

# The Effects of A Money-financed Fiscal Stimulus in A Small Open Economy

OKANO, Eiji (Nagoya City University)

and

Masataka Eguchi (Komazawa University)

November 19, 2022

# 1 Introduction

- Gali(2020) proposes a theoretical framework of money-financed (*MF*) fiscal stimulus and demonstrates its effectiveness in stabilizing both output and inflation, even in an economy becoming stuck in a liquidity trap.
- We extend a closed economy model in Gali (2020) to a small open economy model where in addition to interest rates, the monetary-fiscal policy interaction also affects exchange rate.

- Although we simply modify the closed economy model in Gali (2020) to a small open economy model with relevant assumptions, our findings are non-negligible.
- Our main finding is that *MF* fiscal stimulus is more effective than it in a closed economy, regardless of whether the means is a tax cut or an increase in government expenditure, in a liquidity trap.
- Although Gali (2020) emphasizes the effectiveness of government expenditure under the debt financed (*DF*) scheme in a liquidity trap, it is no longer effective in a small open economy, in comparison with the *MF* scheme.

# Effectiveness of the *MF* Fiscal Stimulus in a Small Open Economy in a Liquidity Trap

- The *MF* fiscal stimulus alleviates the problem by the fiscal expansion which applies a pressure to increase consumer price index (CPI) inflation and depreciates the nominal exchange rate, resulting from an increase in money growth.
- The terms of trade (TOT) returns to stability and the real consumption interest rate decreases.
- Then, output and CPI inflation recover (Relative increase in the import price worsens the TOT and worsening in the TOT contribute to recover output through expenditure-switching effect).
- Due to open economy setting, the TOT is additionally involved in determination of the output so that effectiveness of the *MF* fiscal stimulus is higher than it in a closed economy.

## Effectiveness of the *DF* Fiscal Stimulus in a Small Open Economy in a Liquidity Trap

- Under the *DF* scheme, the nominal exchange rate appreciates and CPI inflation severely decreases.
- This decrease increases the government debt and tax revenue increases because of Ricardian fiscal policy.
- The government loses incentive to obtain seigniorage, money growth decreases and the real consumption interest rate increases.
- This increase in the real consumption interest rate and an improvement in the TOT resulting from an appreciation in the nominal exchange rate hamper recovery in the output.

## Imperfect Pass-through and a Liquidity Trap

- We investigate our main finding even in the imperfect pass-through environment.
- Under the *DF* scheme, an increase in the government expenditure increases the domestic inflation while the import price has nominal rigidity so that the TOT improves.
- Due to sticky import price, the government has much tax revenue under Recardian tax rule and the real consumption interest rate becomes positive amid the adverse demand shock arising.
- Because of the TOT improving and the positive real consumption interest rate, the output does not necessarily rise strongly even if there is an increase in the government expenditure under *DF* fiscal stimulus.

- The remainder of the paper is organized as follows:
  2. Section 2 discusses the related literature (Skipped Today).
  3. Section 3 introduces the set of equilibrium dynamics based on the model, and defines the fiscal and monetary policies we examine.
  4. Section 4 shows the effects of fiscal stimulus in normal times when the ZLB is not available by calculating the fiscal multipliers.
  5. Section 5 considers the effects of fiscal stimulus in a liquidity trap where there is a ZLB.
  6. Section 6 concludes the paper.

### 3 The Model

- Following Gali and Monacelli (2016, *AER*), we extend a model in Gali (2020) to a small open economy model.
- We assume:
  1. Complete International Financial Markets
  2. Sticky Prices for Domestic Goods (Calvo Pricing)
  3. Exports Elastic to Changes in the terms of trade (TOT)
  4. The Law of One Price (LOOP, with an extension where these prices are sticky as well)
  5. Flexible Wages

### 3.1 Equilibrium Dynamics

- We approximate the equilibrium around the steady state in which inflation is zero as follows (ignoring the ZLB constraint at this point):

$$\hat{\xi}_t = -(1 - \nu) s_t + \hat{\xi}_t^* - \zeta_t, \quad (1)$$

$$\hat{y}_t = \nu (2 - \nu) s_t + (1 - \nu) \hat{c}_t + \nu \hat{y}_t^* + \hat{g}_t, \quad (2)$$

$$\hat{\xi}_t = \hat{\xi}_{t+1} + (\hat{i}_t - \pi_{t+1} - \hat{\rho}_t), \quad (3)$$

$$\hat{\xi}_t = -\sigma \hat{c}_t + \nu \hat{l}_t, \quad (4)$$

$$\pi_{H,t} = \beta \pi_{H,t+1} - \kappa \hat{\mu}_t, \quad (5)$$

$$\hat{\mu}_t = \hat{\xi}_t - \frac{\alpha + \varphi}{1 - \alpha} \hat{y}_t - \nu s_t, \quad (6)$$

### 3.1 Equilibrium Dynamics

$$\hat{l}_t = \hat{c}_t - \eta \hat{i}_t, \quad (7)$$

$$\hat{l}_{t-1} = \hat{l}_t + \pi_t - \Delta m_t, \quad (8)$$

$$\begin{aligned} \hat{b}_t = & (1 + \rho) \hat{b}_{t-1} + (1 + \rho) \hat{b} \hat{i}_{t-1} - (1 + \rho) b \pi_t + \hat{g}_t \\ & - \hat{t} \hat{r}_t - \chi \Delta m_t, \end{aligned} \quad (9)$$

$$\pi_t = \pi_{H,t} + \nu (s_t - s_{t-1}), \quad (10)$$

$$\hat{n} \hat{x}_t = \hat{y}_t - \nu s_t - \hat{c}_t - \hat{g}_t, \quad (11)$$

$$s_t = e_t + p_t^* - p_{H,t}, \quad (12)$$

$$\pi_{H,t} = p_{H,t} - p_{H,t-1}, \quad (13)$$

$$\pi_{F,t} = p_{F,t} - p_{F,t-1}, \quad (14)$$

$$\pi_{F,t} = s_t - s_{t-1} + \pi_{H,t}, \quad (15)$$

### 3.1 Equilibrium Dynamics

- Our log-linearized model inherits features in a small open economy in Gali and Monacelli (2005) whose model consists of not only the New keynesian IS and Philips curves but also international risk sharing condition.
- In addition, market clearing condition and the average markup include the TOT.
- Then, both consumption and the output are affected by changes in the TOT.
- Thus, different from Gali (2020), not only the real consumption interest rate but also the TOT involves in fiscal monetary interactions.

## 3.2 Fiscal and Monetary Policies

### 3.2.1 Financing Regime

Simple (Ricardian) Tax Rule

$$\widehat{tr}_t = \psi_b \widehat{b}_{t-1} + \widehat{\varsigma}_t. \quad (38)$$

### 4.3.2 Experiments

A Tax Cut

$$\widehat{\varsigma}_t = -\delta^t < 0.$$

An Increase in the Government Expenditure

$$\widehat{g}_t = \delta^t > 0.$$

### 4.3.2 Experiments

The *MF* Scheme

$$\Delta m_t = \frac{1}{\chi} [\hat{g}_t - \hat{\varsigma}_t + (1 + \rho) b (\hat{i}_{t-1} - \pi_t)], \quad (40)$$

which suffices  $\hat{b}_t = 0$  for all  $t$ . Under the *MF* Scheme, the government debt is unchanged.

The *DF* Scheme

$$\pi_{H,t} = 0, \quad (41)$$

or,

$$\pi_t = 0, \quad (42)$$

for all  $t$ . Under the *DF* Scheme, monetary policy is the domestic inflation targeting (DIT) or CPI inflation targeting (CIT).

## 4.4 Calibration

- Our parameterization is consistent with Gali (2020) (Table 2).

Tab.2: Parameterization

Parameter	Description	Value	Source
$\sigma$	Relative Risk Aversion	1	
$\nu$	Openness	0.4	Monacelli(2005)
$\beta$	Discount Factor	0.995	
$\varphi$	Curvature of Labor Disutility	5	
$\alpha$	Index of Decreasing Returns to Labor	0.25	
$\epsilon$	Elas. of Substitution among Goods	9	
$\theta$ and $\theta_F$	Calvo Index of Price Rigidities	$\frac{3}{4}$	
$\chi$	The S.S. Inverse Velocity	$\frac{1}{3}$	
$\eta$	Semi Elas. of Money Demand	7	
$v$	Separability of Money Demand	0	
$\psi_b$	Tax Adjustment	0.02	
$b$	Target Debt Ratio	2.4	
$\delta$	Persistence	0.5	

## 4 The Effects of Fiscal Stimulus in Normal Time

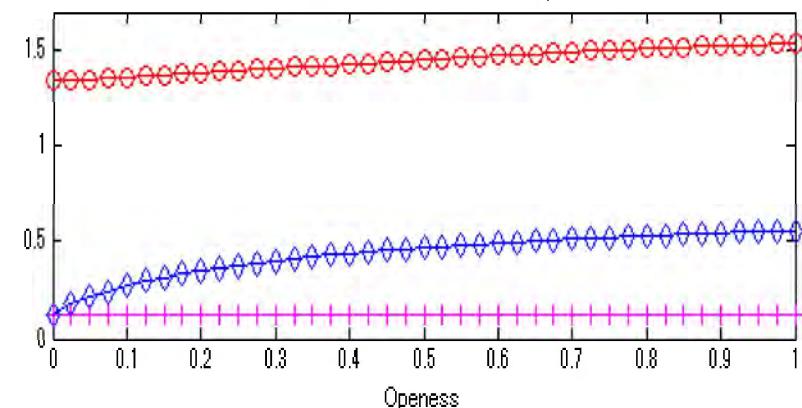
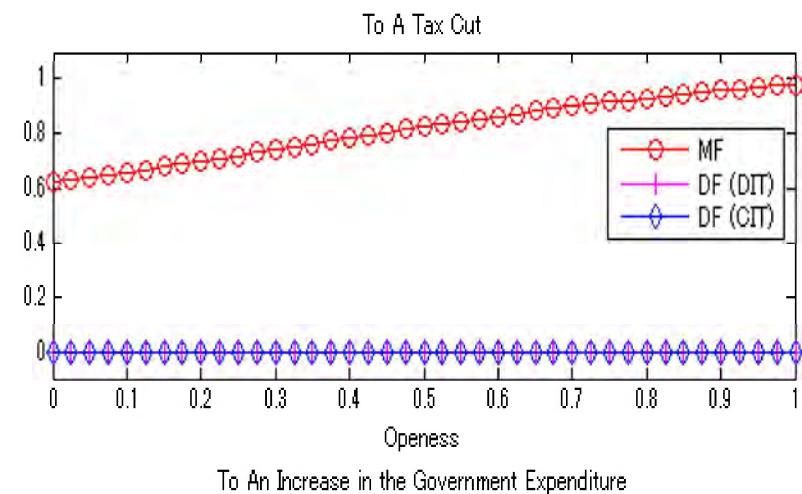
### 4.1 Sensitivity Analysis

- Following Gali (2020), we define cumulative output multiplier  $(1 - \delta) \sum_{t=0}^{\infty} \hat{y}_t$  with  $\delta$  being the persistence of the shock.
- The focus is the parameter measuring the degree of openness  $\nu$ .

### 4.1.1 Fiscal Multipliers to A Tax Cut

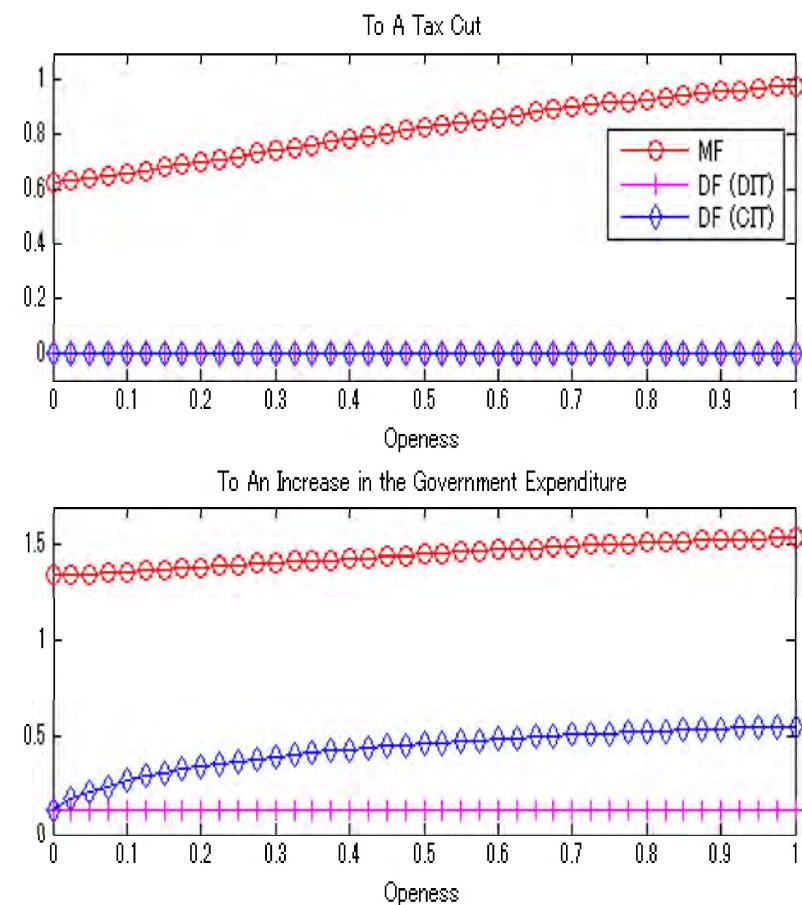
#### *DF* Scheme

- The multipliers are zero regardless of the changes in the openness under the *DF* scheme.
- Ricardian equivalence holds and there are no fiscal effects in the first instance.



## MF Scheme

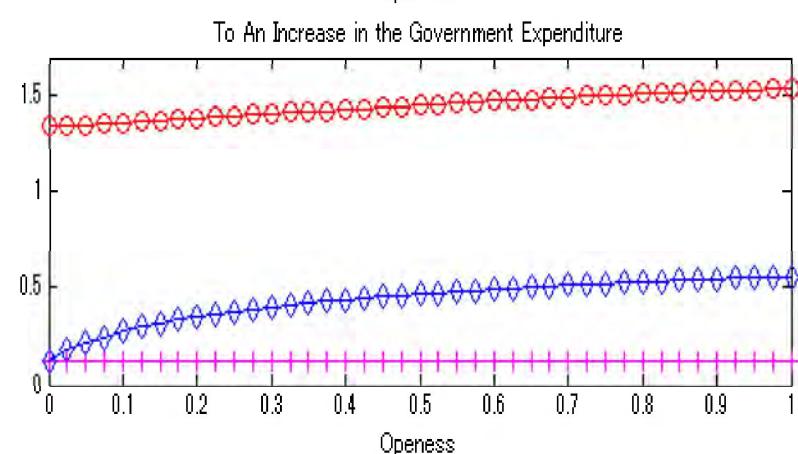
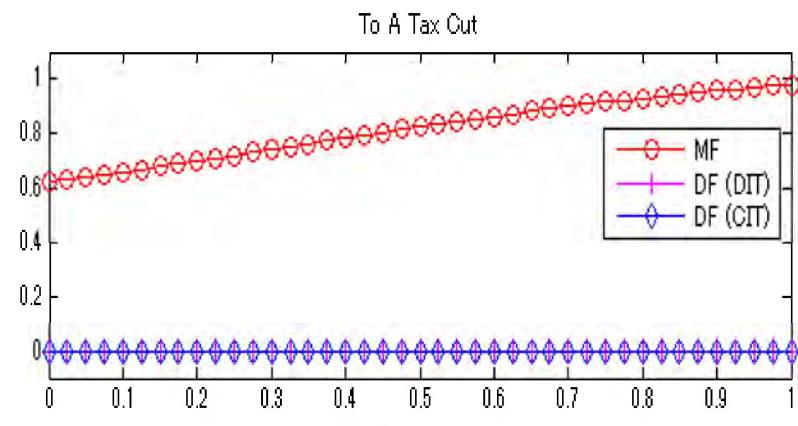
- Under the MF scheme, the multipliers strongly increase with a tax cut as the openness increases.
- The greater the openness, the higher the CPI (level) and the more depreciating the nominal exchange rate because of PPP in the long run.
- The TOT worsens as openness increases.
- More open the economy, the higher its output.



#### 4.1.2 Fiscal Multipliers to An Increase in the Government Expenditure

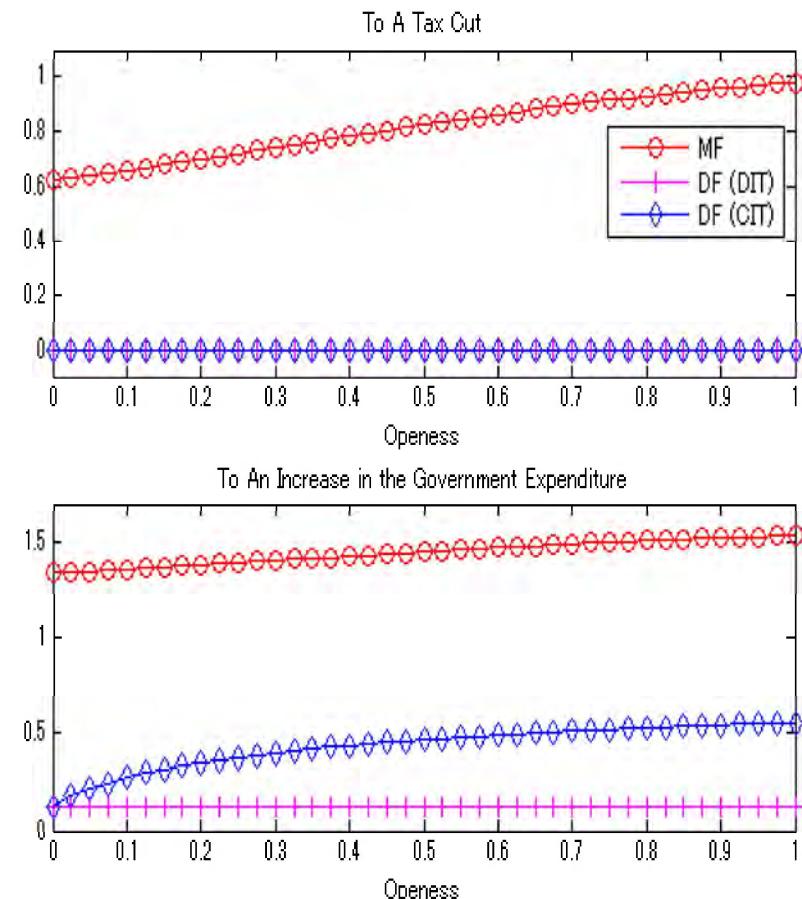
##### *MF* Scheme

- The multipliers to an increase in the government expenditure under the *MF* scheme increases as the openness increase.
- The reason why is that the TOT worsens as the openness increases.

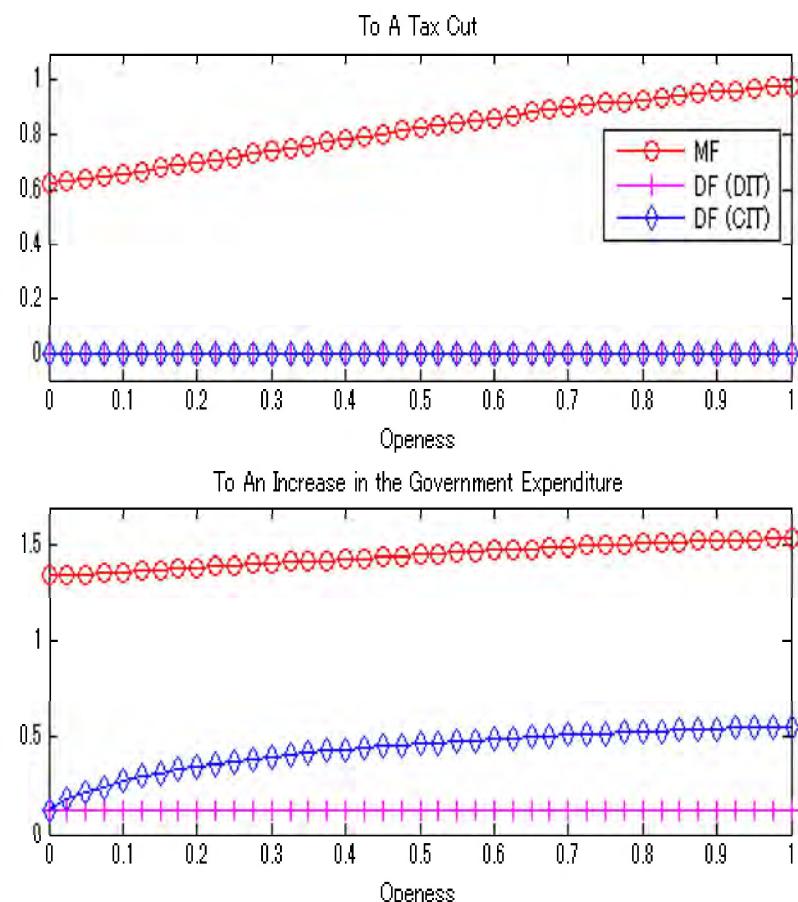


## DF Scheme with DIT

- Regardless of the openness, the multipliers are identical with it in a closed economy, on DF scheme with the DIT.
- The output is not affected by the openness and depends on the government expenditure, as long as  $\zeta_t$  does not shift the logarithmic international risk sharing condition.



- As Gali and Monacelli (2005) discuss, the nominal exchange rate moves one-for-one with the TOT, given that domestic prices are fully stabilized under the DIT.
- Thus, under the DIT, the dynamics of the output, the domestic inflation and so fourth in a small open economy are identical with those in a closed economy.



## DF Scheme with CIT

- To offset the pressure to increase CPI inflation, import inflation must decrease through an appreciation in the nominal exchange rate.

The diagram illustrates the relationship between inflation rates and the nominal exchange rate ( $S_t$ ) for two levels of openness: Low Openness and High Openness.

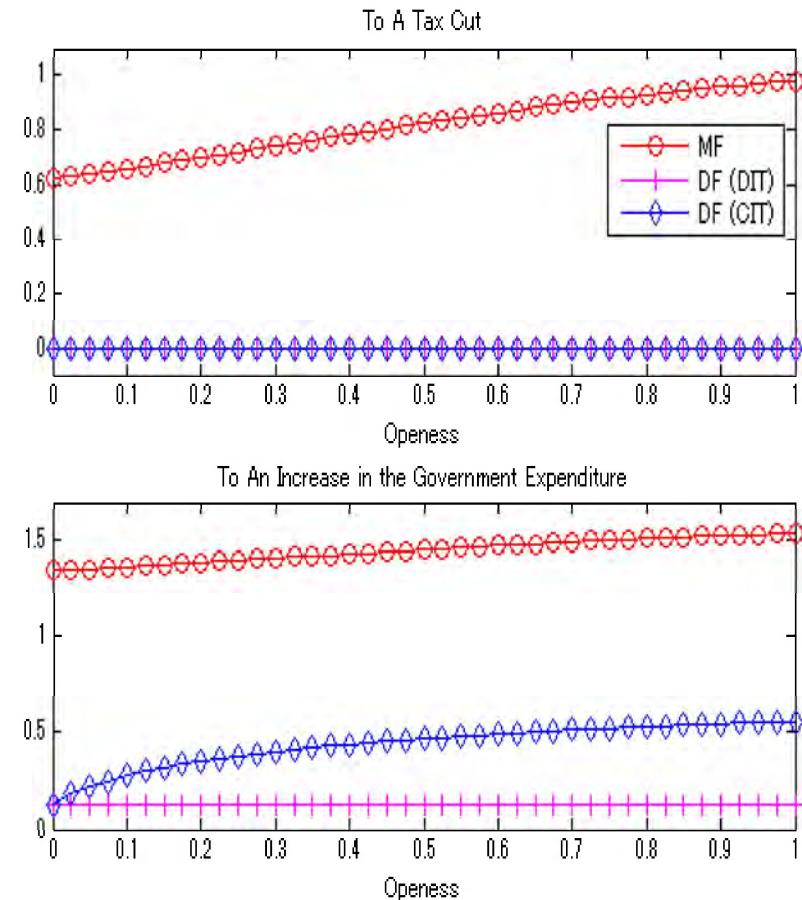
**Low Openness:** The equation is  $\pi_t = (1-\nu)\pi_{H,t} + \nu\pi_{F,t} = 0$ . The diagram shows two upward arrows from the CPI inflation ( $\pi_t$ ) to the import inflation ( $\pi_{H,t}$ ) and the foreign inflation ( $\pi_{F,t}$ ). A downward arrow from the import inflation ( $\pi_{H,t}$ ) points to the nominal exchange rate ( $S_t$ ). The formula for  $S_t$  is  $S_t \equiv \frac{P_{F,t}}{P_{H,t}}$ .

**High Openness:** The equation is  $\pi_t = (1-\nu)\pi_{H,t} + \nu\pi_{F,t} = 0$ . The diagram shows two upward arrows from the CPI inflation ( $\pi_t$ ) to the import inflation ( $\pi_{H,t}$ ) and the foreign inflation ( $\pi_{F,t}$ ). A downward arrow from the foreign inflation ( $\pi_{F,t}$ ) points to the nominal exchange rate ( $S_t$ ). The formula for  $S_t$  is  $S_t \equiv \frac{P_{F,t}}{P_{H,t}}$ .

Openness and TOT in DF Fiscal Stimulus

## DF Scheme with CIT

- As openness increases, the pressure to decrease import inflation must be mitigated so that an improvement in the TOT must be mitigated as openness increases.
- As a result, the multipliers increase with openness.



## 5 The Effects of Fiscal Stimulus in a Liquidity Trap

- This section explores the effectiveness of the *MF* fiscal stimulus in stabilizing the economy in the face of a temporary adverse demand shock, similar to Gali (2020).
- A temporary 1% adverse demand shock that brings the natural rate into negative territory up to period 5.
- The ZLB constraint is imposed on the nominal interest rate.

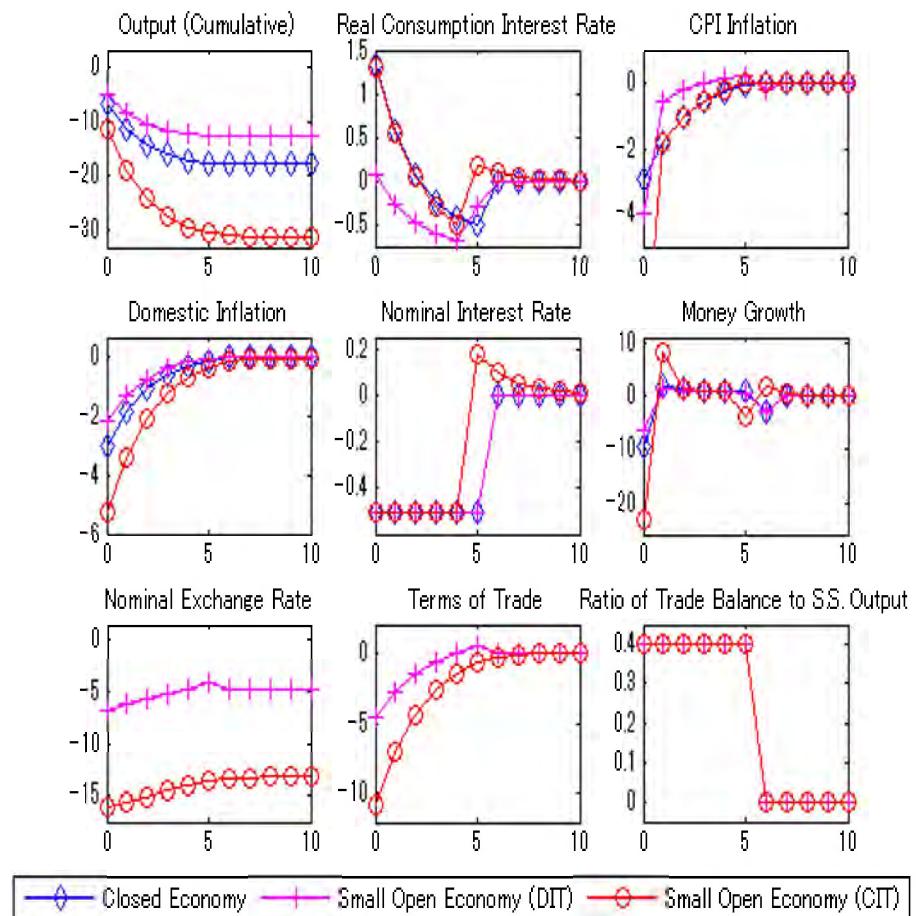
- The scenarios for the tax cut and the increase in government expenditure are as follows:
  1. 1% tax cut
  2. 1% increase in the steady-state ratio of government expenditure to output
- One of them is lasting for the duration of the adverse shock.
- Those scenarios are identical with Gali (2020).

## 5.1 No Response

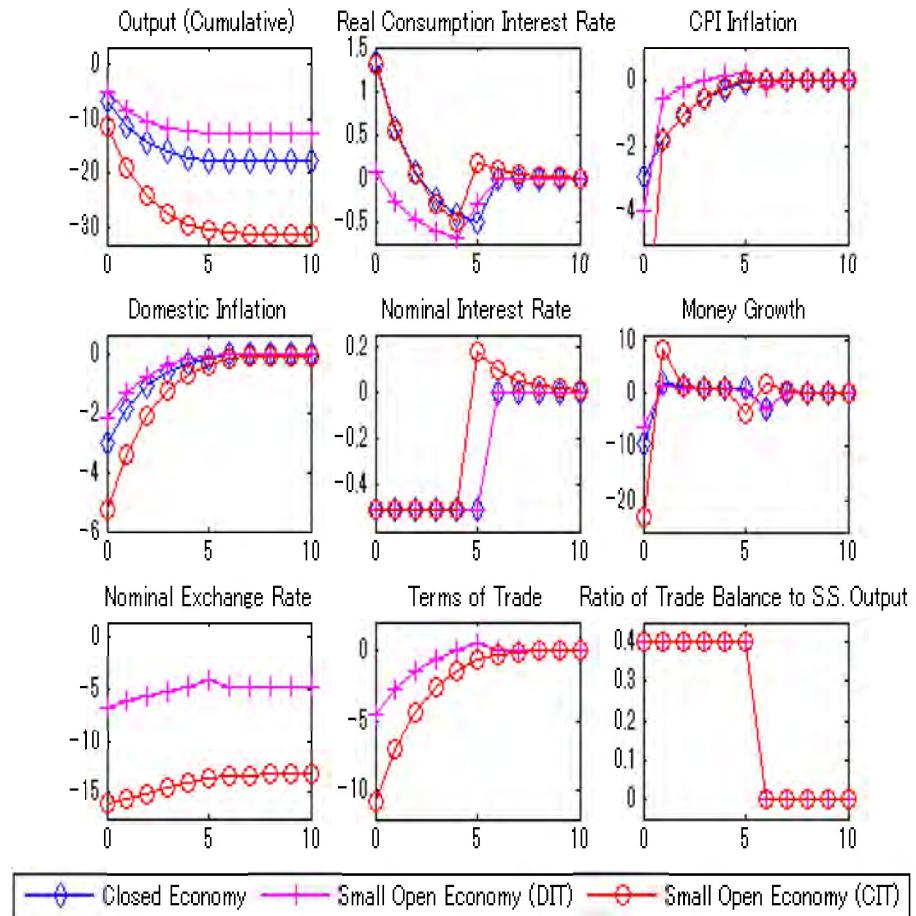
### No Response (DIT)

- Firstly, we show the case of *no responses* with DIT.
- Gali and Monacelli (2002) show that the equilibrium dynamics in a small open economy is isomorphic to the one of a closed economy under the DIT.
- However, in our small open economy model, changes in  $\hat{\rho}_t$  cause changes in  $\zeta_t$  which shifts the international risk sharing condition.
- Thus, adverse demand shock makes the marginal utility of consumption larger than it in foreign country and increases the trade balance even if we assume perfect substitution between domestic and foreign goods and  $\sigma = 1$ .

- Due to fluctuation in the trade balance, dynamics in a small open economy is not necessarily identical with it in a closed economy.
- The adverse demand shock decreases domestic inflation and the CPI inflation decreases.

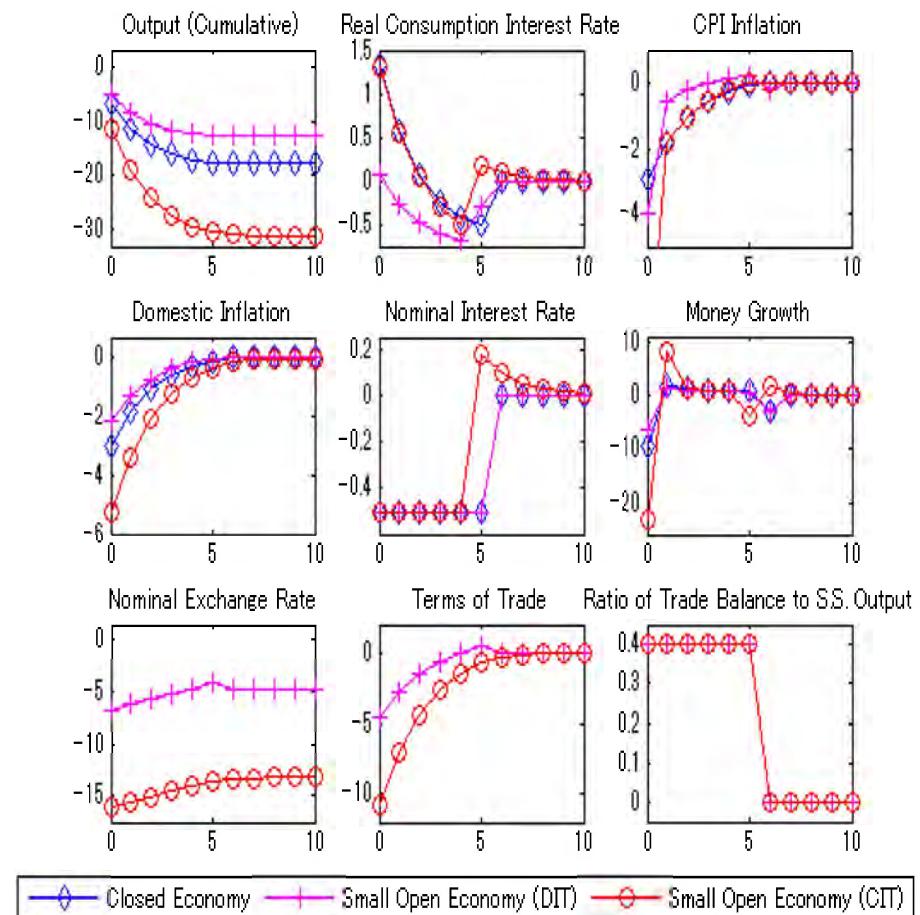


- The decrease in the CPI inflation is larger than it in a closed economy, because the CPI inflation includes the import inflation which has no nominal rigidity.
- This decrease in the CPI appreciates the TOT through improving in the nominal exchange rate because of PPP in the long run and the output decreases.

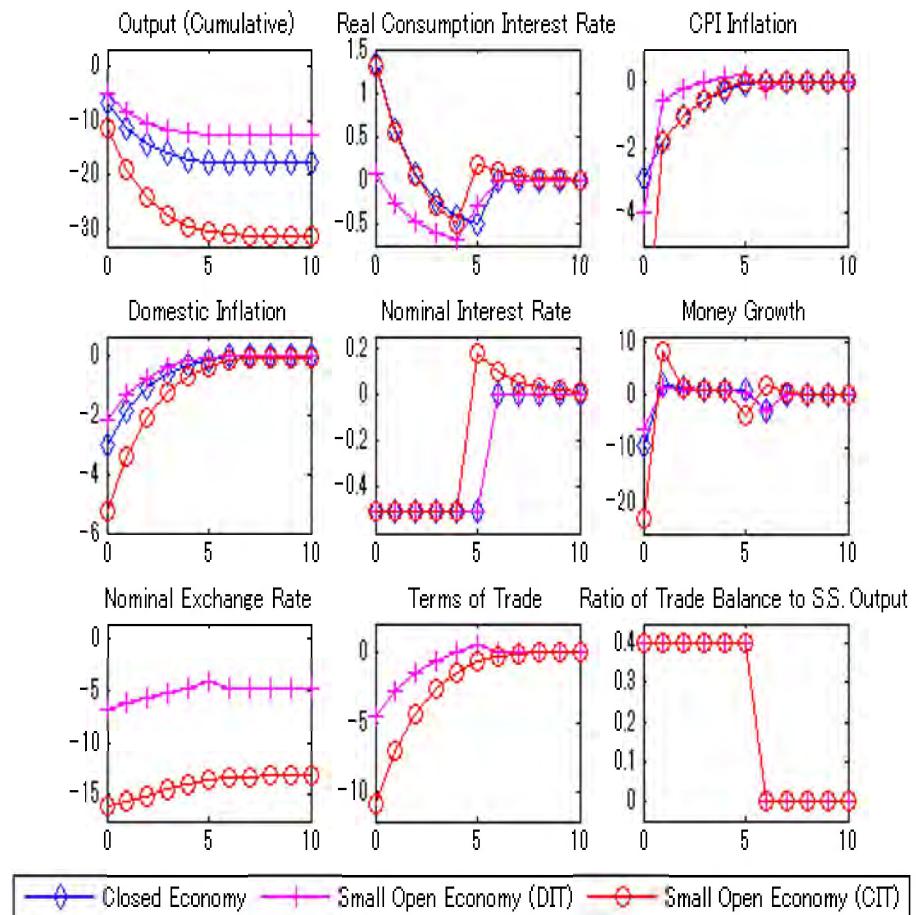


## No Response (CIT)

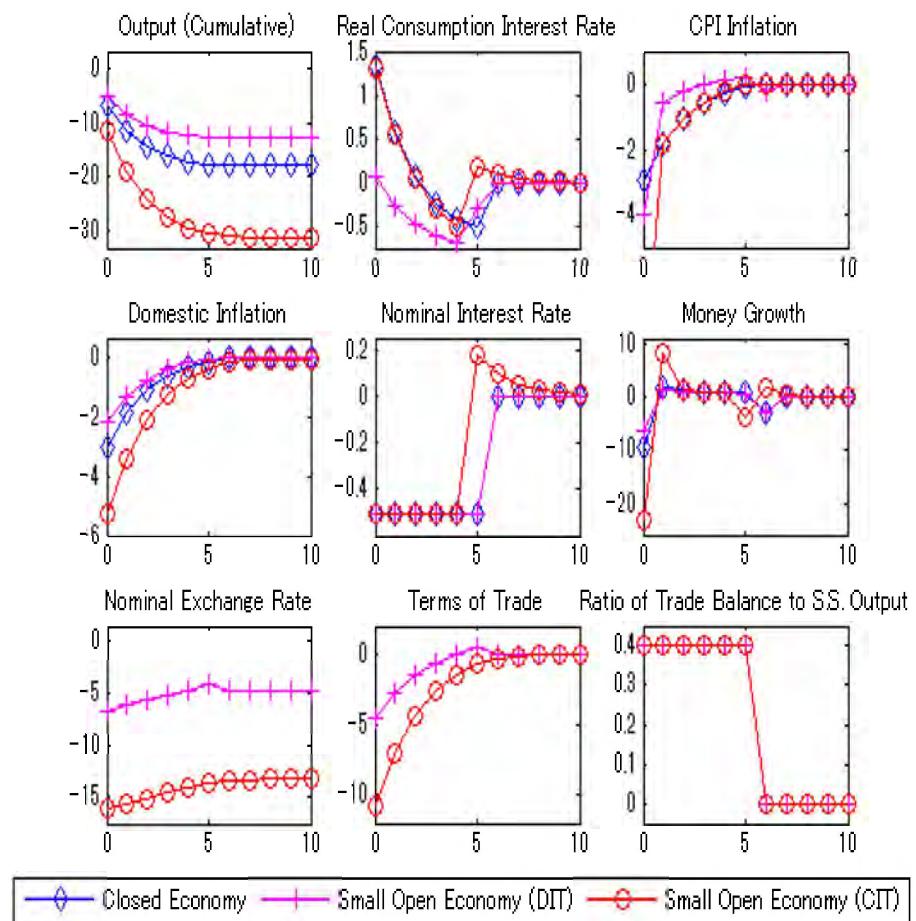
- Next, we discuss on responses in a small open economy with the CIT.
- The fall in domestic inflation is larger than the DIT because domestic inflation is not the target to stabilize.
- This decrease applies higher pressure on the nominal exchange rate to appreciate than it in the DIT.



- This appreciation in the nominal exchange rate decreases import inflation and the TOT improves.
- This severe decrease in domestic inflation amplifies the burden of redeeming government debt through a decrease in CPI inflation.



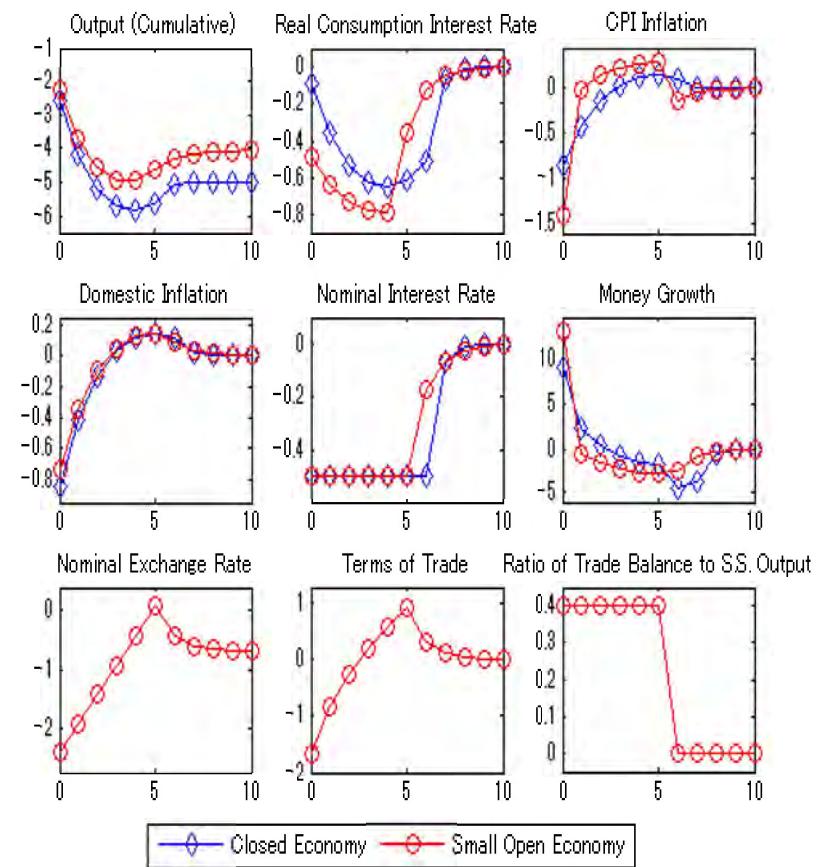
- Given Ricardian tax rule, the larger balance of real government debt brings about higher tax revenue.
- Seigniorage is no longer necessary, money growth decreases and the nominal interest rate increases.
- The recovery of output delays and the decrease in (cumulative) output in a small open economy is 1.77 times larger than what it would be in a closed economy.



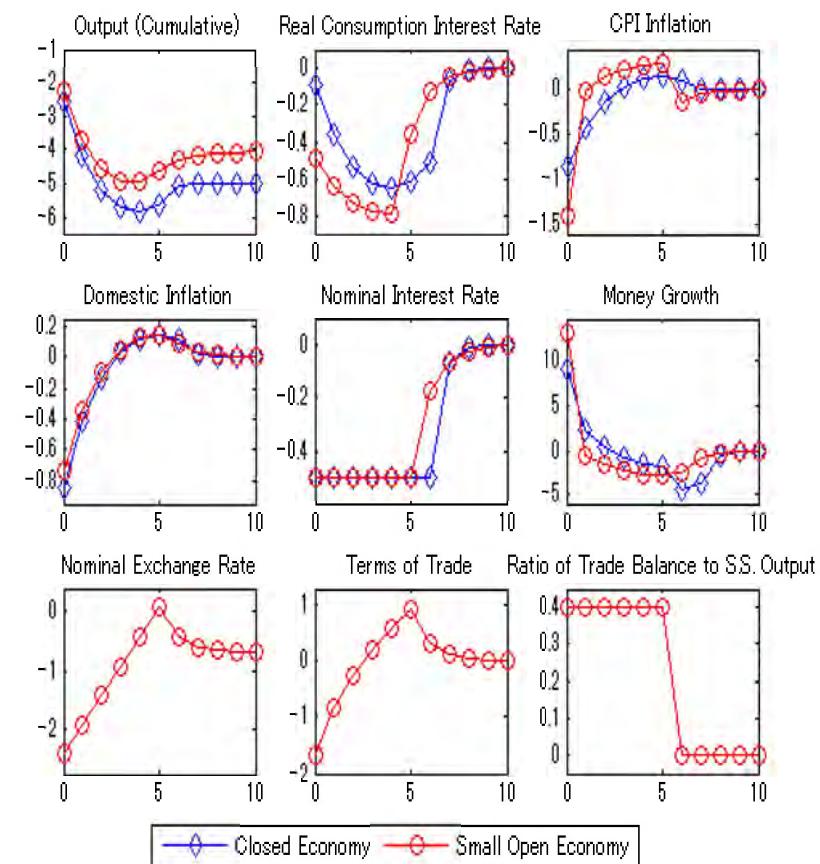
## 5.2 The MF Fiscal Stimulus

### 5.2.1 A Tax Cut

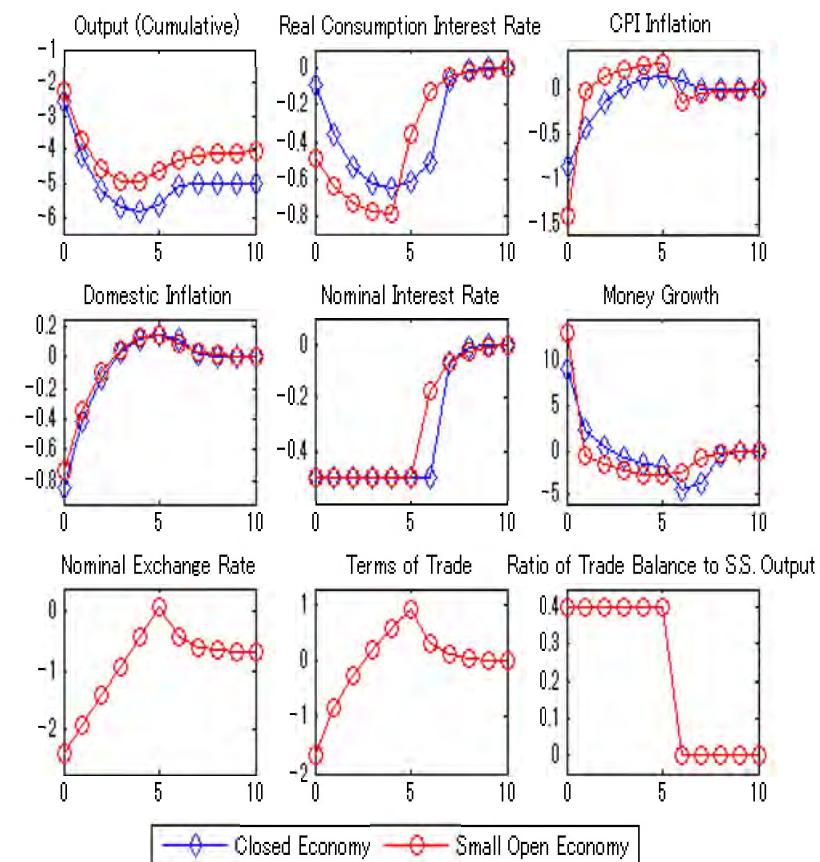
- A tax cut under the *MF* scheme in a small open economy stabilizes output and inflation and is more effective than that in a closed economy.
- The decrease in CPI inflation immediately after the adverse demand shock rises is larger than in a closed economy.



- This larger decrease in CPI inflation deprives revenue of the inflation tax so that, together with financing a tax cut, the government has strong incentive to obtain seignorage.
- Thus, an increase in money growth is larger than in a closed economy.
- This higher money growth mitigates the decline in consumption through lower real consumption interest rate.

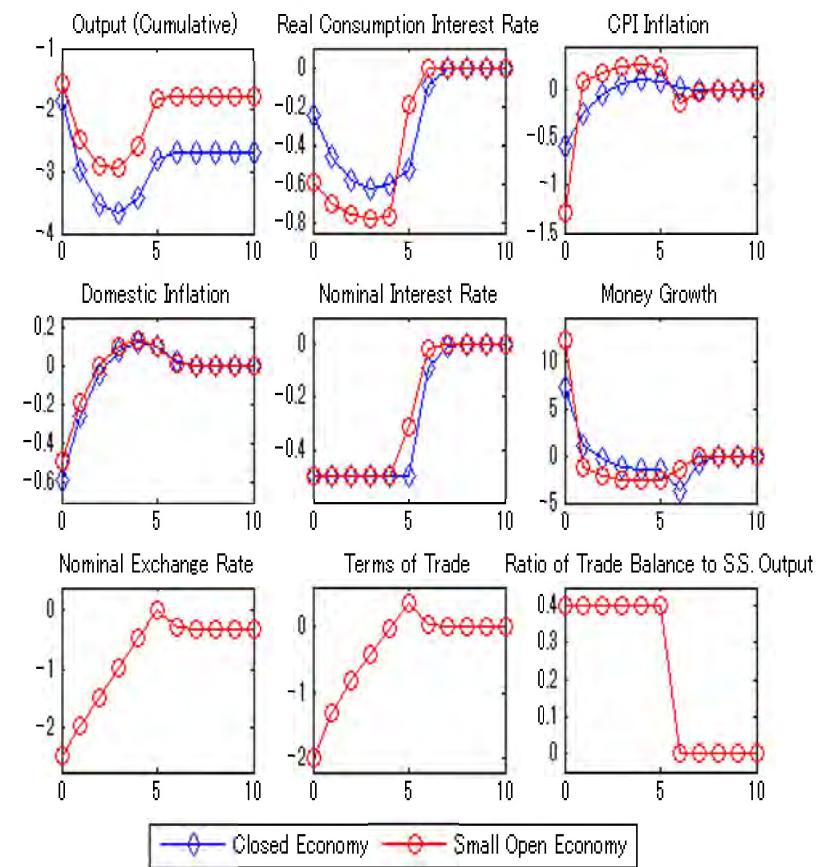


- Faster recovery in the CPI inflation contributes to alleviate an appreciation in the nominal exchange rate.
- An appreciation in the nominal exchange rate is mitigated so that the improvement in the TOT is smaller than it in the case of *no response*.
- Thus, *MF* fiscal stimulus is more effective in a small open economy than a closed economy.



### 5.2.2 An Increase in the Government Expenditure

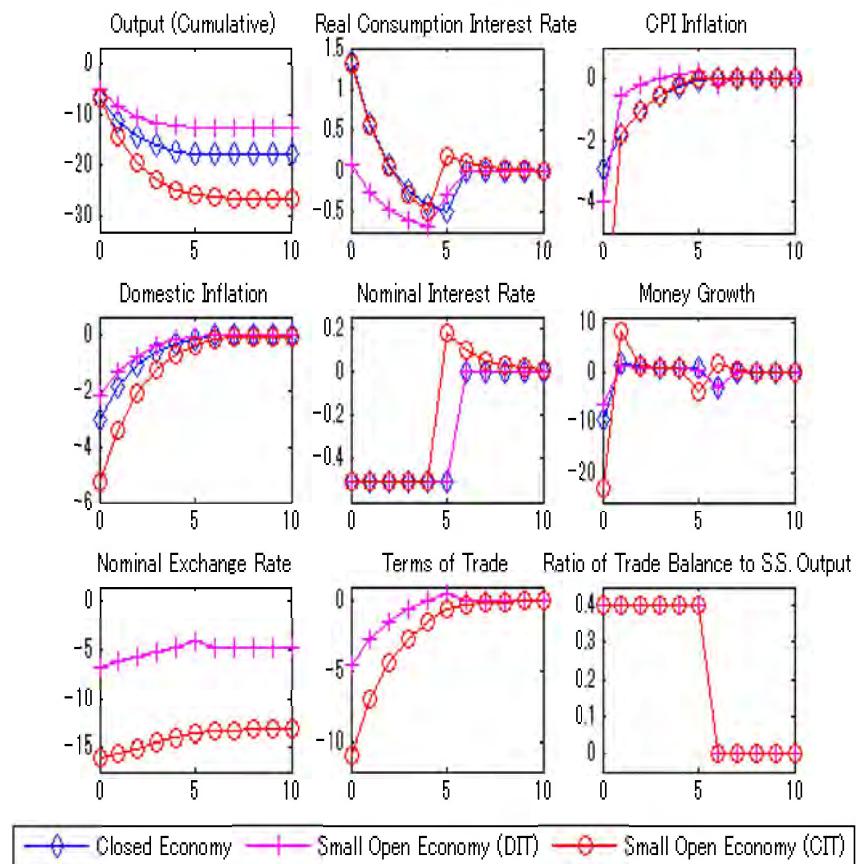
- An increase in government expenditure is more effective in stabilizing output than in a closed economy, similar to a tax cut in a small open economy.
- Fall in the consumption real interest rate is larger than in a closed economy.
- Faster recovery in the CPI inflation contributes to alleviate an improvement in the TOT.



## 5.3 The DF Fiscal Stimulus

### 5.3.1 To a Tax Cut

- The responses to a tax cut under the DF scheme are identical to those in the case of *no response* except for taxes, real government debt, and the fiscal surplus with inflation tax.
- Ricardian equivalence is attained.

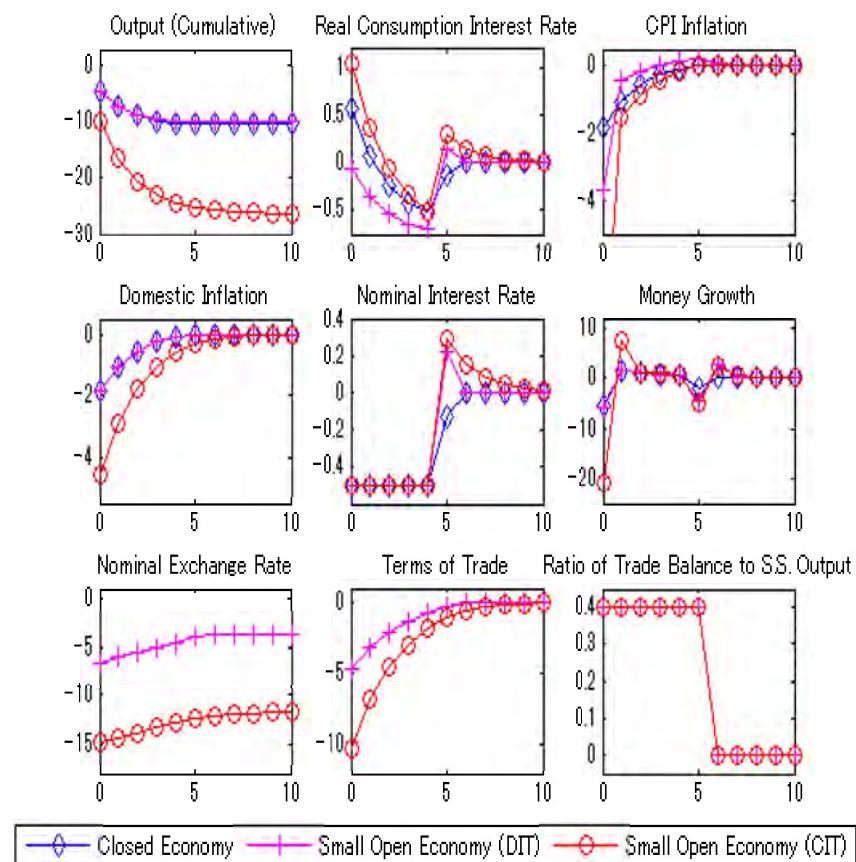


### 5.3.2 To an Increase in Government Expenditure

- Unlike *MF* fiscal stimulus, an increase in government expenditure under the *DF* scheme in a small open economy is not effective for stabilizing output and inflation.
- The reason why is an improvement in the TOT as well as strong effects of *MF* fiscal stimulus.
- Gali (2020) suggests that the increase in government expenditure under the *DF* scheme has a strong impact on output and inflation.
- Thus, our finding concerning an increase in government expenditure under the *DF* scheme is quite different from that derived by Gali (2020).

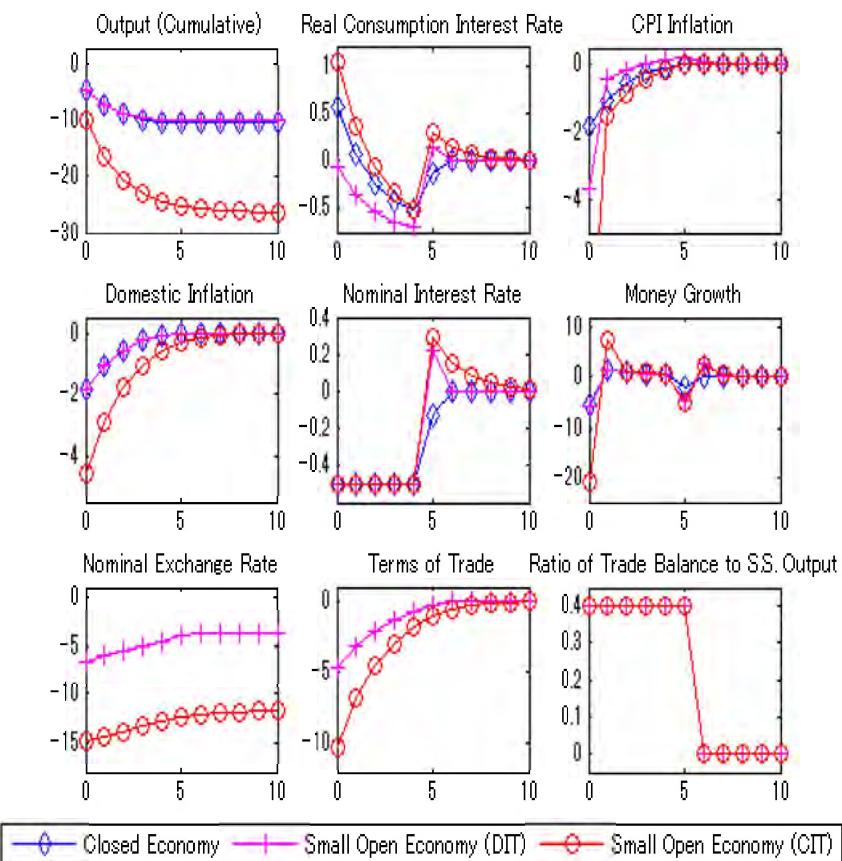
## DF with CIT

- Under the *DF* scheme with the CIT, CPI decreases severely and the nominal exchange rate appreciates.
- This severe decrease in the CPI inflation increases tax revenue.
- The real consumption interest rate increases and recovery on consumption delays.
- TOT improves and output decreases.

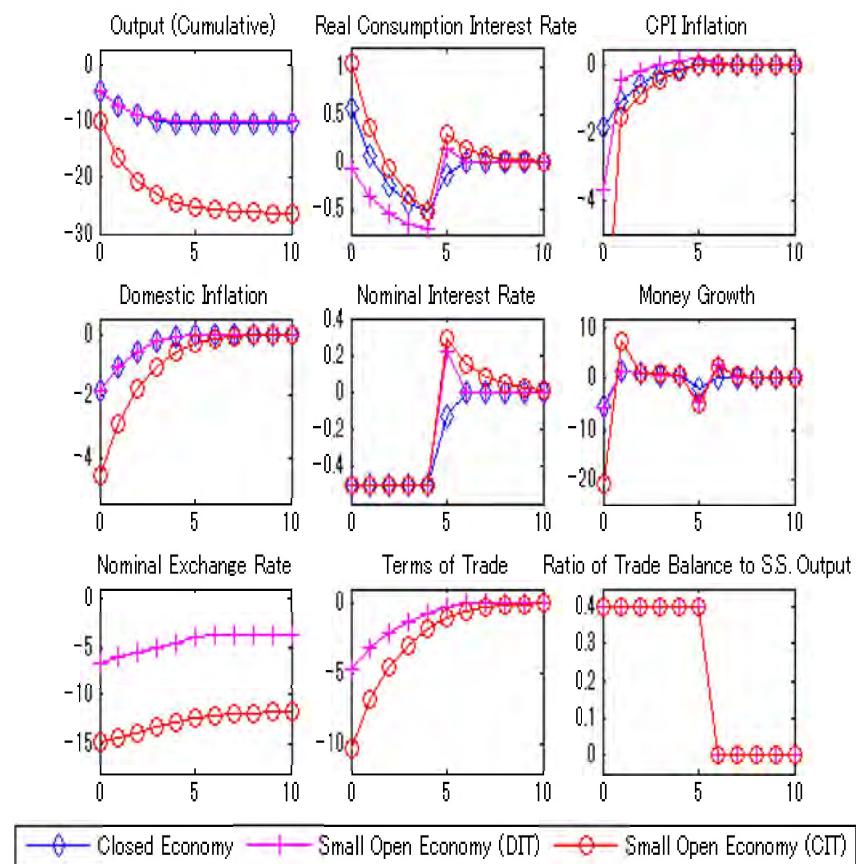


## DF with DIT

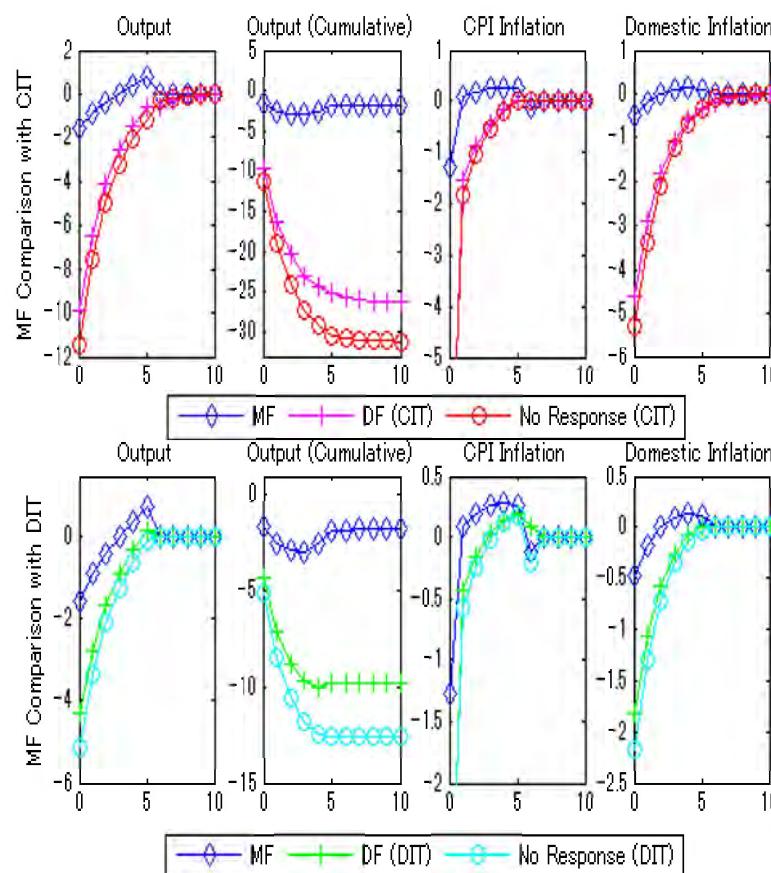
- Under the *DF* scheme with the DIT, while the CPI inflation decreases, the recovery in the CPI inflation is very fast.
- This fast recovery in the CPI inflation completes fiscal reform faster.
- Thus, the real consumption interest rate is higher than it in the case of *no response* in the DIT and the recovery in the consumption stagnates.



- While an increase in the government expenditure applies a pressure to increase the output, this pressure increases domestic inflation so that the TOT improves.
- Cumulative output is almost same as it in a closed economy.



- Figure 7 compare responses under the *MF* scheme with the *DF* scheme and the case of *no response* in a small open economy.
- Response of the *DF* fiscal stimulus are closer to responses of the case of *no response* in each panel.
- Thus, an increase in government expenditure under the *DF* scheme is not effective in a small open economy.
- Clearly, our finding differs from that in Gali (2020).



## 7 Conclusion

- We analyze the effects of *MF* fiscal stimulus compared with those resulting from conventional *DF* fiscal stimulus with and without the ZLB on the nominal interest rate in a small open economy.
- In a liquidity trap, *MF* fiscal stimulus is more effective in stabilizing both output and inflation than a closed economy.
- The increase in government expenditure under the *DF* scheme is less effective irrespective of nominal exchange rate pass-through, although its effectiveness is highlighted by Gali (2020) assuming a closed economy.