Revisiting the Fiscal Theory of Sovereign Risk from a DSGE Viewpoint

OKANO, Eiji and Kazuyuki Inagaki

Nagoya City University

Dec. 27, 2016 at CIGS

1 Introduction

- Uribe (2006, JME) argues that if the central bank's policy is to peg the price level, government surrenders its ability to inflate away the real value of nominal public liabilities, and so public debt default is inevitable.
- Alternatively, if the central bank's policy is to peg the nominal interest rate, government preserves its ability to suppress public debt default, but it no longer stabilizes the price level.

- The stabilizing of inflation and the suppressing of the default trade-off (SI—SD trade-off) observed by Uribe (2006) appears to be increasingly emphasized, especially in the Euro area.
- However, after revisiting Uribe's (2006) fiscal theory of sovereign risk (FTSR) from the viewpoint of a DSGE model with nominal rigidities, we find that there is not necessarily an SI—SD trade-off, and even if there is, it is not as severe as that suggested by Uribe (2006).

Our Results

1. There is not necessarily a trade-off between stabilizing inflation and suppressing default.
2. The trade-off between stabilizing inflation and suppressing default is not as severe as Uribe (2006) suggests.

Our Policy Implications

1. We can practically solve the SI—SD trade-off and suppressing default by adopting optimal monetary and fiscal (OMF) policy.
2. The interest rate spread-minimizing (MIS) policy does not represent an 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)?

- We adopt Uribe's (2006) default rule.
- We refocus our attention on the fiscal balance, which is an exogenous shock in Uribe (2006), and note that this exogenous setting generates Uribe's (2006) result that there is SI—SD trade-off.
- 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.

$$Default\ Rate = 1 - \frac{Fsical\ Surplus\ (Exogenous)}{Burden\ of\ Redemption} \times Inflation$$

- That is, the default rate depends on government solvency.
- A decrease in the fiscal surplus, which is exogenous in his setting, decreases government solvency.

$$Default\ Rate = 1 - \frac{Fsical\ Surplus\ (Exogenous)}{Burden\ of\ Redemption} \times Inflation$$

- If the central bank stabilizes inflation, the burden of government debt redemption cannot be mitigated, and the default rate increases.
- If the central bank gives 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

- Here, the most important thing is that the fiscal surplus is endogenous.
- That is, stabilizing the fiscal surplus stabilizes not only the default rate but also both inflation and the output gap.
- Note that optimal monetary (OM) policy and the OMF policy are de facto inflation stabilization policies because inflation volatility determines welfare costs stemming from household utility.

- Suppose that an increase in government expenditure, which is exogenous, and the policy authorities, the government and the central bank, adopt the OMF policy, where the nominal interest and tax rates are policy instruments.
- An increase in government expenditure is about to increase the inflation because it increases the marginal cost.

$$Default\ Rate = 1 - \frac{Fsical\ Surplus\ (Endogenous)}{Burden\ of\ Redemption} \times Inflation$$

$$SP_t = \tau_t Y_t - G_t$$

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

- The government hikes the tax rate to decrease the GDP gap by lowering consumption.
- As a result, the inflation—output gap trade-off is completely dissolved

$$Default\ Rate = 1 - \frac{Fsical\ Surplus\ (Endogenous)}{Burden\ of\ Redemption} \times Inflation$$

$$SP_t = \tau_t Y_t - G_t$$

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

- Although an increase in government expenditure applies pressure to worsening the fiscal deficit, the increased taxation cancels out any such pressure, so the fiscal deficit improves.
- Because the fiscal deficit is almost zero as a result and the fiscal balance is more stabilized, the default rate is roughly zero.

$$Default\ Rate = 1 - \frac{Fsical\ Surplus\ (Endogenous)}{Burden\ of\ Redemption} \times Inflation$$

$$SP_t = \tau_t Y_t - G_t$$

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

The Remainder of the Paper

- Section 2 develops the model.
- Section 3 defines the policy target under the three policies mentioned.
- Section 4 solves the LQ problem, shows the FONCs for the policy authorities.
- Section 5 calibrates the model under the three policies.
- Section 6 clarifies the SI—SD trade-off under the three policies.
- Section 7 concludes the paper.

2 The Model

- We introduce firms into Uribe's (2006) model and develop a class of DSGE models with nominal rigidities following Gali and Monacelli (2005), although we do assume a closed economy.
- 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 and assume that a tax is levied on output and is distorted.
- Thus, monopolistic power remains, and the steady state is distorted, unlike Gali and Monacelli (2005).

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 and $\Gamma'(\bullet)>0$.
- 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:

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

2.2 Government

- Government Budget Constraint

$$B_t = R_{t-1}\Gamma\left(-sp_{t-1}\right)\left(1-\delta_t\right)B_{t-1}\Pi_t^{-1} - SP_t \qquad (12)$$

- 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.(12) with the TVC and Euler equation (8), we have our FTSR as follows:

$$\delta_t = 1-\frac{\dfrac{R_{t-1}^G}{R_{t-1}^H}\displaystyle\sum_{k=0}^{\infty}\prod_{h=0}^{k}\beta^k\mathrm{E}_t\left(\frac{R_{t+h-1}^G}{R_{t+h-1}^H}C_{t+k}^{-1}SP_{t+k}\right)}{C_t^{-1}R_{t-1}^G B_{t-1}\Pi_t^{-1}} \qquad (15)$$

3 Policy Target

- Under the MIS policy, the policy authorities minimize the interest rate spread between the nominal interest rate and the government debt yield.
- That is, they minimize the following:

$$L^R \equiv \sum_{t=0}^{\infty} \beta^t \mathrm{E}_0 \left(L_t^R \right) \tag{29}$$

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

- Under the OM and the OMF policies, the policy authorities minimize the welfare cost function:

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

$$\text{with: } L_t \equiv \frac{\Lambda_x}{2} x_t^2 + \frac{\Lambda_\pi}{2} \pi_t^2 \qquad (31)$$

- We derive the period welfare cost function not only Gali (2008) but also Benigno and Woodford (2003) and Benigno and Woodford (2005).

5 Numerical Analysis

- We run a series of dynamic simulations and adopt the following benchmark parameterization.
- Calibrated parameters mainly follow Ferrero (2009) who analyzes optimal monetary and fiscal policy, except for the unfamiliar parameters, which are estimated, including:

1. The interest rate spread for risky assets φ
2. The elasticity of the interest rate spread to a one percent change in the fiscal deficit γ
3. The price stickiness ϑ.

- 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: 0.705
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.

Table 2 (Abstract): Correlation between Selected Variables

	Policy	π_t	$\hat{\tau}_t$	δ_t	sp_t
π_t	OM	1.00			
	OMF	1.00			
$\hat{\tau}_t$	OM	NA	1.00		
	OMF	NA	1.00		
δ_t	OM	-0.88	NA	1.00	
	OMF	NA	-0.56	1.00	
sp_t	OM	0.26	NA	-0.48	1.00
	OMF	NA	0.72	-0.45	1.00

- The correlation between inflation and default is -0.8770 under the OM policy.
- This implies that there is an SI—SD trade-off.
- This result is consistent with Uribe (2006).
- That is, the lower inflation, the higher the default, and vice versa.

Table 2 (Abstract): Correlation between Selected Variables

	Policy	π_t	$\hat{\tau}_t$	δ_t	sp_t
π_t	OM	1.00			
	OMF	1.00			
$\hat{\tau}_t$	OM	NA	1.00		
	OMF	NA	1.00		
δ_t	OM	-0.88	NA	1.00	
	OMF	NA	-0.56	1.00	
sp_t	OM	0.26	NA	-0.48	1.00
	OMF	NA	0.72	-0.45	1.00

- How does the OMF policy dissolve or mitigate the SI—SD trade-off?
- The correlation between the default rate and the fiscal surplus under the OMF policy is -0.4537, and the sign is negative.

Table 2 (Abstract): Correlation between Selected Variables

	Policy	π_t	$\hat{\tau}_t$	δ_t	sp_t
π_t	OM	1.00			
	OMF	1.00			
$\hat{\tau}_t$	OM	NA	1.00		
	OMF	NA	1.00		
δ_t	OM	-0.88	NA	1.00	
	OMF	NA	-0.56	1.00	
sp_t	OM	0.26	NA	-0.48	1.00
	OMF	NA	0.72	-0.45	1.00

- That is, the higher the fiscal surplus, the lower the default rate, and vice versa.
- In addition, the correlation between the fiscal surplus and the tax gap under the OMF policy is 0.7191, and the sign is positive.

Table 2 (Abstract): Correlation between Selected Variables

	Policy	π_t	$\hat{\tau}_t$	δ_t	sp_t
π_t	OM	1.00			
	OMF	1.00			
$\hat{\tau}_t$	OM	NA	1.00		
	OMF	NA	1.00		
δ_t	OM	-0.88	NA	1.00	
	OMF	NA	-0.56	1.00	
sp_t	OM	0.26	NA	-0.48	1.00
	OMF	NA	0.72	-0.45	1.00

- This implies that the tax gap increases facing shocks that increase inflation and that an increase in the tax gap contributes to an increase in the fiscal surplus.

Table 2 (Abstract): Correlation between Selected Variables

	Policy	π_t	$\hat{\tau}_t$	δ_t	sp_t
π_t	OM	1.00			
	OMF	1.00			
$\hat{\tau}_t$	OM	NA	1.00		
	OMF	NA	1.00		
δ_t	OM	-0.88	NA	1.00	
	OMF	NA	-0.56	1.00	
sp_t	OM	0.26	NA	-0.48	1.00
	OMF	NA	0.72	-0.45	1.00

- As shown in the NKIS and NKPC, an increase in the fiscal surplus decreases inflation through a decrease in the OGTL, and vice versa.

Table 2 (Abstract): Correlation between Selected Variables

	Policy	π_t	$\hat{\tau}_t$	δ_t	sp_t
π_t	OM	1.00			
	OMF	1.00			
$\hat{\tau}_t$	OM	NA	1.00		
	OMF	NA	1.00		
δ_t	OM	-0.88	NA	1.00	
	OMF	NA	-0.56	1.00	
sp_t	OM	0.26	NA	-0.48	1.00
	OMF	NA	0.72	-0.45	1.00

- Thus, inflation is stabilized through an increase in the tax gap.
- In addition, an increase in the tax gap contributes to decreasing the default rate through an increase in the fiscal surplus.

Table 2 (Abstract): Correlation between Selected Variables

	Policy	π_t	$\hat{\tau}_t$	δ_t	sp_t
π_t	OM	1.00			
	OMF	1.00			
$\hat{\tau}_t$	OM	NA	1.00		
	OMF	NA	1.00		
δ_t	OM	-0.88	NA	1.00	
	OMF	NA	-0.56	1.00	
sp_t	OM	0.26	NA	-0.48	1.00
	OMF	NA	0.72	-0.45	1.00

- Thus, the default rate is stabilized through an increase in the tax gap.
- An increase in the tax gap then stabilizes both inflation and the default rate when facing pressure to inflation.

Table 2 (Abstract): Correlation between Selected Variables

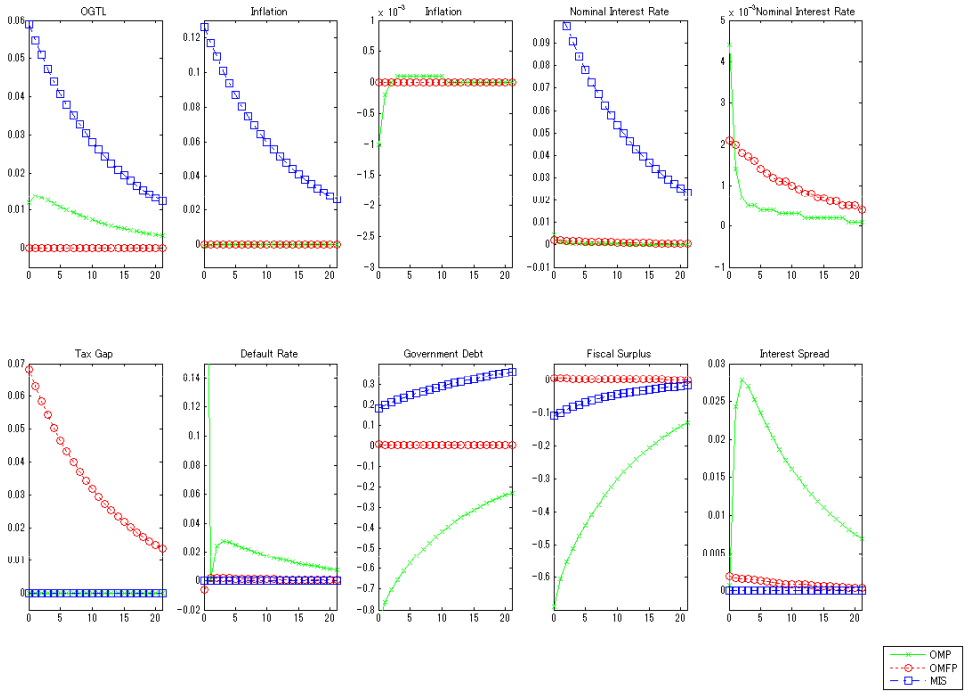
	Policy	π_t	$\hat{\tau}_t$	δ_t	sp_t
π_t	OM	1.00			
	OMF	1.00			
$\hat{\tau}_t$	OM	NA	1.00		
	OMF	NA	1.00		
δ_t	OM	-0.88	NA	1.00	
	OMF	NA	-0.56	1.00	
sp_t	OM	0.26	NA	-0.48	1.00
	OMF	NA	0.72	-0.45	1.00

- Stabilizing inflation is then consistent with suppressing default.
- There is not necessarily representative of the SI—SD trade-off.

5.2.2 Impulse Response Functions

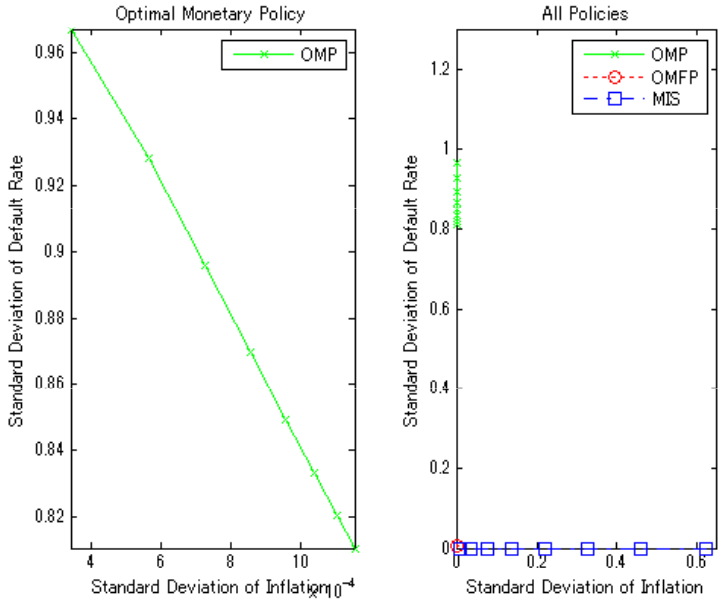
- While the default rate is not completely stabilized, it is more stable than one under the OM policy, under the OMF.
- The inflation is completely stabilized under the OMF.
- Thus, there is not necessarily the SI-SD trade-off.

Figure 2: IRFs to Government Expenditure



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

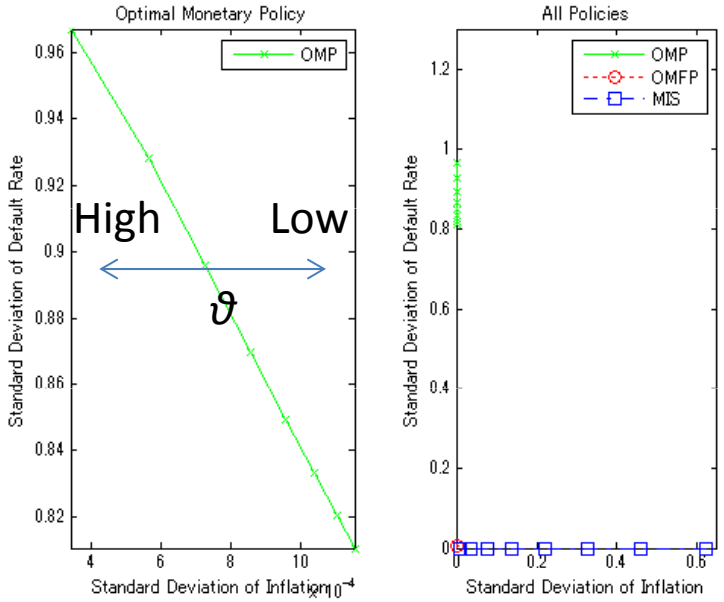
Fig. 3: The Trade-off between Stabilizing Inflation and Default Rate Volatilities



- Is the SI—SD trade-off as severe as that highlighted by Uribe (2006)?
- To respond, we calculate both volatilities on inflation and the default rate under various levels of price stickiness ϑ from 0.6 to 0.95 every 0.05.

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

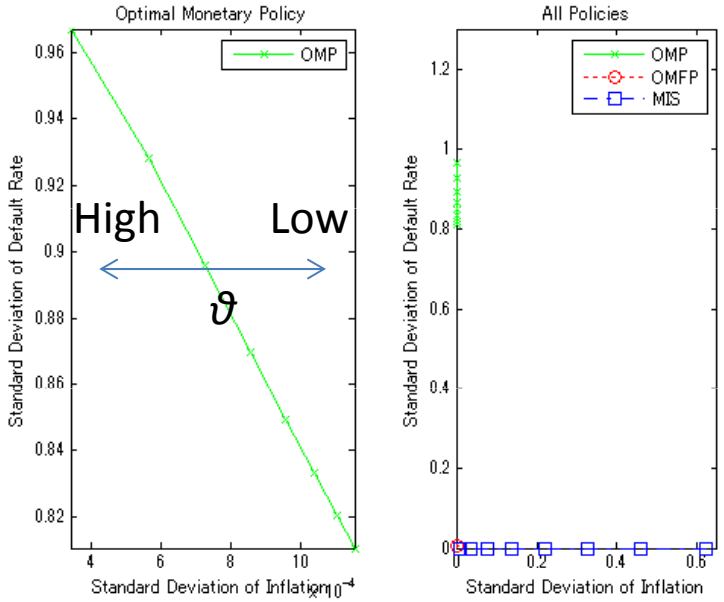
Fig. 3: The Trade-off between Stabilizing Inflation and Default Rate Volatilities



- Under the OM policy, there is the SI-SD trade-off clearly.
- The higher the price stickiness, the higher the volatility on the default rate and the lower the volatility on inflation, and vice versa.

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

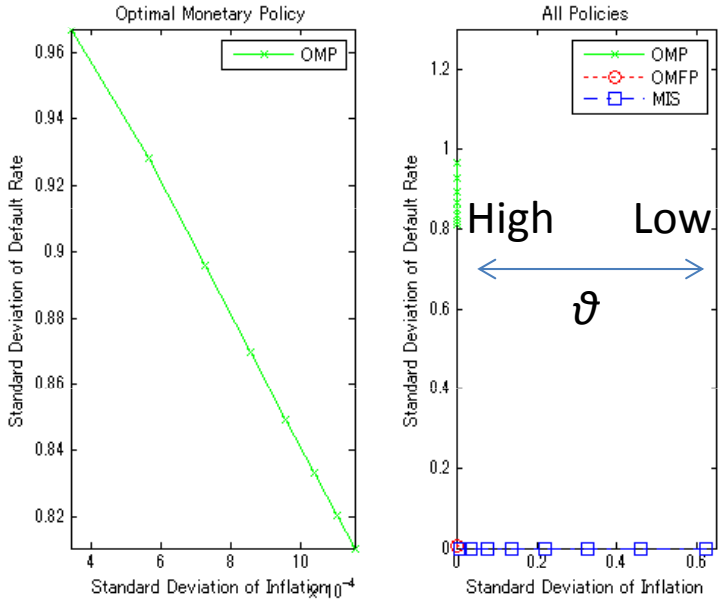
Fig. 3: The Trade-off between Stabilizing Inflation and Default Rate Volatilities



- The higher the price stickiness, the higher the weight on inflation in the period welfare costs Λ_π.
- Thus, the higher the price stickiness, the lower the volatility on inflation.

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

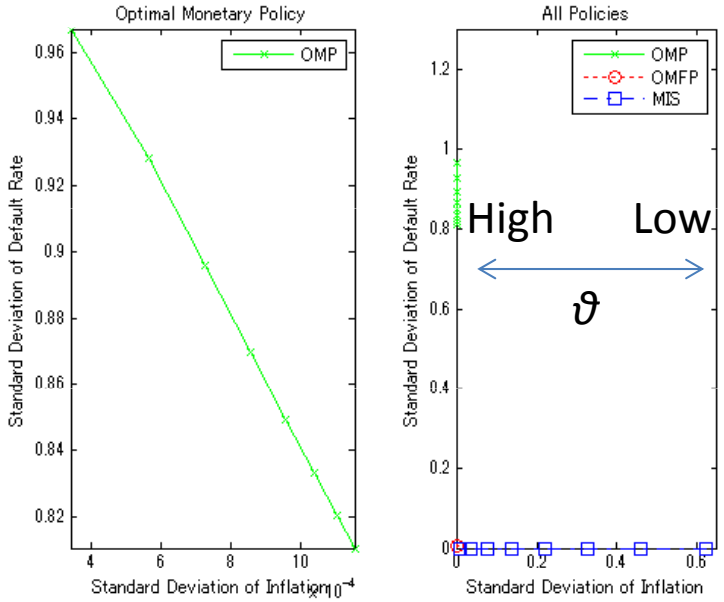
Fig. 3: The Trade-off between Stabilizing Inflation and Default Rate Volatilities



- The volatility on inflation depends on price stickiness under the MIS policy, similar to the OM policy.
- However, unlike the OM policy, the default volatility does not depend on the price stickiness and is definitely zero.

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

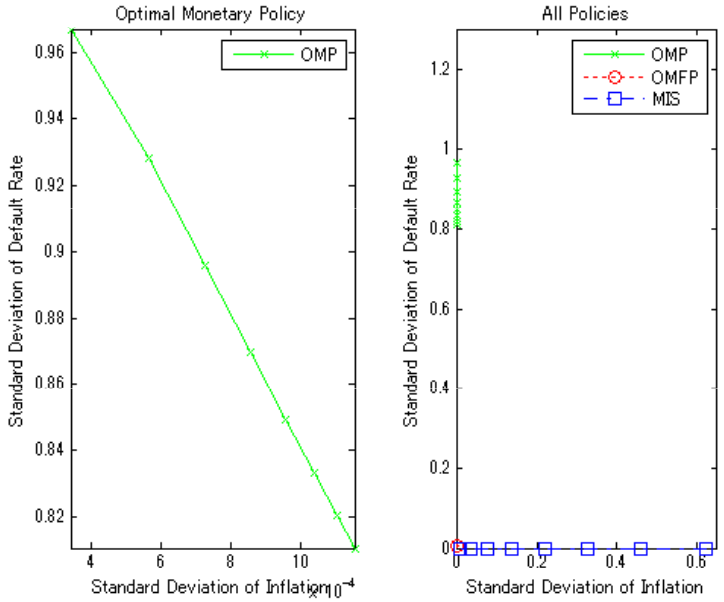
Fig. 3: The Trade-off between Stabilizing Inflation and Default Rate Volatilities



- In addition, the standard deviation on inflation is just 0.0084 when the price stickiness is 0.95.
- Policy authorities may then choose the MIS policy rather than the OM policy because the default rate volatility is quite high under the OM policy.

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

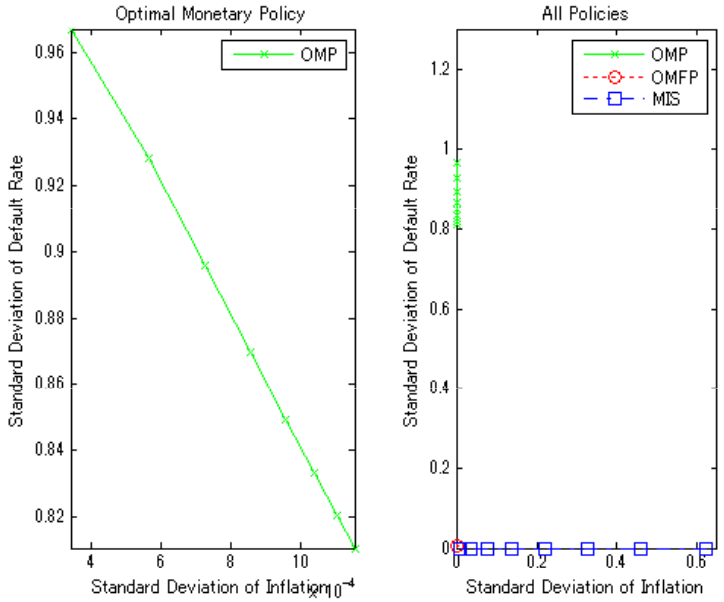
Fig. 3: The Trade-off between Stabilizing Inflation and Default Rate Volatilities



- What about the SI—SD trade-off under the OMF policy?
- The inflation volatility is definitely zero, and on the default rate, it is 0.0076, which is constant.
- Thus, it can be said that there is not necessarily an SI—SD trade-off.

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

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



- Or if there is an SI—SD trade-off, the SI—SD trade-off is not as severe as that suggested by Uribe (2006).
- If price stickiness is sufficiently high, and the MIS policy is adopted instead of the OMF policy, both inflation and default are well stabilized.

6 Conclusion

- We develop a class of DSGE models with nominal rigidities and find that:

1. there is not necessarily an SI—SD trade-off.
2. the trade-off is not as severe as what Uribe (2006) described.

- As policy implications, we argue:

1. we can practically solve the SI—SD trade-off by adopting the OMF policy.
2. the MIS policy is not an inferior policy from the viewpoint of dissolving the SI—SD trade-off if the price stickiness is sufficiently high.