

Asset Portfolio Choice of Banks and Inflation Dynamics

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Motivation:

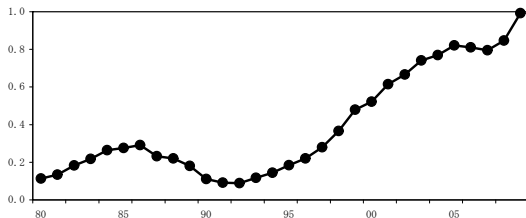
- accumulating government bond since the late 1990s in Japan.
- bulk of government bond is held by banks.
- ex-post spreads bw capital return and government bond is widening in current years.

- are the three observations important to JPN economy?
- why do banks choose to hold government bond instead of loan claim to firms?

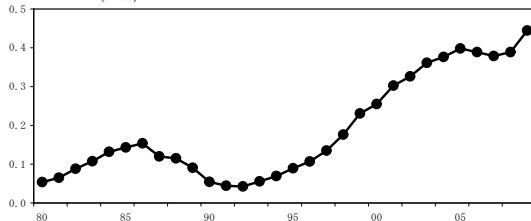
- are output downturn and deflation during the two decades are related to the bond accumulation and the banks' portfolio choice?

Data I: debt relative to output and capital stock

(1) Government Debt over GDP

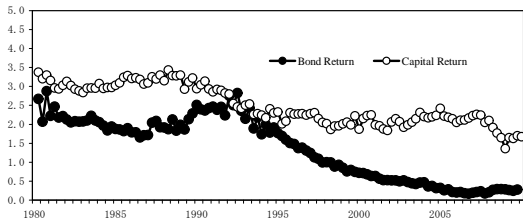


(2) Government Debt over Capital
(times)

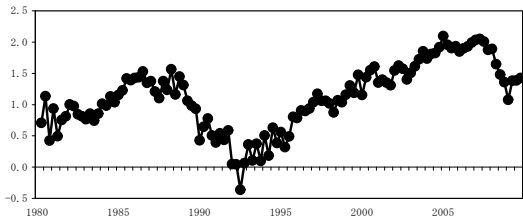


Data II: ex-post return from bond and capital

(1) Bond Return and Capital Return

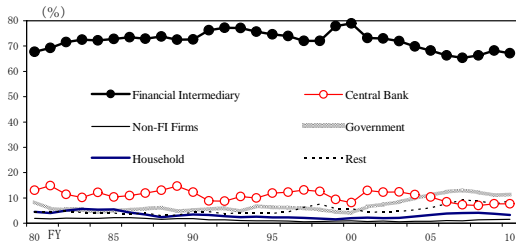


(2) Spread between the Two Assets

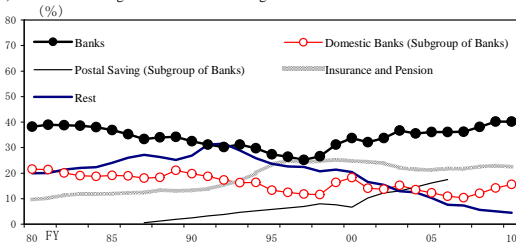


Data III: bond holding by banks

(1) Sectoral share of government bond holding

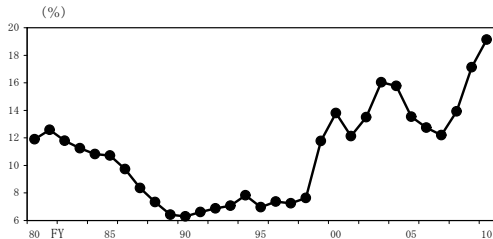


(1) Sectoral share of government bond holding within FI

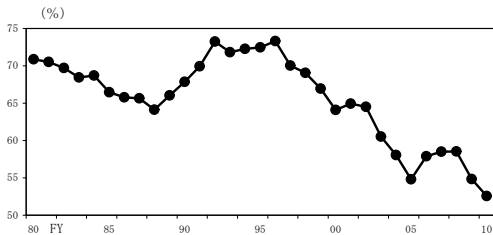


Data IV: banks' behavior

(1) Portion of Public Bond in the Banks' Asset

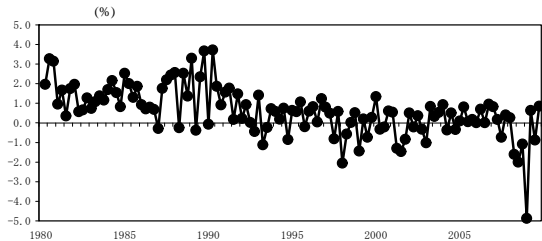


(2) Portion of Loan Claim in the Banks' Asset

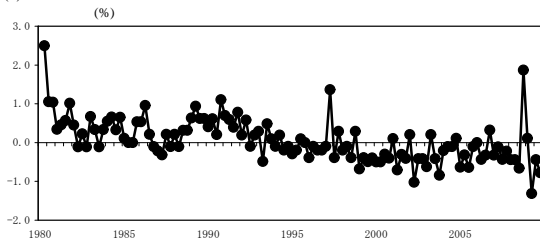


Data V: macroeconomic variables

(1)GDP



(2)GDP Deflator



Related studies I: Value at Risk (VaR) constraint

- Adrian and Shin (2011)
- VaR constraint as a source of leverage cycle: the bank determines how much to invest and how much to borrow, so that it is able to repay all of its debt to lenders even if the lowest possible value is realized for the investment.
- Consequently, bank's leverage depends on the net worth of the bank. Bank increases lending (expands leverage) when its net worth is ample, and shrinks otherwise.
- We extend Adrian and Shin (2011) by allowing 2 assets and incorporating the VaR framework into NK model. The bank now determines how much to invest in each of the two assets.

Related studies II: Asset portfolio composition

- Brunnermeier and Sanikov (2011)
 - analyzes how bank allocates asset bw safe asset (money) and risky asset. adverse shock encourages safe asset holding, leading to deflation.
- Fernandez-Villaderde et al. (2011)
 - analyzes how increase in uncertainty affects hhs' portfolio choice based on a segmented market model. uncertainty increases money holding, leading to deflation.
- In our model, bank determines asset allocation between capital and gov. bond.
- Capital: Expected return is higher, but maximum loss is also higher.
- Bond: Expected return is lower, but maximum loss is also lower.

- Construct a NK sticky price model where banks decide how much to invest in gov. bond and capital endogenously under the VaR constraint.
- Analyze the property of VaR constraint model under simple setting.
- Estimate the model using JPN data from 1980 to 2009.
- Investigate the determinants of accumulating gov. bond and banks' portfolio choice, widening spread, and the causes behind output downturn and deflation during the lost decades.

Our findings

- Under VaR, banks choose gov. bond (less risky asset compared to capital) when economic outlook is more uncertain, banks' net worth is more scarce, or tfp growth is slower.
- Portfolio shift towards gov. bond reduces output and incurs deflation, since it hampers capital accumulation and economic activity.
- Quantitatively, hike of gov. bond is attributed to changes in gov. policy, although such policy plays a minor role in economic activity.
- Compositional change in bank's portfolio plays a minor role in the bond increase, but it brings about a sizable impact on output and inflation.
- Ex-ante spread is kept wide by bank's asset portfolio choice.

- HHs:earn wage by supplying labor, make deposit to bank and pay tax to gov.
- Banks:invest on capital and gov. bond, using own net worth and deposit.
- Firms:borrow capital and labor from bank and HH to produce final goods.
- Government:issues bond and collects lump-sum tax to finance repayment for debt (we assume no tax distortion).
- CB:adjusts policy rate.

- bank invests in two assets, capital and bond.
- return and maximum loss of capital are denoted by

$$r_k (s^t), \underline{r}_k (s^{t+1} | s^t)$$

- return and maximum loss of government bond are denoted by

$$r_b (s^t), \underline{r}_b (s^{t+1} | s^t)$$

- we assume that

$$Er_{\underline{k}} < Er_{\underline{b}} < r_b < Er_b < Er_k$$

- bank maximizes bank's net worth by making investment under VaR constraint.
- asset and liability

$$k(s^t) + \frac{B(s^t)}{P(s^t)} = n(s^t) + d(s^t)$$

- VaR constraint

$$\underline{r}_k(s^{t+1}|s^t) k(s^t) + \underline{r}_b(s^{t+1}|s^t) \frac{B(s^t)}{P(s^t)} - r_d(s^t) d(s^t) \geq 0$$

- net worth evolution

$$n(s^{t+1}) = \gamma \left[r_k(s^{t+1}) k(s^t) + r_b(s^{t+1}) \frac{B(s^t)}{P(s^t)} - r_d(s^t) d(s^t) \right]$$

- bank's asset allocation when VaR is not effective

$$Er_k (s^{t+1}|s^t) = Er_b (s^{t+1}|s^t) .$$

- bank's asset allocation under VaR

$$E \frac{q_k (s^{t+1}|s^t)}{\underline{q}_k (s^{t+1}|s^t)} = E \frac{q_b (s^{t+1}|s^t)}{\underline{q}_b (s^{t+1}|s^t)}$$

where

$$q_k (s^{t+1}|s^t) \equiv r_k (s^{t+1}|s^t) - r_d (s^t) ,$$

$$q_b (s^{t+1}|s^t) \equiv r_b (s^{t+1}|s^t) - r_d (s^t) ,$$

$$\underline{q}_k (s^{t+1}|s^t) \equiv \underline{r}_k (s^{t+1}|s^t) - r_d (s^t) ,$$

$$\underline{q}_b (s^{t+1}|s^t) \equiv \underline{r}_b (s^{t+1}|s^t) - r_d (s^t) .$$

- household maximizes utility subject to budget constraint.

$$E_0 \sum_{t=0}^{\infty} \beta^t (\log c(s^t) + \eta \log(1 - l(s^t)))$$

s.t.

$$\begin{aligned} c(s^t) + d(s^t) &= r_d(s^{t-1}) d(s^{t-1}) \\ &+ \frac{W(s^t)}{P(s^t)} l(s^t) \\ &+ \Pi(s^t) - \tau(s^t) \end{aligned}$$

- firm minimizes cost subject to quantity constraint

$$P_y (s^t) y (s^t) - r_k (s^t) k (s^{t-1}) - W (s^t) l (s^t)$$

s.t.

$$(k (s^{t-1}))^\alpha (A (s^t) l (s^t))^{1-\alpha} \geq y (s^t)$$

- government budget constraint

$$R_B (s^{t-1}) B (s^{t-1}) + P (s^t) G (s^t) = P (s^t) \tau (s^t) + B (s^t) ,$$

where

$$\tau (s^t) = T (s^t) \left(\frac{b (s^{t-1})}{y (s^t)} \right)^\psi ,$$

- Note that bond supply increases by increase in expense or change in gov. policy.
- monetary policy

$$R_B (s^t) = R (\pi (s^t))^\phi \exp (\epsilon_r (s^t)) .$$

- note that

$$r_b (s^{t+1}) = \frac{R_B (s^t)}{\pi (s^{t+1})} .$$

- arbitrage condition gives the following relationship.

$$r_b - r_d = \frac{1 - \gamma r_d}{\gamma r_d} (r_d - \underline{r}_b),$$

$$r_k - r_d = \frac{1 - \gamma r_d}{\gamma r_d} (r_d - \underline{r}_k).$$


$$r_k - r_b = \frac{1 - \gamma r_d}{\gamma r_d} (\underline{r}_b - \underline{r}_k).$$

banks need a higher premium to hold a risky asset, and when own net worth is scarce.

- demand for asset is given by

$$k = \left[\frac{r_k - (1 - \delta)}{\alpha A} \right]^{\frac{1}{\alpha-1}}$$

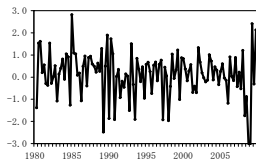
$$\frac{B}{P} = \left[\frac{r_b - 1}{T} \right]^{\frac{1}{\psi}} A k^\alpha$$

a higher capital return implies a smaller capital investment and a higher bond return implies a larger bond investment. 

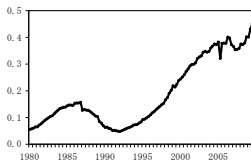
- We calibrate three parameters \underline{r}_k , \underline{r}_b , and γ , at ss so that
 - (i) Er_k at ss equals to 1.4%, historical average from 1980 to 2009 \times average tax rate.
 - (ii) Er_b at ss equals to 0.8%, historical average from 1980 to 2009 \times average tax rate.
 - (iii) b/k at ss equals to 10%, historical average from 1980 to 1990.
- Most of other parameters are estimated using the JPN data from 1980 to 2009.

Observables of Estimation

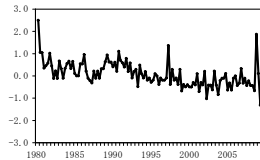
(1) Solow Residual



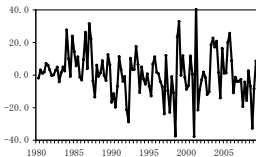
(2) Bond over Capital



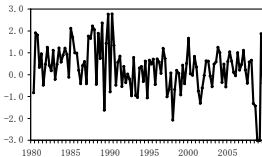
(3) Inflation



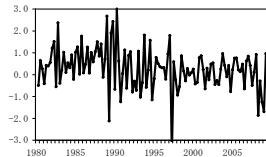
(4) Banks' net worth



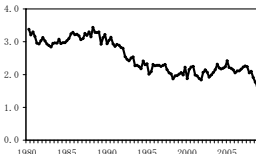
(5) Output



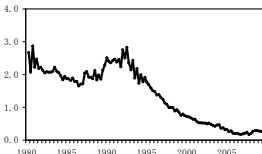
(6) Consumption



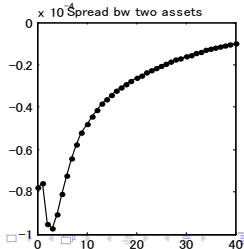
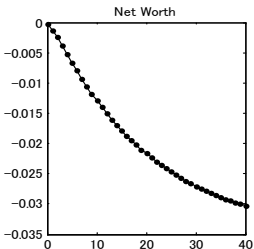
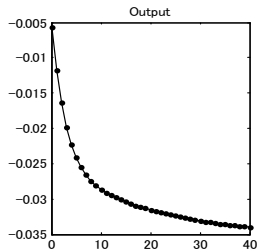
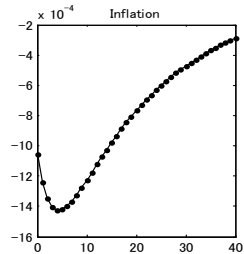
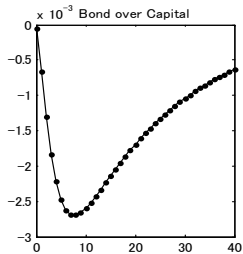
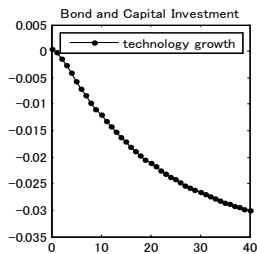
(7) Realized capital return



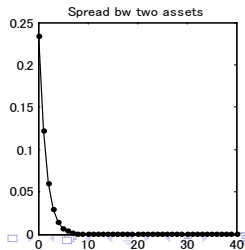
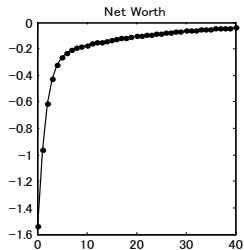
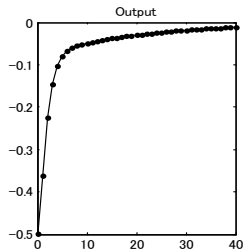
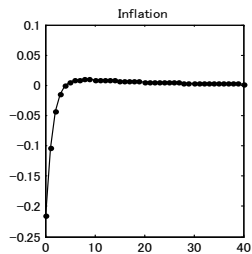
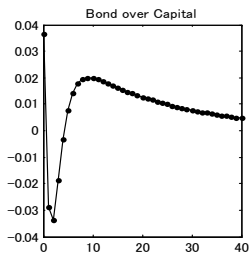
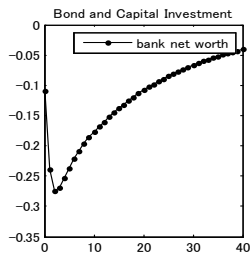
(8) Realized bond return



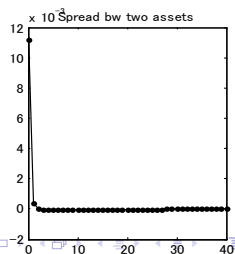
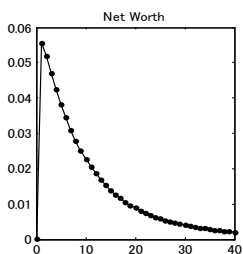
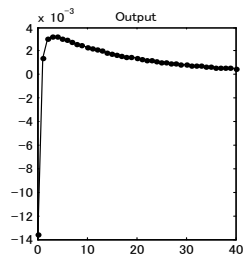
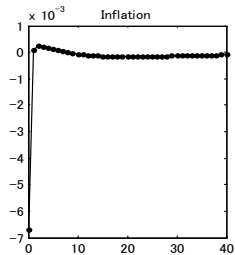
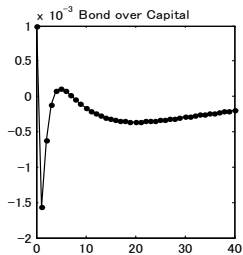
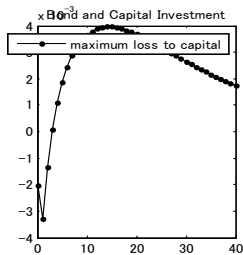
response to tfp growth slow down



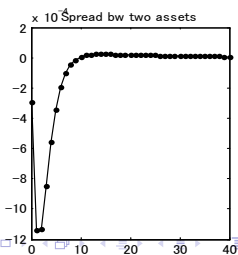
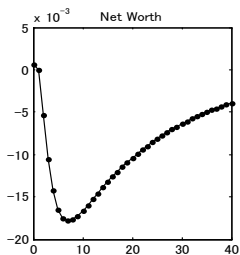
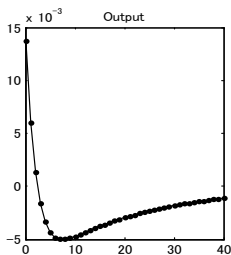
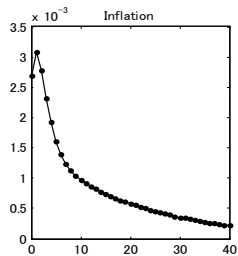
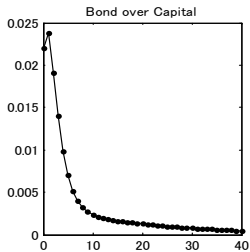
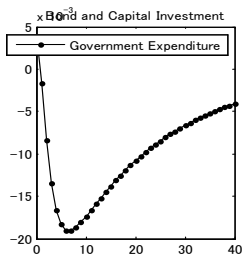
response to net worth disruption



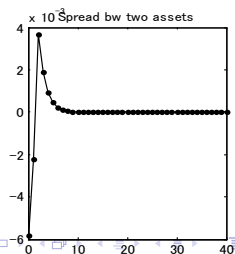
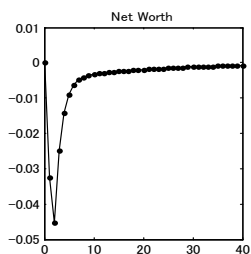
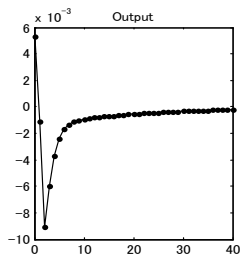
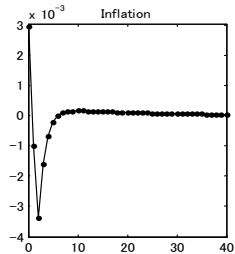
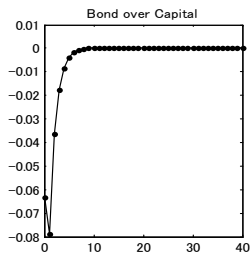
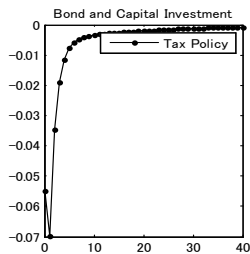
response to increase in capital's maximum loss



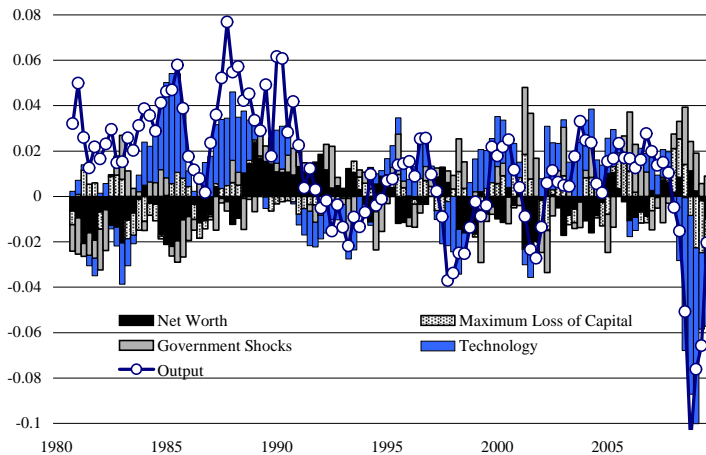
response to increase in gov. expenditure



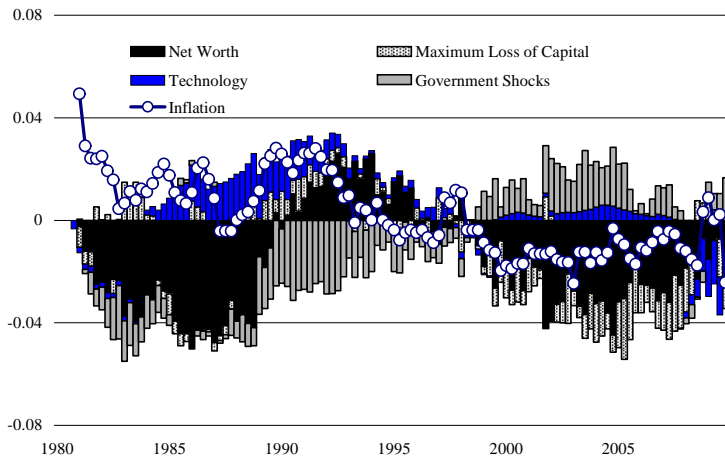
response to change in gov. policy



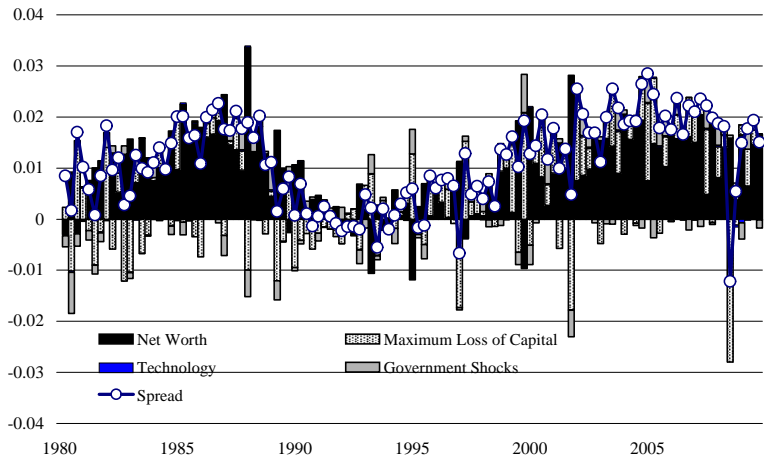
Time path of output



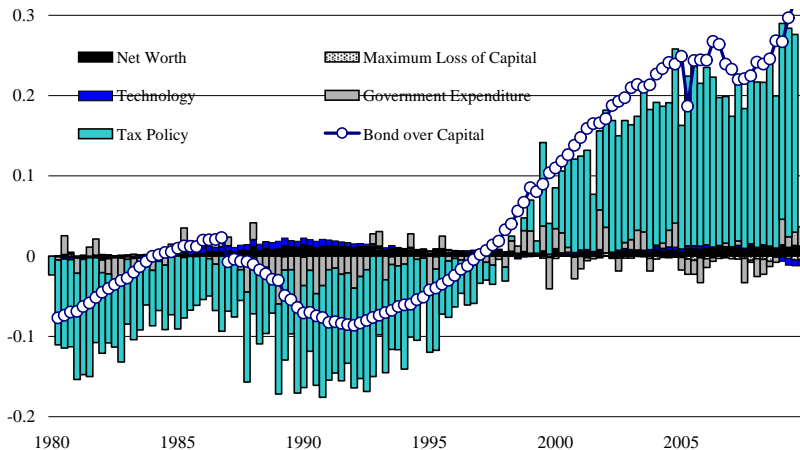
Time path of inflation



Time path of spread (ex-ante)



Time path of gov.bond



Summary

- accumulating bond is accounted for mostly by the government side.
- Bond demand through bank's portfolio choice plays a minor role in the bond accumulation.

- banks' portfolio choice plays quantitatively important role in output and inflation dynamics.
- a deterioration of bank's net worth causes a decline in output and inflation since the latter half of the 1990s.
- a rise in the maximum loss of capital causes a decline in inflation during that time.

- Widening of ex-ante spread between capital investment and government bond is accounted for by endogenous banks' portfolio choice stemming from net worth shocks.

Conclusion and Extension

- We construct a DSGE model that incorporates endogenous portfolio choice of banks.
- Our model explains why bond accumulation and ex-post spread between capital investment and bank coexists.
- Most of bond accumulation is driven by government shocks.
- Portion of variations in inflation, output, and spread are accounted for by banks' asset allocations.

- We aim to extend the model in the following direction.
- Incorporate distortional tax system so that increase in bond supply may affect real economy more.
- Endogenize maximum loss of capital return.