Revisiting the Fiscal Theory of Sovereign Risk from the DSGE View

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1 Introduction

- Uribe (2006, JME) advocates that if the central bank ’s policy is to peg the price level, government gives up its ability to inflate away the real value of nominal public liabilities and default on the public debt is inevitable.
- Or, if it is to peg the nominal interest rate, government obtains its ability to suppress default on the public debt while the price level is no longer stabilized.

- This argument is consistent with our intuition at glance. Through a series of default scare stemming from Greek debt crisis, the stabilizing inflation—suppressing default trade-off (SI-SD Trade-off) precisely found by Uribe (2006) will be emphasized more and more.

Uribe (2006)'s FTSR Having Great Influence

- Uribe (2006)'s FTSR seems having great Influence to the ECB.
- Greece 10-Year Credit Default Swap premium started to soar on Jan., 2008 and reached USD 15,903 on Jul., 2012.
- While HCPI inflation started to increase from -0.6% on July 2009, ECB's policy interest rate was left on 1% until April 2011 when HCPI inflation reached 2.8%.
- The ECB seemed reluctant to stabilize inflation because of sovereign debt problems in Greek and aware of Uribe (2006)'s FTSR.

Our Results

1. There is not necessarily the SI-SD trade-off.
2. The SI-SD trade-off is not so severe as what Uribe (2006) highlight.

Our Policy Implications

1. We can solve practically the SI-SD trade-off by adopting optimal monetary and fiscal policy
2. The minimizing interest rate spread (MIS) policy is not necessarily inferior policy from the viewpoint of dissolving the trade-off between stabilizing inflation and suppressing default if price stickiness is sufficiently high.

What We Do and Why Different from Uribe (2006)?

- While we basically adopt Uribe (2006)'s default rule, we turn our attention to fiscal balance which is an exogenous shock in Uribe (2006).
- This exogenous setting generates Uribe (2006)'s policy implication that there is a trade-off between stabilizing inflation and suppressing default.
- Different from Uribe (2006), we endogenize fiscal balance through introducing firms in the model following the DSGE.
- This endogenized setting generates our policy implication that there is not necessarily the SI—SD trade-off.

Reviewing Uribe's Fiscal Theory of Sovereign Risk

- Uribe (2006) shows that the default rate depends on the ratio of the net present value of the real fiscal surplus to real government debt with interest payment.

$$\delta_t = 1 - \frac{Fsical\ Surplus\ (Exogenous)}{Burden\ of\ \text{Re}dee\text{ming}\ government\ debt} \times Inflation$$

- That is, the default rate depends on the ratio of government solvency to the burden of government debt redemption.
- A decrease in the fiscal surplus which is exogenous in his setting, government solvency decreases.

$$\delta_t = 1 - \frac{Fsical\ Surplus\ (Exogenous)}{Burden\ of\ Redeeming\ government\ debt} \times Inflation$$

- Suppose that there is a shock to decrease fiscal surplus.
- If the central bank stabilizes inflation, the burden of government debt redemption cannot be mitigated, the default rate increases.
- If the central bank give up to stabilize inflation, the burden of government debt redemption can be mitigated by inflation which decreases real government debt and the default is mitigated.

How Endogenized Production Derives Quite Different Results

- The most important thing is that the fiscal surplus not only deeply involves the default rate but also deeply involves the inflation through the output gap.
- That is, stabilizing fiscal surplus not only stabilizes the default rate but also stabilizes both the inflation and the output gap.
- Note that the optimal monetary (OM) policy and the optimal monetary and fiscal (OMF) policy are de facto inflation stabilization policy.

- Suppose that an increase in government expenditure under the OMF policy where the nominal interest rate and the tax rate are policy instrument.
- An increase in government expenditure is about to increase the inflation because it increases the marginal cost.

$$\delta_t = 1 - \frac{Fsical\ Surplus\ (Endogenous)}{Burden\ of\ \text{Re}dee\text{ming}\ government\ debt} \times Inflation$$

$$SP_t = \tau_t Y_t - G_t$$

$$\tau_t \rightarrow C_t \rightarrow GDP\ Gap \rightarrow Inflation$$

- To stabilize inflation, the tax rate is hiked.
- An increase in the tax rate mitigates pressure to decrease the fiscal surplus and it is stabilized.
- Stabilizing the fiscal surplus stabilizes the default rate.

$$\delta_t = 1 - \frac{Fsical\ Surplus\ (Endogenous)}{Burden\ of\ \text{Redeeming}\ government\ debt} \times Inflation$$

$$SP_t = \tau_t Y_t - G_t$$

$$\tau_t \rightarrow C_t \rightarrow GDP\ Gap \rightarrow Inflation$$

- Increased taxation applies to decrease output gap and cancel pressure to increase output gap stemming from an increase in government expenditure.
- Totally, inflation is stabilized.

$$\delta_t = 1 - \frac{Fsical\ Surplus\ (Endogenous)}{Burden\ of\ \text{Redeeming}\ government\ debt} \times Inflation$$

$$SP_t = \tau_t Y_t - G_t$$

$$\tau_t \rightarrow C_t \rightarrow GDP\ Gap \rightarrow Inflation$$

The OM and the MIS Policy

- We analyze the OMF, the OM and the MIS policies.
- Under the OM policy, inflation is more fluctuate than under the OMF policy because just the nominal interest rate is available to stabilize inflation under the OM policy. Under the OM policy, there is the SI-SD trade-off.
- Under the MIS policy, similar to Uribe (2006), the interest rate spread is zero. While the expected default rate is stabilized, the inflation is not stabilized. There is the SI-SD trade-off although it is not so severe.

The Remainder of the Paper

- Section 2 develops the model.
- Section 3 solves the LQ problem, shows the FONCs for the policy authorities, and the optimal monetary policy and the optimal monetary and fiscal policy.
- Section 4 calibrates the model under both policies.
- Section 5 concludes the paper.

2 The Model

- While We do not assume foreign economy, we follow Okano (2014, JEDC) and introduce firms into Uribe (2006)'s model and develop a class of DSGE models with nominal rigidities.
- Thus, the default mechanism is quite similar to Uribe (2006).
- We follow Benigno (2001) to clarify the households' choice of risky assets.
- The households on the interval [0, 1] and own firms.
- We adopt Calvo pricing.
- Tax is levied on output and is distorted. That is, monopolistical power is not eliminated.

2.1 Households

- Household's preferences

$$U \equiv \mathrm{E}_0\left(\sum_{t=0}^{\infty} \beta^t U_t\right) \tag{1}$$

with $U_t \equiv \ln C_t - \frac{1}{1+\varphi} N_t^{1+\varphi}$.

- Households' Budget Constraint

$$R_{t-1}\left[D_{t-1}^{n}+B_{t-1}^{n}\Gamma\left(-sp_{t-1}\right)\left(1-\delta_{t}\right)\right]+W_{t}N_{t}+PR_{t}\geq P_{t}C_{t}+D_{t}^{n}+B_{t}^{n} \quad (5)$$

with $sp_{t}\equiv SP_{t}/SP-1$ and $SP_{t}\equiv\tau_{t}Y_{t}-G_{t}$.

- Hinted by Benigno (2001), we introduce interest rate multiplier $\Gamma\left(-sp_{t}\right)$ being a function of percentage deviation of fiscal surplus from its steady state.
- The higher the fiscal surplus, the lower the multiplier and vice versa.

- Households' Optimality Conditions

$$\beta \mathrm{E}_t \left(\frac{P_t C_t}{P_{t+1} C_{t+1}} \right) = \frac{1}{R_t} \tag{6}$$

$$C_t N_t^{\varphi} = W_t / P_t \tag{7}$$

- Because of government debt, there is following another intertemporal optimality condition:

$$\beta \mathrm{E}_t \left(\frac{P_t C_t}{P_{t+1} C_{t+1}} \right) = \frac{1}{R_t^H \mathrm{E}_t \left(1 - \delta_{t+1} \right)} \tag{8}$$

with:

$$R_t^H \equiv R_t \left[\Gamma\left(-sp_t\right) + \frac{B_t \Gamma'\left(-sp_t\right)}{B\left(R-1\right)} \right]$$

which is the government bond's yield.

- By log-linearizing this yields:

$$b_t = \frac{\omega_\gamma}{\beta} sp_t + \frac{1-\beta}{\beta\Phi} \mathrm{E}_t\left(\delta_{t+1}\right)$$

which is the government debt demand schedule with $\Phi \equiv \Gamma'(0)$.

2.2 Government

- Government Budget Constraint

$$B_t = R_{t-1}\Gamma\left(-sp_{t-1}\right)\left(1-\delta_t\right)B_{t-1}\Pi_t^{-1} - SP_t \qquad (14)$$

- Appropriate Transversality Condition

$$\lim_{j\to\infty}\beta^{t+j+1}\mathrm{E}_t\left[R_{t+j}^G\left(1-\delta_{t+j+1}\right)\frac{P_{t+j}B_{t+j}}{P_{t+j+1}}\right]=0$$

- Iterating forward Eq.(14) with the TVC and Euler equation (8), we have our FTSR as follows:

$$\delta_t = 1-\frac{\dfrac{R_{t-1}^G}{R_{t-1}^H}\displaystyle\sum_{k=0}^{\infty}\prod_{h=0}^{k}\beta^k\mathrm{E}_t\left(\frac{R_{t+h-1}^G}{R_{t+h-1}^H}C_{t+k}^{-1}SP_{t+k}\right)}{C_t^{-1}R_{t-1}^G B_{t-1}\Pi_t^{-1}} \qquad (16)$$

2.3 Firms

- There is not notable feature on production in our model.
- Production

$$Y_t(i) = A_t N_t(i)$$

- FONC for Firms under Calvo Pricing

$$\tilde{P}_t = \frac{\sum_{k=0}^{\infty} \vartheta^k \beta^k \mathrm{E}_t \left(\tilde{Y}_{t+k} \frac{\varepsilon}{\varepsilon - 1} P_{t+k} MC_{t+k} \right)}{\sum_{k=0}^{\infty} \vartheta^k \beta^k \mathrm{E}_t \left(\tilde{Y}_{t+k} \right)}$$

3 Policy Target

- The central seeks to minimize the minimizing the interest rate spread :

$$\mathcal{L}^R \equiv \sum_{t=0}^{\infty} \beta^t \mathrm{E}_0 \left(L_t^R \right) \tag{33}$$

with:

$$L_t^R \equiv \frac{1}{2} \left(\hat{r}_t^S \right)^2$$

under the MIS policy.

- **The central bank** seeks to minimize the welfare costs :

$$\mathcal{L} \equiv \sum_{t=0}^{\infty} \beta^t \mathrm{E}_0 \left(L_t \right) \tag{33}$$

with:

$$L_t \equiv \left(\Lambda_x / 2 \right) x_t^2 + \left(\Lambda_\pi / 2 \right) \pi_t^2 \tag{33}$$

under the **OM policy**.

- **The central and the government** seek to minimize the welfare costs under the **OMF policy**.

5 Numerical Analysis

- We run a series of dynamic simulations and adopt the following benchmark parameterization.
- Calibrated parameters mainly follows Ferrero (2009) analyzing optimal monetary and fiscal policy while unfamiliar parameters, the interest rate spread for risky assets φ and the elasticity of the interest rate spread to a one percent change in the fiscal surplus γ based on empirical evidence.

- Following Ferrero (2009), we set:

1. The Subjective Discount factor β: 0.99
2. The Elasticity of Substitution across Goods ε: 11
3. Price Stickiness ϑ: 0.75
4. The Inverse of the Labor Supply Elasticity φ: 0.47
5. The Steady State Share of Government Debt to Output ς_B: 2.4
6. The Steady State Share of Government Expenditure to Output ς_G: 0.276
7. The steady State Tax Rate τ: 0.3

- Based on our empirical analysis, we set:

8. The Interest Rate Spread Φ: 0.138
9. The Elasticity of the Interest rate Spread to the Fiscal Deficit γ: 1.145
10. AR (1) Coefficient of the Productivity ρ_A: 0.976
11. AR (1) Coefficient of the Government Expenditure ρ_G: 0.927
12. Standard Deviation of the Productivity: 0.0316
13. Standard Deviation of the Government Expenditure: 0.0728

5.2 Macroeconomic Dynamics

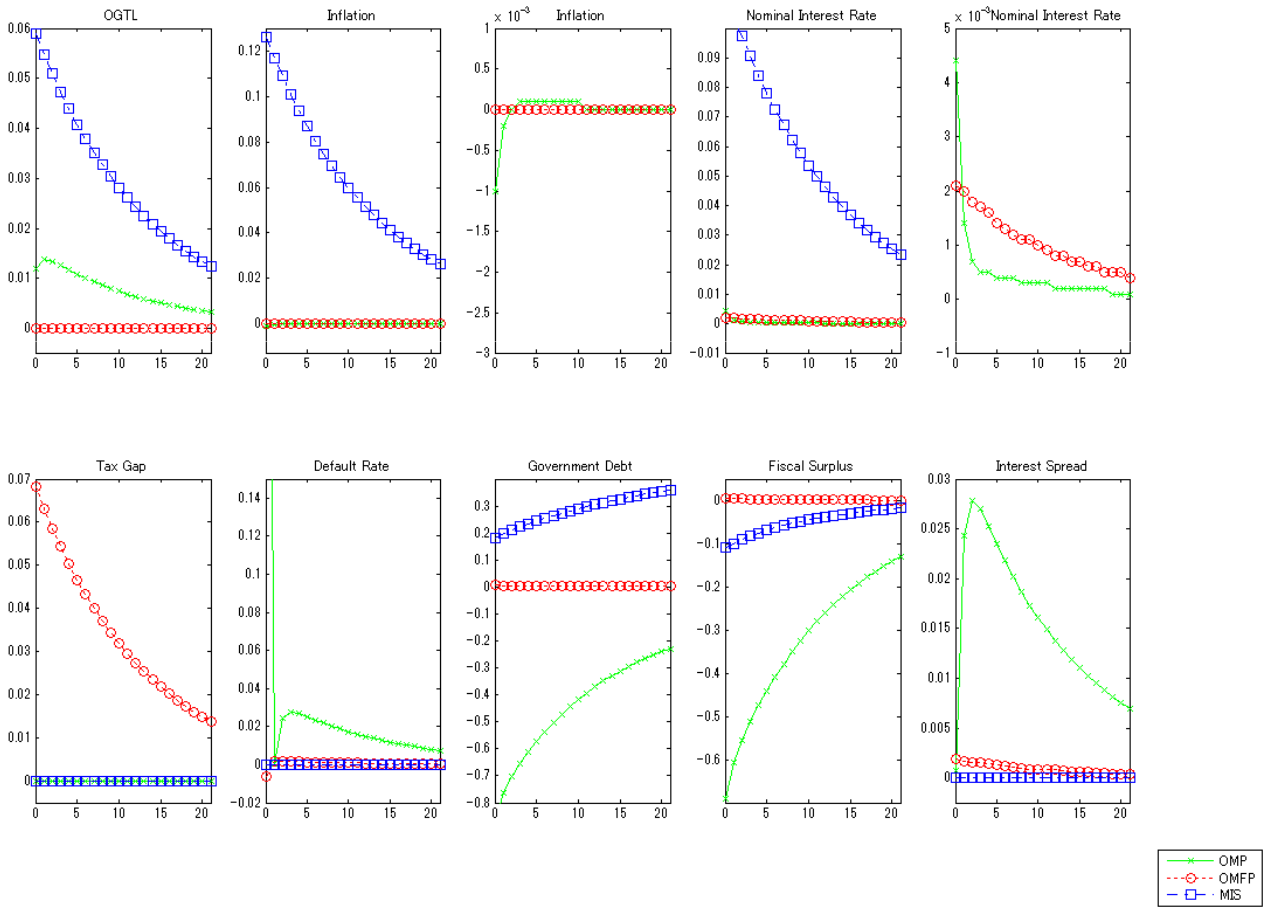
Table 1: Macroeconomic Volatility

Variable	OM	OMF	MIS
x_t	0.0526	0.0000	0.2347
π_t	0.0012	0.0000	1.0977
$\hat{r}_t$	2.7636	0.0085	1.0707
$\hat{\tau}_t$	NA	0.2336	NA
δ_t	1.0554	0.1884	0.0000
sp_t	2.6391	0.6411	0.4677
$\hat{r}_t^S$	0.2271	0.0761	0.0000

- There is SI-SD trade-off clearly under the OM and the MIS policies.
- However, both the inflation and the default rate are well stabilized under the OMF policy.
- There is not necessarily SI-SD trade-off.

5.2.2 Impulse Response Functions

Figure 2: IRFs to Government Expenditure

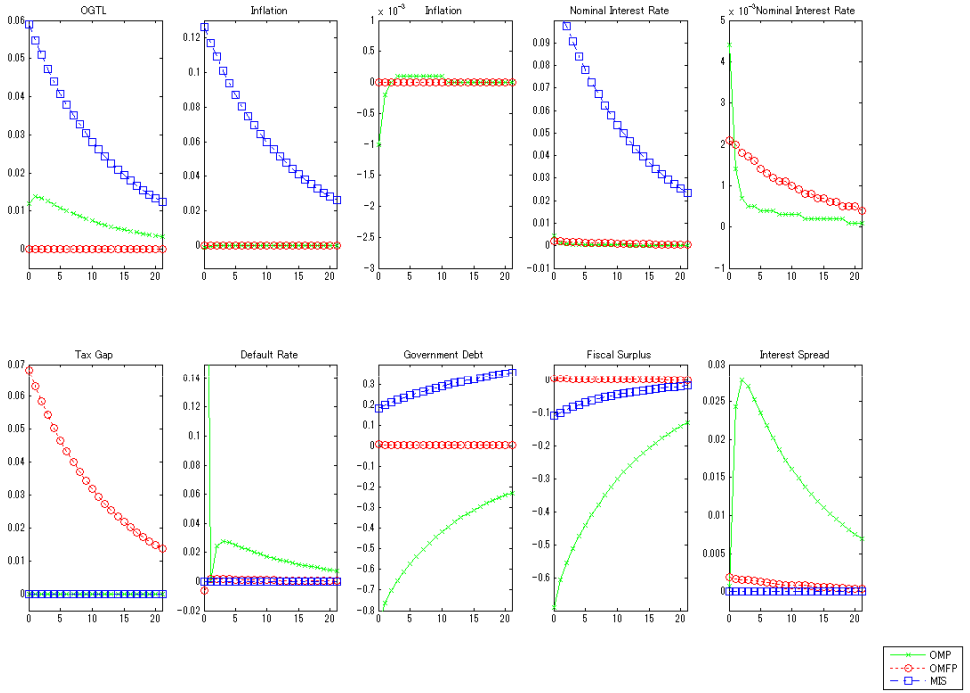


- Under the OMF, while the default rate is not completely

stabilized, it is more stable than one under the OM policy.

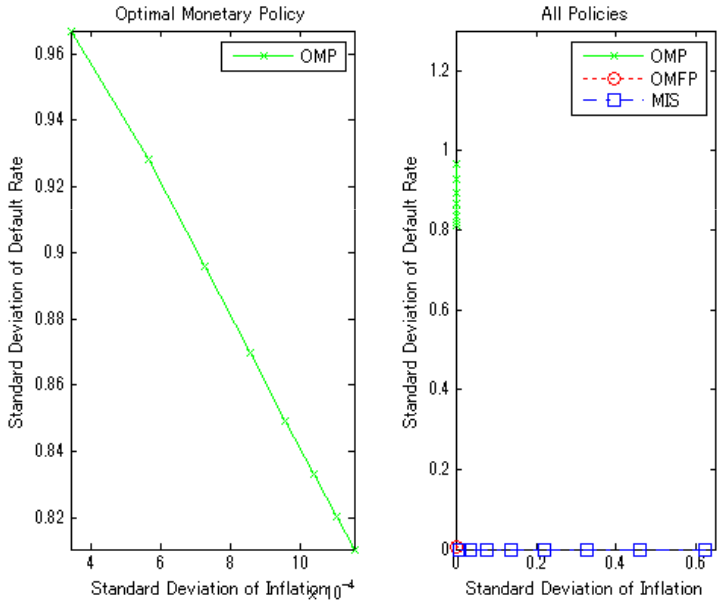
- The inflation is completely stabilized under the OMF.
- Thus, there is not necessarily the SI-SD trade-off.

Figure 2: IRFs to Government Expenditure



6 The Trade-off between Stabilizing Inflation and Suppressing default Rate

Fig. 3: The Trade-off between Stabilizing Inflation and Default Rate Volatilities



- Is the SI-SD trade-off is so severe as highlighted by Uribe (2006)?
- Under the OM policy, there is the SI-SD trade-off clearly.
- Volatility on the inflation is depends on the price stickiness under the MIS policy.
- Under the OMF policy, the volatility on inflation is definitely zero and the volatility on the default rate is quite small.

6 Conclusion

- We develop a class of DSGE model with nominal rigidities and find that stabilizing inflation is not inconsistent with suppressing default.
- There is not a necessarily the SI-SD.
- We have a policy implication that by stabilizing inflation, default risk shall be stabilized and this policy implication is quite different from Uribe (2006)'s.
- While the ECB seems to reluctant to stabilize inflation because of smoldering sovereign risk, our results imply that the policy authorities should focus stabilizing inflation through fiscal policy, if the price stickiness not extremely high.