Aging and Deflation from a Fiscal Perspective

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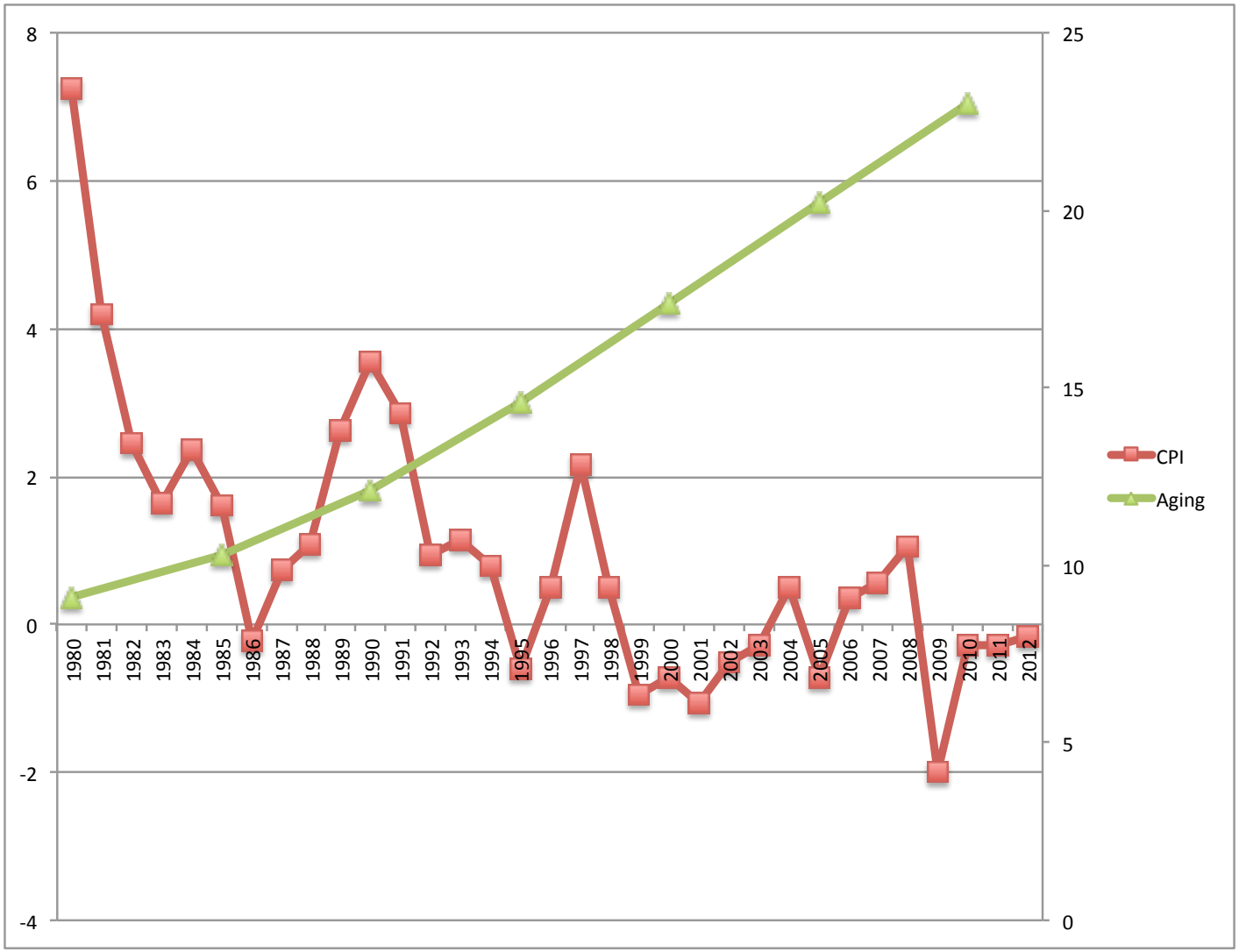
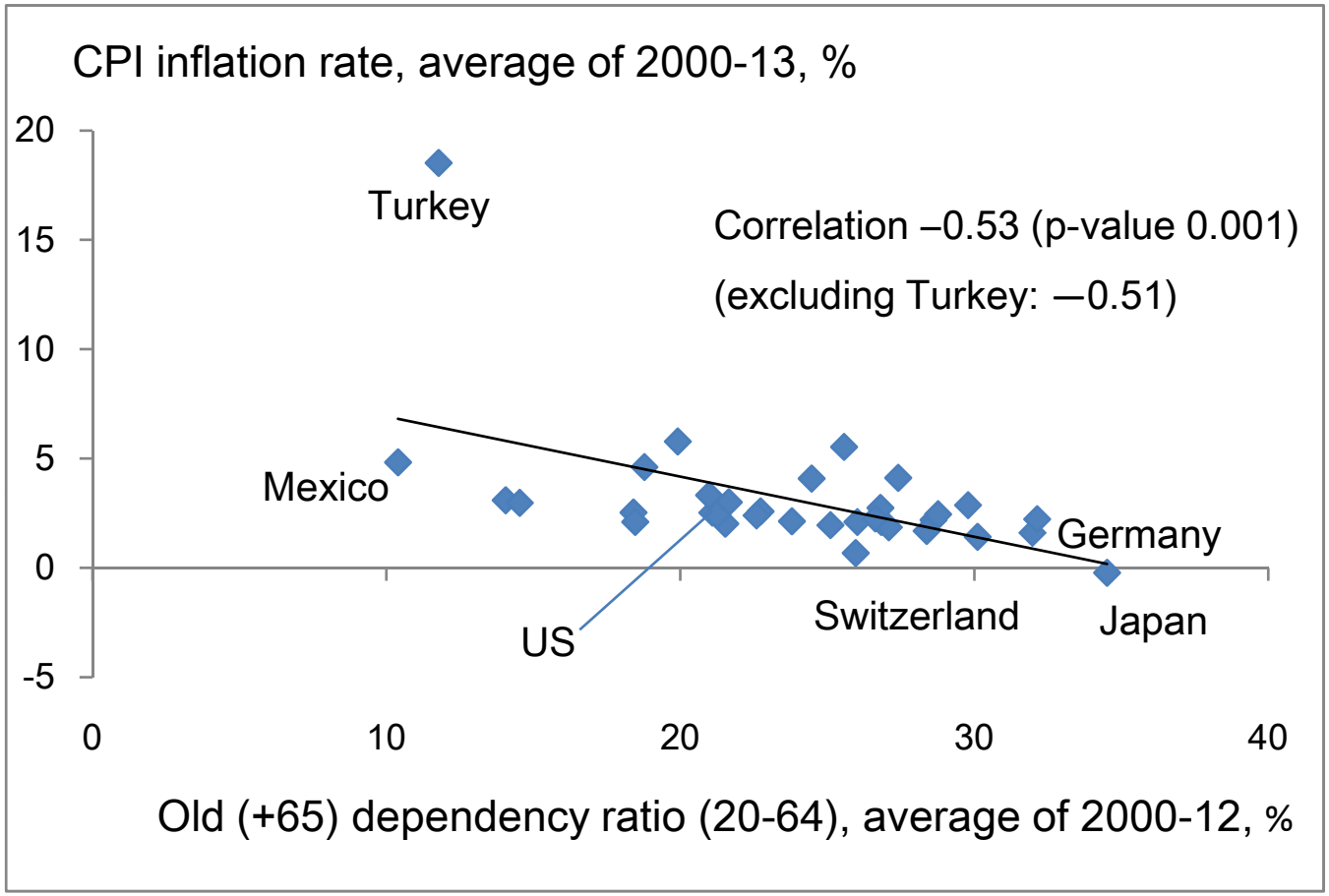
Negative Correlation bw Aging and Deflation in Japan



Negative Correlation bw Aging and Deflation in OECD Countries



Motivation

- We examine how population aging influences fiscal balances and general prices within a *political-economic* framework.

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 make it possible to examine political and economic impacts of demographic changes.
2. We consider endogenous policy making
   - by succession of short-lived governments,
   - who choose tax rates and government bonds outstanding
   - under the political influences of existing generations and strategic responses by future governments.

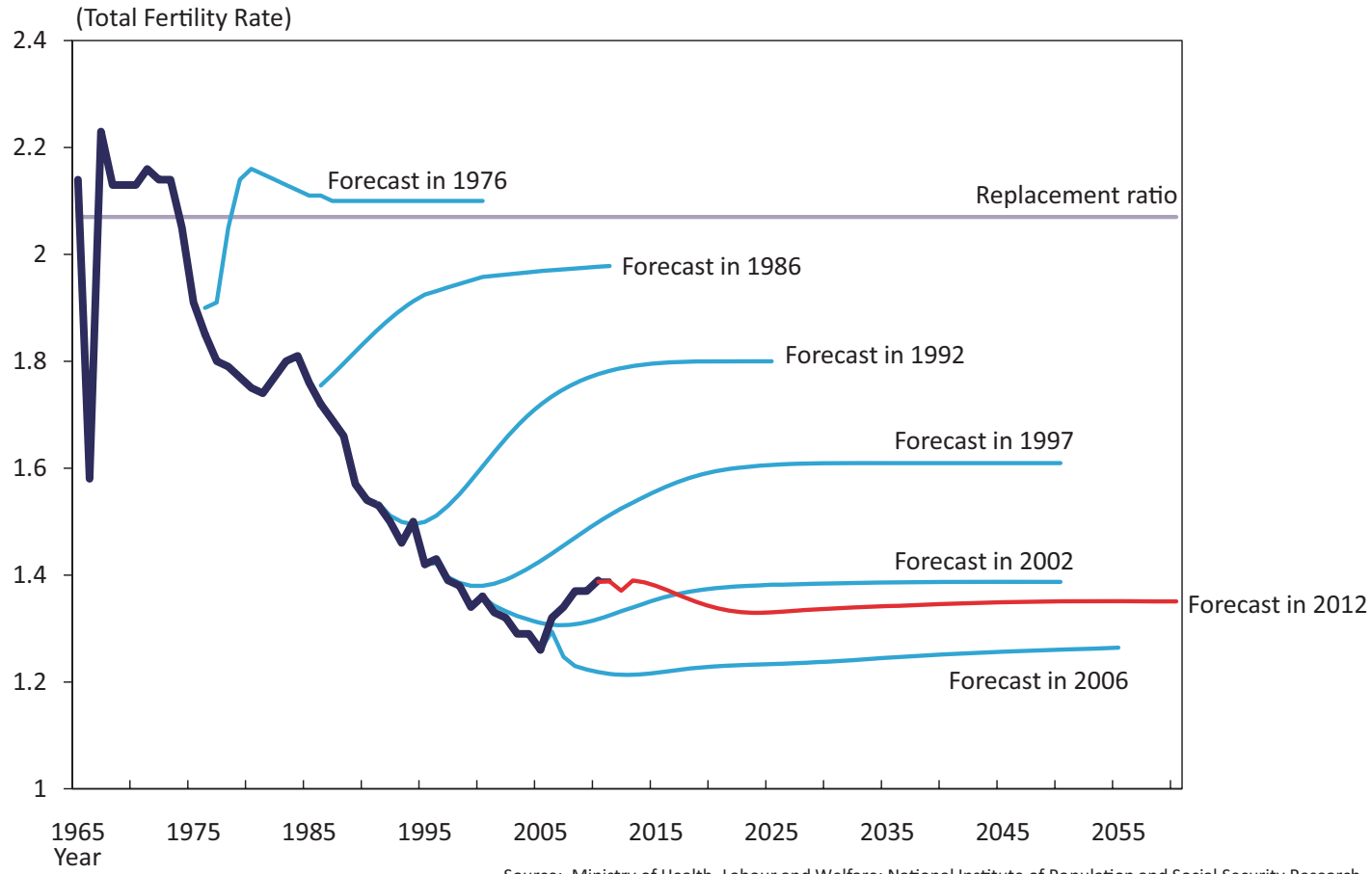
What We Do NOT Do

1. Challenge FTPL
2. Endogenize interactions between monetary policy and fiscal policy
3. Do realistic quantitative analysis
4. Investigate other reasons of persistent deflation
    1. Insufficient monetary policy, growth strategy, malfunctioning of financial system, ...

Four Features in Constructing a Model

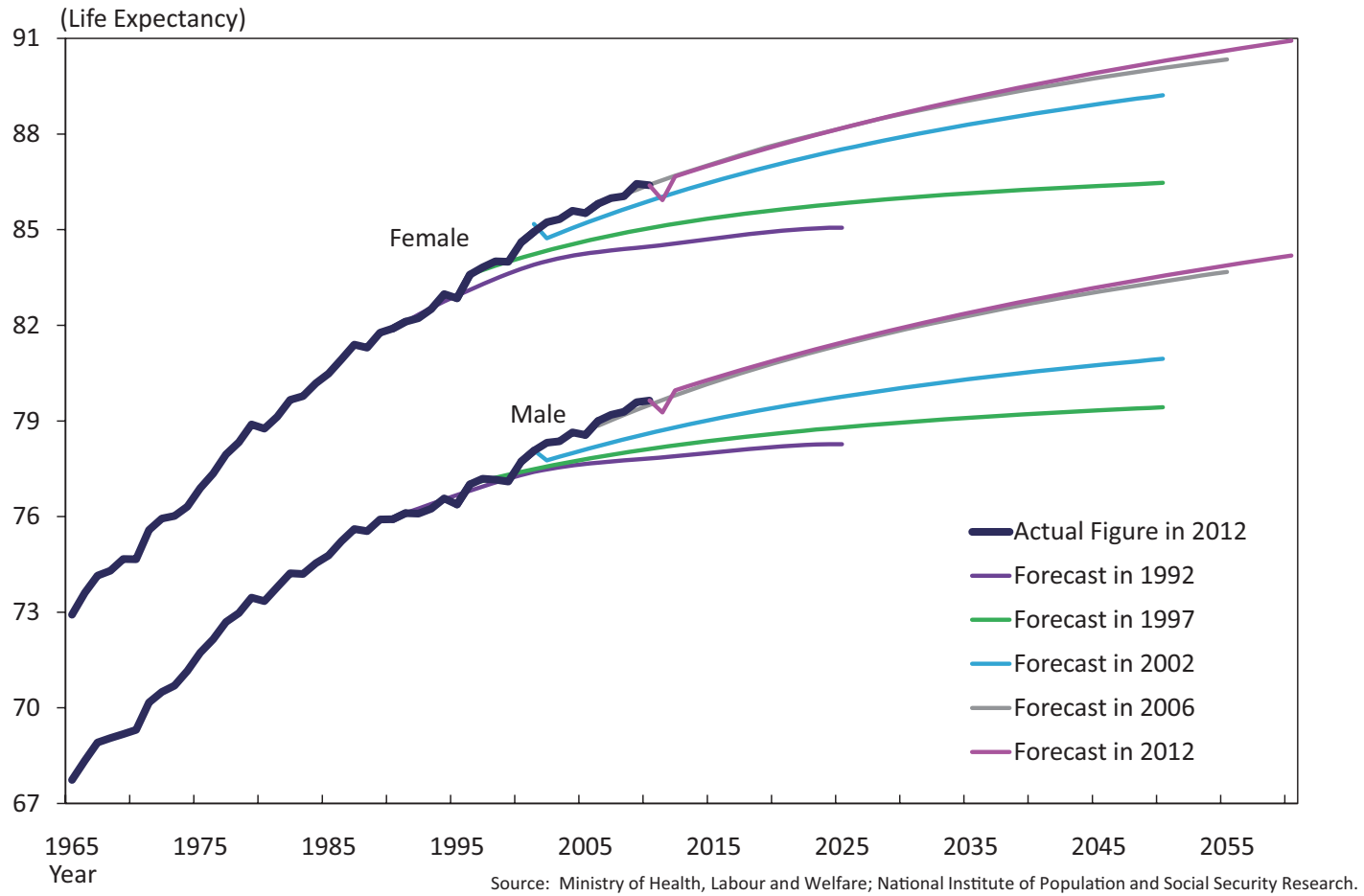
1. Around 90% of the Japanese government bonds (JGBs) are held by domestic investors.
    1. Closed-economy model.
2. Nominal interest rate has been fixed at almost zero.
    1. Passive monetary policy is the key to FTPL.
3. A part of Japanese population aging is an unexpected phenomenon.

Revisions in the Japanese Total Fertility Rate Forcast



Source: Ministry of Health, Labour and Welfare; National Institute of Population and Social Security Research.

Revisions in the Japanese Life Expectancy Forcast



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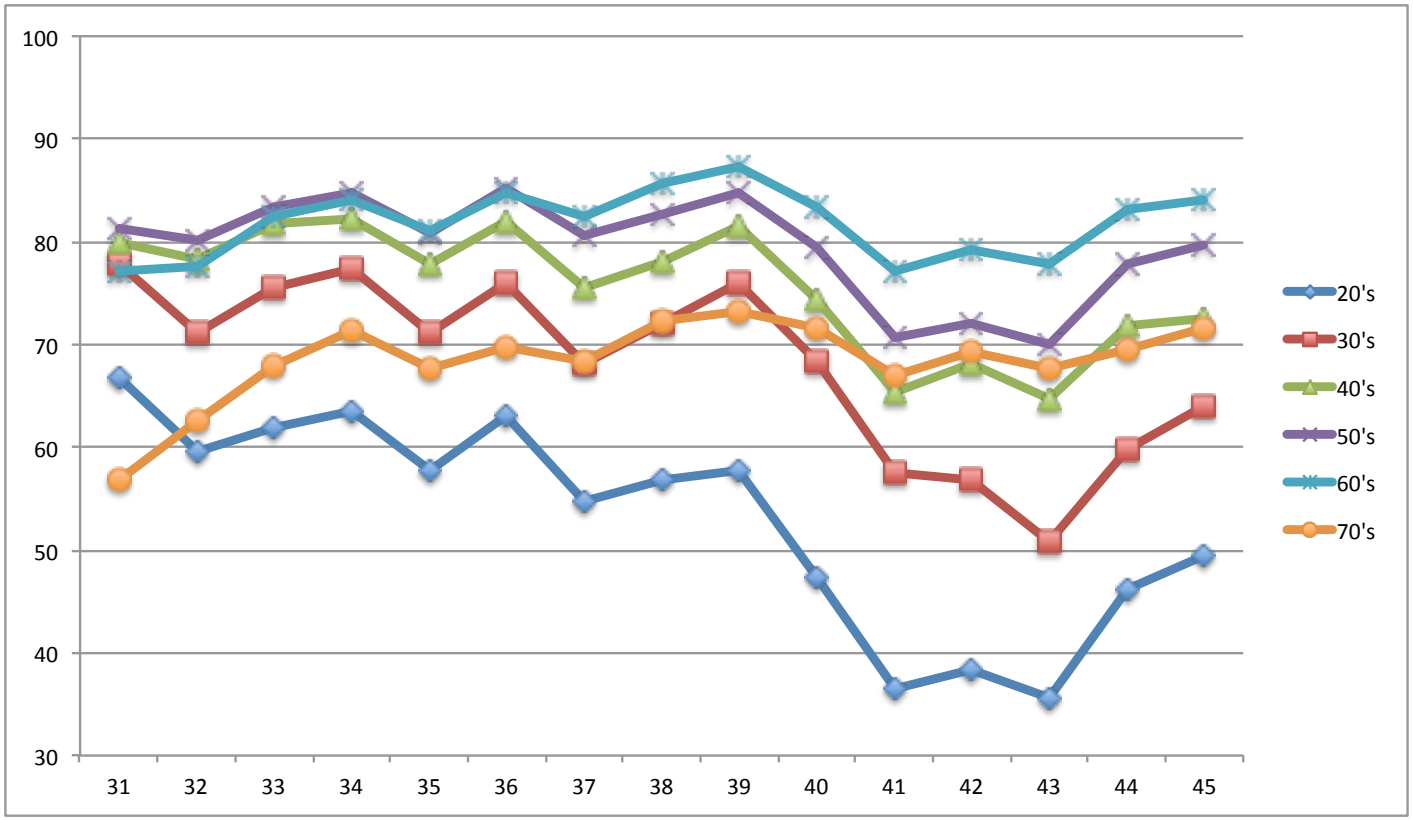
Four Features in Constructing a Model

1. Around 90% of the Japanese government bonds (JGBs) are held by domestic investors.
2. Nominal interest rate has been fixed at almost zero.
3. A part of Japanese population aging is an unexpected phenomenon.
4. The voter turnout rates for the young generation especially 20's, 30's, and 40's are declining and the gap between generations is widening.

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.

Model

Fiscal Theory of Price Level (FTPL)

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

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

- 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.

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

- OLG model consists of the young and the old.
- Labor income tax only. No physical capital.
- Each individual will live for two period with an uncertain survival probability θ_t^j.
- Monetary policy is passive, keeping a fixed nominal interest rate.
- Govt remains in power only for one period.
- A succession of short-lived govts choose debt issues and income tax rates to maximize the weighted average of the young's and the old's utility in each period, taking account of the effects on current and future prices as well as next govt's policy responses.
  - Solve the Markov-perfect equilibrium of the dynamic policy choice game.

Household

Each young household in period t chooses c_t^y and ℓ_t to maximize the expected utility:

$$u^y(c_t^y, \ell_t) + \beta \mathbb{E}_t \left[\theta_{t+1}^j u^o(c_{t+1}^o) \right],$$

where

$$c_{t+1}^o = \frac{r_{t+1}}{\theta_{t+1}} \left[(1 - \tau_t)\ell_t - c_t^y \right] + g_{t+1}^T.$$

Household 2

- Indirect utility function of the young in period t is

$$v_t^y(\tau_t\,;\,\vec{r}_{t+1}) \equiv u^y\left(c_t^y(\tau_t\,;\,\vec{r}_{t+1}),\ell_t(\tau_t\,;\,\vec{r}_{t+1})\right) + \beta\mathbb{E}_t\left[\theta_{t+1}^j u^o\left(\frac{r_{t+1}a_t(\tau_t\,;\,\vec{r}_{t+1})}{\theta_{t+1}} + g_{t+1}^T\right)\right],$$

  where a_t represents saving per young and r_t is the real interest rate given by RP_t/P_{t+1}.
- The indirect utility of the old in period t is

$$v_t^o(r_t, a_{t-1}) \equiv u^o\left(\frac{r_t a_{t-1}(\tau_{t-1}\,;\,\vec{r}_t)}{\theta_t} + g_t^T\right).$$

Market Clearing for Government Bonds

All the government bonds are held by domestic investors through insurance companies, ultimately by the young.

$$a_t(\tau_t\,;\,\vec{r}_{t+1}) = b_t,$$

where b_t is the real government bond supply in t.

Optimization Problem Facing Short-lived Governments

- Govt in period t chooses τ_t, b_t, and r_t to maximize the weighted average of indirect utilities:

$$W_t = \gamma_t v_t^o(r_t, b_{t-1}) + v_t^y(\tau_t\,;\,\vec{r}_{t+1}),$$

taking account of

  - bonds market clearing condition: $a_t(\tau_t\,;\,\vec{r}_{t+1}) = b_t$.
  - the budget balance:
    $r_t b_{t-1} = n_t\left(b_t + \tau_t \ell_t(\tau_t\,;\,\vec{r}_{t+1})\right) - (n_t + \theta_t) g_t^C - \theta_t g_t^T$.
  - and the next-period government's policy decision embodied in $\vec{r}_{t+1}$.

where $n_t \equiv N_t / N_{t-1}$ and θ_t^j represent young population's growth rate and the survival probability. If $\gamma_t = \theta_t / n_t$, the government is a *myopic* utilitarian who maximizes the sum of utilities.

Markov Perfect Equilibrium

- In a multi-period OLG model, extremely complex to calculate equilibrium, even its steady state.
  - The entire path of past and future policies influence the behavior of current households and the current policy.
  - $\partial a_t^j / \partial \tau_t$?
- However, simple in the 2-period OLG model.
- Eliminate r_t and the optimization problem is reduced into

$$\max_{\tau_t, b_t} W_t = \gamma_t u^o \left(\frac{n_t(b_t + \tau_t \ell_t) - (n_t + \theta_t) g_t^C}{\theta_t} + g_t^T \right) + v_t^y(\tau_t \mid \vec{r}_{t+1})$$

  subject to the bonds market clearing condition $a_t(\tau_t ; \vec{r}_{t+1}) = b_t$.
- b_{t-1} **does not appear here!**

Result 1

- b_{t-1} **does not appear here!**
- The government's optimal choices of τ_t and b_t should be independent of b_{t-1}.
  - Only the optimal choice of r_t, or the price level P_t, depends on b_{t-1}.
- Burdens of public debt are not passed to future unborn generations even in the absence of altruistic bequests. [cf. Bowen, Davis, and Kopf (1960), Barro (1979)]
  - Larger bond issues in period t end up with higher prices in period t and $t+1$.
  - Burdens of public debt are fully paid by current old though reductions in the real value of their assets and by young generation through reductions in the real interest rate.

Result 2

- Prices respond to aging in opposite directions, depending on whether it is caused by longer lifetime or by lower birth rate.
- Suppose that $\gamma_t = \theta_t / n_t$, population ratio. Then,
  - Lower birth rate n_t inflates prices as the standard FTPL predicts.
  - Longer life-expectancy θ_t is likely to inflate prices as lower birth rate does, if it is **expected**.
  - Longer life-expectancy θ_t is likely to deflate prices as lower birth rate does, if it is **unexpected**.

Intuition

- Economic impact of aging
  - Fiscal surplus declines due to a decline in tax revenues from the young, raising tax and price.
- Political impact of aging
  - Govt opts to decrease deficits, increase taxes, and lower price.
- Moreover, **unexpectedly long lifetime** makes the old worse-off because their savings turn out insufficient.
  - This strengthens the government's distributional concerns, leading to deflation.

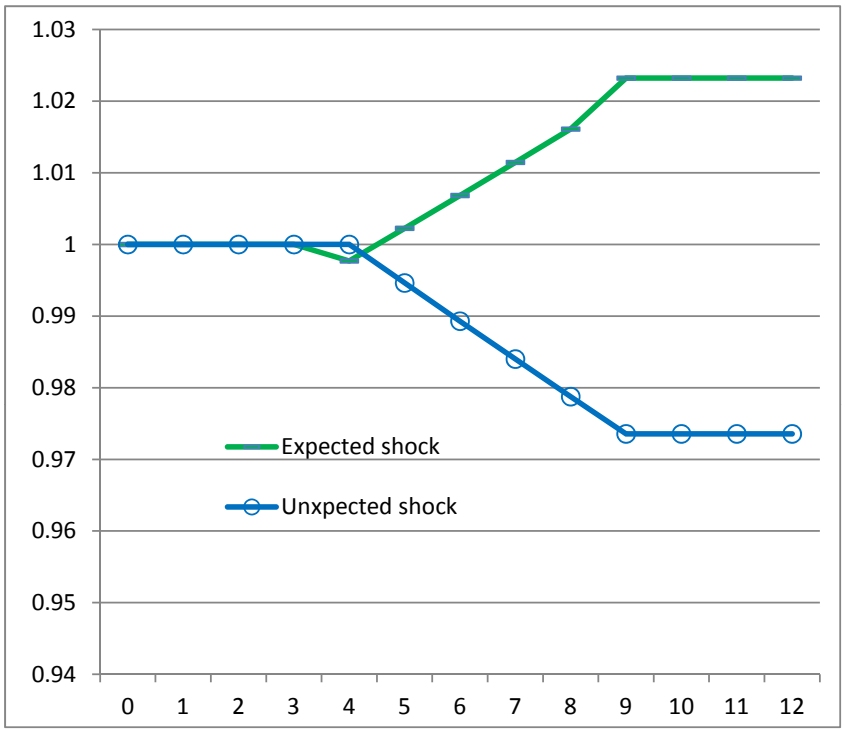
Concluding Remarks

- Negative correlation
  - A mild deflation and population aging in Japan's lost decades.
- Our result here suggests that this puzzling observation might be caused by
  - the combined political and economic effects of unexpected population aging having occurred from extension in longevity.
- Future work
  - address the accumulation in government bonds outstanding that is observed in Japan
  - introduce an endogenous monetary policy response
  - introduce foreign investors to buy the government bonds
  - make a quantitative analysis

Appendix: quantitative analysis

Responses of Prices to Extension of Longevity

- The perfect foresight case experiences *inflation* whereas the unexpected case experiences *deflation*, implying that the public expectation for aging is a key to understanding the response of the price levels.



Calibration

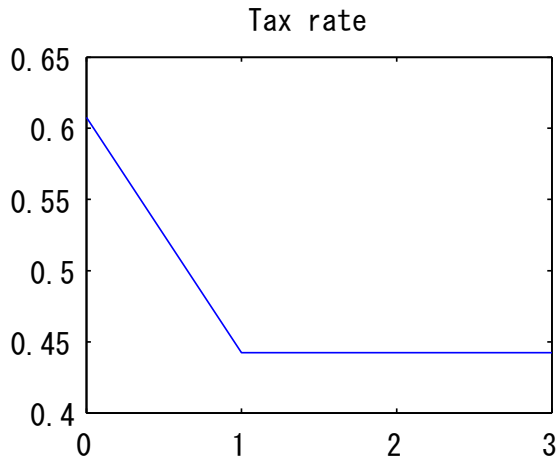
- 2 period OLG
  - 1 period is 40 years.
  - Utility is given by

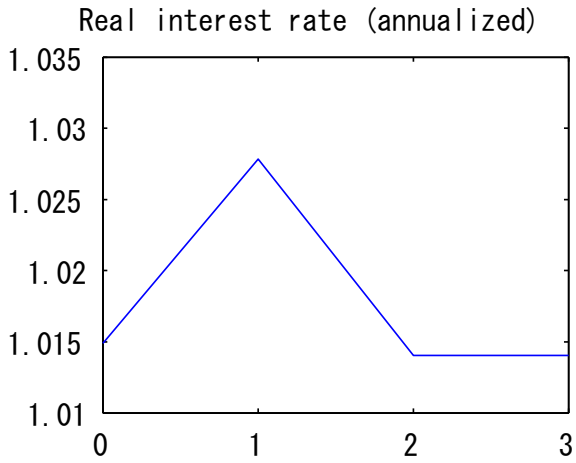
$$u(c_t^I, \ell_t^I) = \frac{\left(c_t^I\right)^{1-\sigma}}{1-\sigma} - \chi \frac{\left(\ell_t^I\right)^{1+1/v}}{1+1/v},$$

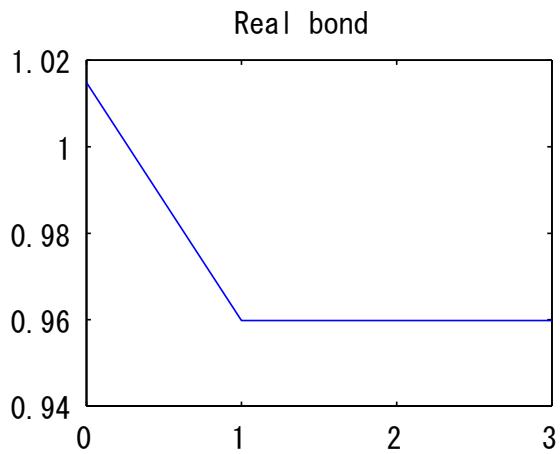
    where $\sigma = 1$ and $v = 0.5$.
  - $\beta = 0.99^{40}$ (1% annually), $g_t^T = 0.01$, and $g_t^C = 0.01$.
  - Variables associated with demography, θ_t and n_t, are derived from Japan's official statistics and forecasts by National Institute of Population and Social Security Research (IPSS).
    - ★ As an innitial state, in 1997, $\theta_t = 0.620$, $n_t = 0.304$, and $\gamma_t^y / \gamma_t^o = 0.828$.
    - ★ As a final state, according to long-run forecasts in 2060 made in 2012, $\theta_t = 0.781$, $n_t = 0.555$, and $\gamma_t^y / \gamma_t^o = 0.856$.

Transition Path

Deflation due to recovered birth rate







Transition Path under Exogenous Tax Rate

Multi-peiod OLG (16 generations, 5-year interval)