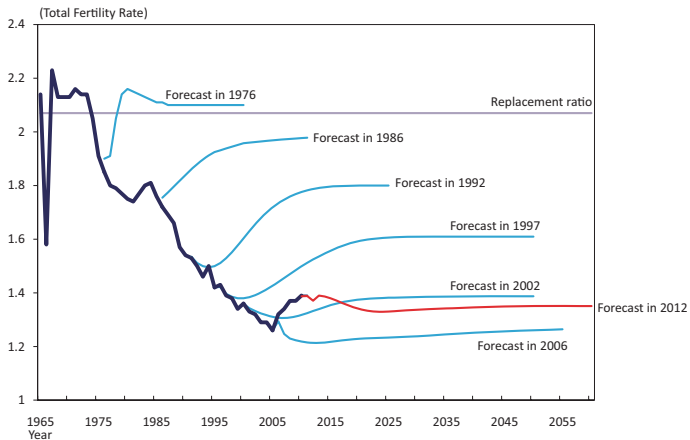
What We Do

- We extend the standard **fiscal theory of the price level (FTPL)**.
- ① We embed the FTPL into a standard overlapping generation (OLG) model
 - ▶ to examine political and economic impacts of demographic changes.
- ② We consider endogenous policy making.
 - ▶ Succession of short-lived governments choose income tax rates and bond issues.
 - ▶ Politico-economic perspective
 - ★ Governments are under the political influence of existing generations, taking into account the general equilibrium effects on the price level and the real interest rate as well as the expected strategic responses of future governments.

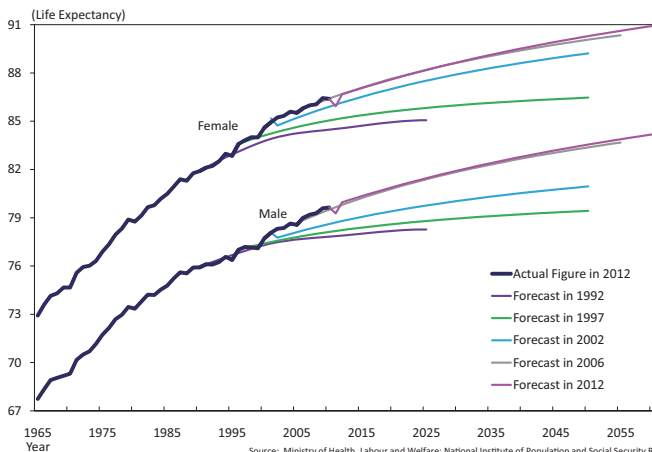
Three Features in Constructing a Model

- 1 Nominal interest rates have been fixed at almost zero.
 - 1 Passive monetary policy is the key to FTPL.
- 2 A part of Japanese population aging is an unexpected phenomenon.
- 3 Voter turnout rates for the young generation especially 20's, 30's, and 40's are declining and the gap between generations is widening.

Revisions in the Japanese Total Fertility Rate Forecast



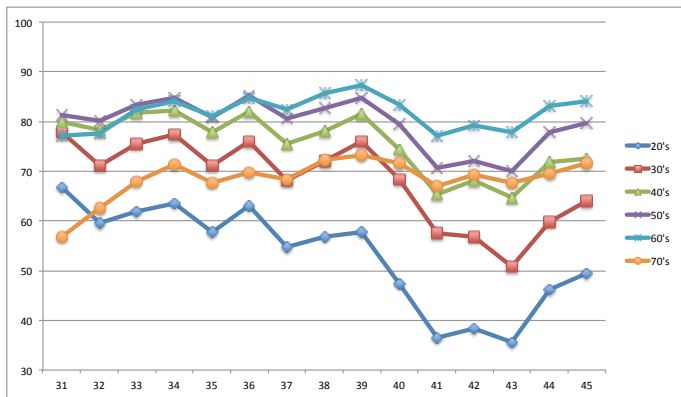
Revisions in the Japanese Life Expectancy Forecast



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Voter Turnout Rates by Age in Japan



Note: The turnout rates by age in the Japanese lower house elections No.31–45 (from 1967 to 2009) are depicted.

What We Find

- The accumulation of government debt does not become a burden on future generations,
 - ▶ because of price adjustments.
- The effects of aging depend on its causes.
 - ▶ Aging is deflationary when caused by an increase in longevity
 - ▶ but inflationary when caused by a decline in birth rate.
 - ▶ Numerical simulation shows that aging over the past 40 years in Japan generated deflation of about 0.6 percentage points annually.

Literature Review 1

- FTPL

- ▶ Leeper (1991), Sims (1994), Woodford (1995), and Cochrane (2005), among others.
 - ▶ FTPL framework into an OLG model (e.g., Cushing [1999] and Braun and Nakajima [2012], Sims [2013])
 - ▶ Although not dealing with the FTPL, Bullard *et al.* (2012) is also similar to our analysis in that it focuses on income redistribution to the older generation through deflation.
- These studies do not endogenize political decisions on fiscal policy variables.
 - To the best of our knowledge, our study is the first to analyze the public choice of fiscal policy variables such as income tax rates and bond issues in the FTPL framework.

Literature Review 2

- Fiscal burden
 - ▶ Bowen *et al.* (1960) and Barro (1974)
 - ▶ Strategic debt accumulation: Tabellini and Alesina (1990) and Persson and Svensson (1989)
 - ▶ Rohrs (2010), Song, Storesletten, and Zilibotti (2012), and Ono (2013) incorporated national debt into a political economy framework like ours.
- All these previous studies, however, assume that government debts are specified in **real terms** and therefore adjustments in the price level do not change the intertemporal budget constraint of the public sector.
- In the FTPL framework, irrespective of the amount of nominal debt accumulated, each government can pursue a fiscal policy in its own interest, thanks to the adjustments in the price level.

Model

Recap: Fiscal Theory of Price Level (FTPL)

- Assumptions of FTPL

- ▶ Nominal debts: govt has liabilities predetermined in nominal terms.
- ▶ Passive monetary policy: CB keeps a nominal interest rate constant over time.
- ▶ Active govt policy: govt is not constrained by its budget balance eqn.
- ▶ Price adjustment: Intertemporal budget is balanced only in equilibrium through current price adjustment.

- Today's price level P_t is determined to balance govt's intertemporal budget in real terms [Leeper ('91), Woodford ('01) etc.] .

$$\frac{RB_{t-1}}{P_t} = T_t - G_t + \sum_{s=t+1}^{\infty} \left(\prod_{k=t+1}^s r_k \right)^{-1} (T_s - G_s)$$

What does the Standard FTPL Predict?

- Price level in Japan should rise sooner or later.
 - ▶ Fiscal surplus is expected to deteriorate due to aging.
- The standard FTPL takes account of no political factors.
 - ▶ Policy choice will also respond to demographic aging through intergenerational politics.
 - ▶ Need to incorporate intergenerational politics and endogenize policy choice into FTPL.

Model Features

- Endowment economy. No physical capital.
- OLG model. The economy consists of the young N_t and the old $\theta_t N_{t-1}$.
 - ▶ Each individual will live at most for two periods with a survival probability θ_t^j . No aggregate uncertainty.
 - ▶ $n_t = N_t / N_{t-1}$ represents a birth rate.
- Monetary policy is passive.
- Govt remains in power only for one period.
 - ▶ Income tax only, which is imposed on the young.
 - ▶ Govt determines bond issues and tax rates. Expenditure is fixed.

Household

Each young household in period t maximizes the expected utility:

$$\log c_t^y + \beta \theta_{t+1} \log c_{t+1}^o \quad (1)$$

st

$$c_t^y + \frac{\theta_{t+1}}{r_{t+1}} c_{t+1}^o = 1 - \tau_t, \quad (2)$$

where $r_{t+1} \equiv R_t P_t / P_{t+1}$ is the real interest rate a young household faces in period t .

Behind this, we assume insurance firms faced with perfect competition.

A young household's utility maximization yields its demand for goods and nominal annuities as follows:

$$c_t^y = \frac{1 - \tau_t}{1 + \beta\theta_{t+1}}, \quad (3)$$

$$c_{t+1}^o = \frac{\beta r_{t+1}(1 - \tau_t)}{1 + \beta\theta_{t+1}} \quad (4)$$

and

$$A_t = \frac{P_t \beta \theta_{t+1} (1 - \tau_t)}{1 + \beta \theta_{t+1}}. \quad (5)$$

Government

Fiscal balance:

$$R_{t-1}B_{t-1} = B_t + P_t N_t \tau_t. \quad (6)$$

Market clearing for government bonds:

$$N_t A_t = B_t. \quad (7)$$

Economic Equilibrium with Exogenous Fiscal Policy

- Tax rates are exogenous.

Real Interest Rate

- The fiscal balance equation together with market clearing for government bonds yields the equilibrium real interest realized in period $t + 1$:

$$\frac{r_{t+1}}{n_{t+1}} = \frac{1 + \beta\theta_{t+1}}{\beta\theta_{t+1}(1 - \tau_t)} \frac{\beta\theta_{t+2} + \tau_{t+1}}{1 + \beta\theta_{t+2}}. \quad (8)$$

- ▶ r_{t+1} depends on τ , n , and θ .
- ▶ In the model of an infinitely lived representative household, r_{t+1} is constant at $1/\beta$ irrespective of the stream of tax rates.

Price

- The fiscal balance equation together with market clearing for government bonds yields the equilibrium price level in period t :

$$\left(\frac{R_{t-1}B_{t-1}}{N_{t-1}} \right) \frac{1}{P_t} = \frac{n_t(\tau_t + \beta\theta_{t+1})}{1 + \beta\theta_{t+1}}. \quad (9)$$

- A higher τ_t and a higher θ_{t+1} deflate P_t , but a lower n_t inflates it.

Indirect Utility

$$v_t^y = (1 + \beta\theta_{t+1}) \log(1 - \tau_t) + \beta\theta_{t+1} \log r_{t+1} + \beta\theta_{t+1} \log \frac{\beta}{1 + \beta\theta_{t+1}} \quad (10)$$

$$v_t^o = \log \frac{R_{t-1} B_{t-1}}{\theta_t N_{t-1} P_t} \quad (11)$$

Politico-Economic Equilibrium

- Tax rates are endogenous.

Optimization Problem Facing Short-lived Governments

- To endogenize government policies and characterize the politico-economic equilibrium, we assume that tax rates and bond issues are chosen by a succession of short-lived governments.
 - ▶ Song, Storesletten, and Zilibotti (2012), among others.
- Each government remains in power just for one period and chooses policies to maximize

$$W_t = \gamma_t v_t^o + v_t^y, \quad (12)$$

- ▶ following the spirit of the probabilistic voting model,
- ▶ where γ_t represents the political bias toward the well-being of the old, and v_t^o and v_t^y represent the indirect utility of the old and the young, respectively.

- The policy decisions of successive governments are usually considered intertemporally linked by the inheritance of outstanding debts.
 - ▶ Strategic debt creation pioneered by Persson and Svensson (1989) and Tabellini and Alesina (1990)

- In our model, the previous problem is reduced to

$$\gamma_t \log(\tau_t + \beta\theta_{t+1}) + (1 + \beta\theta_{t+1}) \log(1 - \tau_t) + \beta\theta_{t+1} \log r_{t+1} \quad (13)$$

subject to (8). b_{t-1} **does not appear here!**

- This suggests that government $t - 1$'s decision has **no influence** on government t 's policy choice.
- Since the governments issue nominal bonds and are in the situation of fiscal dominance, the price level adjusts to eliminate the linkage and each government can pursue its own optimal policy irrespective of how much nominal debt it inherits from its predecessor.

Markov Perfect Equilibrium

Assume

$$\gamma_t = \frac{\omega\theta_t}{n_t}, \quad (14)$$

and $\theta_t = \theta_{t+1} = \theta$ and $n_t = n_{t+1} = n$. Then, we have

$$\tau_t = 1 - \frac{1 + \beta\theta}{1 + \omega\theta/n} \quad (15)$$

$$r_{t+1} = \frac{\omega}{\beta} \quad (16)$$

$$P_t = \left(\frac{R_{t-1}B_{t-1}}{N_{t-1}} \right) \left(\frac{1}{\omega\theta} + \frac{1}{n} \right). \quad (17)$$

Results

	Tax (τ_t)	Bond (b_t)	Price (P_t)	Real interest rate (r_{t+1})
$\omega_t \uparrow$	+	-	-	+
$n_t \downarrow$	+	-	+	0
$\theta_t \uparrow$	+	+	-	0

- The price level response to demographic aging depends on its causes.
- If the birth rate declines, a contraction in the tax base will reduce the fiscal surplus and the government will be induced to generate inflation in order to maintain solvency at the cost of the older generation's well-being and impose higher taxes on the younger generation to mitigate the extent of inflation, based on the strengthened political influence of the older generation.
- In contrast, in case of an unexpected increase in life expectancy and the old survive longer than expected, the government will be inclined to favor them because of their shortage in savings for their retirement period and their strengthened political power relative to the younger generation. In such a situation, the government will opt to suppress inflation and support the older generation's well-being with deflation.

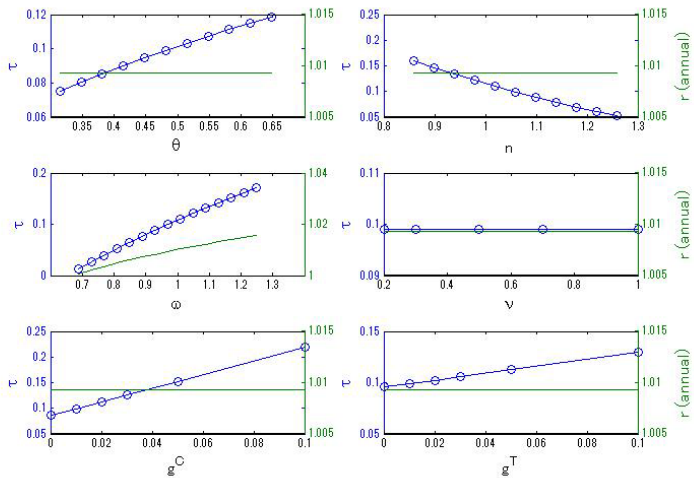
Quantitative Investigations Using a Generalized Model

Model Features

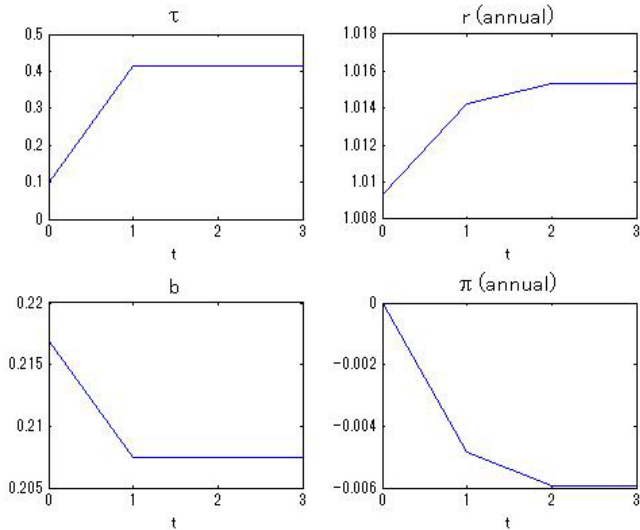
- A production economy with variable labor supply.
- General utility functions and employ the constant relative risk aversion (CRRA) class.
- Two types of government expenditure, government consumption and transfer to the older generation

Calibration

- A period consists of 40 years.
- $\sigma = 1$; Frisch elasticity $v = 0.5$; $\beta = 0.99^{40}$; government spending $g^C = g^T = 0.01$.
- In 1976, $\theta = 0.482$; $n = 1.058$; $\omega = 0.969$.
 - ▶ Forecasts of the National Institute of Population and Social Security Research (IPSS)
 - ▶ Voter turnout rates in the election No. 34 held in 1976.
- In 2012, $\theta = 0.781$; $n = 0.629$; $\omega = 1.230$.



Note: The blue lines with circles represent the tax rate τ (left axis) and the green lines the annualized real interest rate r (right axis).



Note: $t = 0$ corresponds to 1974. At $t = 1$, unexpected demographic and political changes occur, which corresponds to the year 2012. From $t = 2$ onward, demographic and political parameters are unchanged. The inflation rate at $t = 0$ is set 0.

Coccluding Remarks: Future Work

- Our study represents a first step toward embedding the FTPL in a politico-economic framework.
- Two main challenges.
 - ▶ Address Japan's accumulation of government bonds over the past 40 years. Our finding that aging improves fiscal balances by increasing the tax rate imposed on the young seems questionable in reality.
 - ▶ Introduce foreign investors buying government bonds into the model. It is well known that around 90% of Japanese government bonds are held by domestic investors.