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中 文 摘 要 ： 在此研究中，我們利用一個小型開放經濟體系的DSG模型，其中主要包含了央行的資產負債表以便探討央行的外匯干預政策。在此架構下，我們考慮央行同時採行兩種貨幣政策--貨幣成長率法則與管理浮動匯率，以貼近台灣現況。研究結果顯示，相較於浮動匯率制度，管理浮動匯率在減緩名目匯率波動之餘，亦有助於穩定通貨膨脹率。

中 文 關 鍵 詞 ： 動態隨機一般均衡、貨幣成長率法則、管理浮動匯率

英 文 摘 要 ： In this study, we establish a small-open-economy DSGE model. We emphasize the central bank's balance sheet where the central bank may conduct the regular monetary policy with the foreign exchange intervention. We consider the policy coordination involving monetary aggregate rule and managed floating exchange rate which is consistent with the current monetary policy regime of Taiwan. The dynamic analyses show that the managed floating exchange rate which dampens the nominal exchange rate depreciation also helps stabilize the inflation rate.

英 文 關 鍵 詞 ： dynamic stochastic general equilibrium (DSGE), monetary aggregate policy, managed floating exchange rate

Analyses of Monetary Policy Coordination with A DSGE Framework

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Abstract

In this study, we establish a small-open-economy DSGE model. We emphasize the central bank's balance sheet where the central bank may conduct the regular monetary policy with the foreign exchange intervention. We consider the policy coordination involving monetary aggregate rule and managed floating exchange rate which is consistent with the current monetary policy regime of Taiwan. The dynamic analyses show that the managed floating exchange rate which dampens the nominal exchange rate depreciation also helps stabilize the inflation rate.

Keyword : dynamic stochastic general equilibrium (DSGE), monetary aggregate policy, managed floating exchange rate

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1. Introduction

In small open economies where trades play an important role, central banks usually tend to stabilize the exchange rate movements to prevent the impacts of exchange rate fluctuations on trades. Therefore, the central banks of most countries implement managed floating exchange rate regime (such as Singapore and most Asian countries) through its participation on the foreign exchange market. Taiwan, as a typical small open economy with export and import taking up around 70% and 60% of the GDP respectively, the central bank also conducts the managed floating exchange rate regime.

However, after the financial crisis in 2008, many central banks in advanced economies implemented quantitative easing. These expansionary policies have great impacts on emerging economies, particularly through the foreign exchange markets. In recent years, the large fund inflows to emerging economies have led to significant exchange rate appreciation in these small open economies, as shown in Table 1. As a result, the central banks which take actions to avoid significant exchange rate appreciation may lead to significant increase in foreign reserves, which in turn results in the increase in the money supply and the rise in inflation. Table 1 outlines the experiences that major Asian economies have undergone. As we can see, during the past years

Table 1: Average annual growth rate in foreign reserves, M2, inflation and exchange rate depreciation, 2010-2014

	Singapore	**Korea**	**Malaysia**	**Philippines**	**Thailand**	**Taiwan**
M2 growth rate	6.45	5.64	8.49	11.94	9.20	4.87
inflation	2.76	2.41	2.07	3.83	2.22	0.91
exchange rate						
depreciation rate*	-13.83	-19.17	-7.46	-7.14	-5.54	-8.46
std of annual depreciation	5.90	4.11	5.40	4.00	5.21	3.87
Reserve assets	6.79	6.14	4.44	13.58	3.14	7.55

*: the negative number refers to the appreciation of the domestic currency against the US dollars.
Source: World Bank; International Financial Statistics, IMF.

(2010-2014), there are significant increases in M2, inflation and foreign reserves, while the nominal exchange rate experienced significant appreciation with drastic fluctuation in these countries.

The experiences of emerging economies in past years show the tradeoff between controlling the monetary aggregate and stabilizing exchange rate fluctuations that monetary policy making may encounter, particularly under the significant foreign fund inflows. The primary policy instrument of the central bank of Taiwan is monetary aggregate targeting by setting the target for the growth rate of M2 with a fluctuation range of 2%. However, as a small open economy, the central bank of Taiwan also conducts the managed floating exchange rate regime to avoid drastic exchange rate fluctuations. In past years, to stabilize the exchange rate fluctuations due to large foreign fund inflows, the foreign reserves and monetary aggregates rise. The M2 growth rate has continuously reached the upper bound of the target.[1] The massive fund inflows have led to the challenge to maintain the target of monetary aggregate.

The macroeconomic effects of quantitative easing (QE) have been widely discussed in the literature. Most of these papers use closed-economy models, and the impacts of QE on foreign countries are relatively rare.[2] The current studies on QE's impact fall on its impacts on emerging economies. For example, Chang, Liu and Spiegel (2015) discuss this issue for China to emphasize the decline in the foreign interest rate increases the cost of sterilization which leads to the increase in the monetary aggregate and inflation. Liu and Spiegel (2014) follow the similar framework to examine the combination of conventional monetary policy and capital account policies including taxing the fund inflows and sterilization may help stabilize the economy.

Alternatively, Escudé (2013) uses a dynamic stochastic general equilibrium (DSGE) model with the description of balances sheet of the central bank to examine the simultaneous implementation of two policy rules, the conventional interest rate rule and managed floating exchange rate. The balance sheet of the central bank includes the government bonds and foreign reserves. The intention of the central bank on the foreign reserve market will lead to the change in the foreign reserve (or bonds if it is sterilized) and money supply. The welfare analyses show that the simultaneous implementation of two monetary policy rules will help stabilize the economy and lead to greater welfare.

[1] For example, the target of M2 growth rate in 2015 was set at the range between 2.5% and 6.5%. However, the growth rate of M2 is above 6% every month in 2015.

[2] The details of the related literature is described in the footnote 3 in the literature review.

With the similar framework, Escudé (2014) examines the trilemma in international finance and shows that the "impossible trinity" can be possible.

However, all the studies consider the interest rate rule. While the interest rate rule has been subject to severe criticism after the financial crisis, some studies have started to reexamine the performance of monetary aggregate management. For example, Hwang and McNelis (2015) show that the monetary aggregate rule can perform better in stabilizing consumption and asset price fluctuations than an interest rate rule. Similar results are found in Kelly, Binner, Chang and Tseng (2014) and Belongia, Binner, Tepper and Kelly (2014).

In this paper, we plan to focus on the examination of monetary policy coordination in response to the massive fund inflows to a small open economy. While the fund inflows may cause the problem for the central bank to maintain the monetary stability and exchange rate stability, we plan to examine the effects and welfare implications of alternative policy coordination. We will use the framework of Escudé (2013) to assess the fluctuations and welfare under the simultaneous implementation of the monetary aggregate rule, in contrast to the interest rate rule, and managed floating exchange rate. While the central bank of Taiwan conducts the monetary aggregate rule, this study may provide the policy implications for monetary policy coordination of Taiwan, instead of implementation of one single conventional policy, under massive foreign funds inflows.

This paper is structured as follows. We outline the model in Section 2. We state calibration in Section 3, conduct policy analyses in Section 4, and conclude in Section 5.

2. Model

In this study, we will use a small-open-economy DSGE model to examine how well the different monetary policy coordination may help stabilize the macroeconomic fluctuations under massive foreign fund inflows. We will follow Escudé (2013) to include the balance sheet of the central bank, and two monetary policy rules including the monetary aggregate rule and managed floating exchange rate.

2.1 Final goods market

Final goods are made from intermediate goods, produced in the home and foreign countries. Final goods are nontradable, and are used for household's consumption,

investment and government spending. The composite goods, which are composed of domestic goods Q_t^d and imported goods Q_t^f:

$$Z_t = \left[\left(\alpha^d\right)^{1-\theta} \left(Q_t^d\right)^{\frac{\theta-1}{\theta}} + \left(\alpha^f\right)^{1-\theta} \left(Q_t^f\right)^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}, \tag{1}$$

where $\alpha^d, \alpha^f > 0$ represent the ratio of home and imported intermediate goods respectively. θ is the intratemporal elasticity of substitution between these two types intermediate goods. The demand function for the domestic and imported intermediate goods can be written as:

$$Q_t^d(i) = \left(\frac{P_t^d(i)}{P_t^d} \right)^{-\nu} Q_t^d, \quad Q_t^f(i) = \left(\frac{P_t^f(i)}{P_t^f} \right)^{-\nu} Q_t^f, \tag{2}$$

$$Q_t^d = \alpha^d \left(\frac{P_t^d}{P_t} \right)^{-\theta} Z_t, \quad Q_t^f = \left(\alpha^f\right) \left(\frac{P_t^f}{P_t} \right)^{-\theta} Z_t, \tag{3}$$

where $Q_t^d(i)$ and $Q_t^f(i)$ stand for the domestic goods and imported goods of variety i. ν is the elasticity of substitution among the individual goods. The corresponding prices are shown as follows:

$$P_t = \left[\alpha^d \left(P_t^d\right)^{1-\theta} + \left(\alpha^f\right) \left(P_t^f\right)^{1-\theta} \right]^{\frac{1}{1-\theta}}, \tag{4}$$

where $$P_t^j = \left[\int_0^1 P_t^j(s)^{1-\nu} ds \right]^{\frac{1}{1-\nu}}, \quad j = d, f,$$

$P_t^d(i)$ and P_t^d are the home-currency prices of individual and aggregate domestic goods, respectively, $P_t^f(i)$ and P_t^f are the home-currency prices for the imported goods. P_t is the aggregate price index. We assume that the imports are priced according to the international prevailing price such that $P_t^f = S_t P_t^*$ where S_t is the nominal exchange rate, expressed in units of the home currency of foreign currency and P_t^* is the international price.

2.2 Households

Household obtains utility from consumption and disutility from labor supply. The utility function can be characterized as below:

$$E_t \sum_{j=0}^{\infty} \beta^j \left[\frac{C_{t+j}^{1-\sigma^C}}{1-\sigma^C} - \xi^N \frac{N_{t+j}^{1+\sigma^N}}{1+\sigma^N} + \frac{\left(M_t / P_t\right)^{1-\sigma^M}}{1-\sigma^M} \right], \tag{5}$$

where C_t and N_t represent the consumption and labor supply in the period t respectively. $\beta \in (0,1)$ is the intertemporal elasticity of substitution. σ^C, σ^N and σ^M stand for the intertemporal elasticity of substitution of consumption, inverse of the elasticity of labor supply, and elasticity of money. ξ^N characterizes the disutility from labor supply.

Households provide capital K_t and labor N_t to firms for production. The capital can be accumulated with investment. The law of motion for capital is

$$K_{t+1} + \Phi\left(K_{t+1}, K_t\right) = (1-\delta)K_t + I_t, \tag{6}$$

where $\delta \in (0,1)$ is the depreciation rate of capital and I_t is the investment in period t. The accumulation of capital will incur the adjustment cost $\Phi\left(K_{t+1}, K_t\right)$ so we can model the Tobin's Q as the indicator of asset price. $\Phi\left(K_{t+1}, K_t\right)$ is specified as a convex function, $\Phi(K_{t+1}, K_t) = \phi\left(K_{t+1} - K_t\right)^2 / 2K_t$.

Moreover, households hold the home bonds B_t^H with the interest rate i_t, and foreign bonds B_t^f with interest rate i_t^f. We assume that the transaction of foreign bonds incurs the risk premium:

$$1 + i_t^f = (1 + i_t^*)\phi_t^* \tau_{B^f}(\gamma_t^{B^f}), \tag{7}$$

where $\gamma_t^{B^f} = S_t B_t^f / P_t Y_t = e_t b_t^f / Y_t$, $e_t = S_t P_t^* / P_t$, $b_t^f = B_t^f / P_t^*$. ϕ_t^* denotes the liquidity

on the international capital market and e_t is the real exchange rate. Y_t and b_t^f are GDP and real foreign bonds respectively. $\tau_{B^f}(\gamma_t^{B^f})$ is the function of risk premium which is a convex function of the ratio of foreign bonds to GDP, $\tau_{B^f}(\gamma_t^{B^f})$ where $\tau_{B^f} = 1 + \bar{\tau}_{B^f} > 1,\ \tau'_{B^f} > 0,\ \tau''_{B^f} > 0$.

Therefore, the budget constraint of household can be written as:

$$\begin{aligned} & P_t C_t + P_t I_t + P_t \Phi\left(K_{t+1}, K_t\right) + M_t + B_t^h - S_t B_t^f + Tax_t \\ & = W_t N_t + R_t^K K_t + \Pi_t + M_{t-1} + (1 + i_{t-1}) B_{t-1}^h + (1 + i_{t-1}^f) S_t B_{t-1}^f \end{aligned} \tag{8}$$

where W_t and R_t^K are the nominal wage and rental rate on capital goods. Π_t and Tax_t are the profit of firms and the lump-sum tax payment to the government.

Household will maximize the utility subject to the budget constraint Eq. (8) and capital accumulation process Eq. (6) with the Lagragian multiplier λ_t and Ω_t respectively. The first-order conditions are listed as below:

$$1 = (1 + i_t) E_t\left[\beta \frac{C_t^{\sigma^C}}{C_{t+1}^{\sigma^C}}\right] \frac{1}{\Pi_{t+1}} \tag{9}$$

$$1 = (1 + i_t^f) E_t\left[\beta \frac{C_t^{\sigma^C}}{C_{t+1}^{\sigma^C}}\right]\left(\frac{e_{t+1}}{e_t}\right) \tag{10}$$

$$\frac{W_t}{P_t} = C_t^{\sigma^C} N_t^{\sigma^N}, \tag{11}$$

$$\left(\frac{M_t}{P_t}\right)^{\sigma^M} = \frac{1 + i_t}{i_t} C_t^{\sigma^C}, \tag{12}$$

$$\frac{R_{t+1}^K}{P_t} = \frac{\Omega_{t+1}}{\lambda_{t+1}}(1 - \delta) + \frac{\Omega_t}{\beta \lambda_{t+1}}, \tag{13}$$

$$\lambda_t = \Omega_t + \phi\Omega_t \frac{I_t}{I_{t-1}^2} + \beta\phi E_t \left\{ \Omega_{t+1} \left[\left(\frac{I_{t+1}}{I_t} \right)^2 \frac{1}{I_t} \right] \right\}. \quad (14)$$

$\Pi_{t+1} = P_{t+1}/P_t$. Letting $q_t = \Omega_t / \lambda_t$, Eq. (13) and (14) can be written as:

$$\frac{R_{t+1}^K}{P_t} = q_{t+1}(1-\delta) + q_t \frac{\lambda_t}{\beta\lambda_{t+1}}, \quad (15)$$

$$1 = q_t + \phi q_t \frac{I_t}{I_{t-1}^2} + \beta\phi q_{t+1} E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left[\left(\frac{I_{t+1}}{I_t} \right)^2 \frac{1}{I_t} \right] \right\}. \quad (16)$$

q_t is Tobin's q which represents the asset price in this model.

2.3 Intermediate goods

We assume that the intermediate goods markets are monopolistically competitive where firms produce heterogeneous goods for the final goods. Firms hire capital and labor for production:

$$Q_t(i) = Z_t (K_t(i))^{\chi} (N_t(i))^{1-\chi} \quad (17)$$

where Z_t is the total factor productivity and χ is the elasticity of capital. The marginal cost associated with the production function is

$$MC_t = \left(\frac{1}{Z_t} \right) R_t^{K\chi} W_t^{\chi} \chi^{-\chi} (1-\chi)^{(-1+\chi)} \quad (18)$$

The goods produced by the domestic firms will be sold domestically and to the foreign country. The home firm produces goods sold in both the domestic and foreign markets. The foreign demand for the home intermediate goods $Q_t^X(i)$ of variety i is assumed as:

$$Q_t^X(i) = \left(\frac{P_t^X(i)}{P_t^X} \right)^{-\nu} Q_t^X \quad \text{and} \quad Q_t^X = X_t^* \left(\frac{P_t^X}{P_t^*} \right)^{-\mu}, \mu > 0, \quad (19)$$

where $P_t^{X*}(i)$ is the firm's export price and P_t^{X*} is the aggregate price index of exported goods, both of which are denominated in the foreign currency. P_t^* is the foreign (international) price. μ is the price elasticity of the aggregate exports. We assume that X_t^* is subject to a random shock.

Firms will set the prices for goods sold in the home country following Calvo's staggered pricing which assumes that each firm may reset its price with a probability $(1-\alpha)$. As a result, on average, a proportion $1-\alpha$ of firms may change the price while α share of firms will maintain their prices. This implies the mean interval of price change is $1/(1-\alpha)$. In period t, a typical firm i will reset the profit-maximizing price $P_t^d(i)$ which maximizes the profit within the period t and $t+s$ when the price remains valid. The optimal price that a typical firm sets is (the subscript i is dropped due to symmetry):

$$P_{t,t}^{d,flex} = \frac{\nu}{\nu-1}\frac{\left\{\sum_{s=0}^{\infty}(\alpha)^s E_t \Lambda_{t+s,t}^d \mathrm{MC}_{t+s,t} Q_{t+s,t}^d \cdot\right\}}{\left\{\sum_{s=0}^{\infty}(\alpha)^s E_t \Lambda_{t+s,t} Q_{t+s,t}^A \cdot\right\}}, \tag{20}$$

where $\Lambda_{t+s,s} = \left(\beta^s \lambda_{t+s}/\lambda_t\right)(P_t/P_{t+s})$. $Q_{t+s,t}^d$ is the demand of goods under this price in the period $t+s$. and $MC_{t+s,t}$ is the associated marginal cost. λ_{t+s} is the Lagragian multiplier in the period $t+s$.

The price index for the domestic price will evolve following the dynamics:

$$\left(P_t^d\right)^{1-\nu} = \alpha\left(P_{t-1}^d\right)^{1-\nu} + (1-\alpha)\left(P_{t,t}^{d,flex}\right)^{1-\nu}, \tag{21}$$

For the foreign country, we assume that the law of one price holds. Therefore, $P_t^{X*} = P_t^d/S_t$.

2.4 Central bank

We assume that the central bank issues money M_t and bonds for households B_t^h, and holds the foreign reserves (denominated in foreign currency) R_t. The Balance sheet of central bank can be written as

$$M_t + B_t^h = S_t R_t, \tag{22}$$

Therefore, the central bank can change the money supply through open market operations. Also, the participation of central bank on the foreign exchange market will change the foreign reserves and money supply. This may also generate the quasi-fiscal surplus as stated below.

The flow income of the central bank can be written as:

$$\begin{aligned} M_t + B_t^h - S_t R_t &= M_{t-1} + (1 + i_{t-1}) B_{t-1}^h - (1 + i_{t-1}^*) S_t R_{t-1} \\ &= (M_{t-1} + B_{t-1}^h - S_{t-1} R_{t-1}) - QF_t, \end{aligned} \tag{23}$$

where

$$QF_t = i_{t-1}^* S_t R_{t-1} + (S_t - S_{t-1}) R_{t-1} - i_{t-1} B_{t-1}^h = [i_{t-1}^* + (1 - \frac{1}{\Delta S_t})] S_t R_{t-1} - i_{t-1} B_{t-1}^h, \tag{24}$$

QF_t is the quasi-fiscal surplus of the central bank. From Eq. (24), we can see that the quasi-fiscal surplus includes the interest payment on the home bonds and interest revenues from foreign bonds.

We assume that the central bank transfers the quasi-fiscal surplus to the government, and thus the net wealth is constant which is assumed to be 0 for simplicity:

$$M_t - B_t^h - S_t R_t = M_{t-1} - B_{t-1}^h - S_{t-1} R_{t-1} = 0. \tag{25}$$

We assume that the government spending is composed of goods resembling the consumption goods, with the lump-sum tax revenues from households and the quasi-fiscal surplus from the central bank. The government's balanced budget can be stated as:

$$G_t = Tax_t + QF_t \tag{26}$$

Combining the budget constraint of households, central bank and government can generate the balance of payments of the nation (in foreign currency):

$$R_t - B_t^f = CA_t + R_{t-1} - B_{t-1}^f, \tag{27}$$

where CA_t stands for the current account:

$$CA_t = i^* R_{t-1} - i^f B_{t-1}^f + TB_t, \tag{28}$$

where TB_t is the trade balance.

2.5 Monetary policy rules

We will follow the specification of Escudé (2013) by implementing two rules. However, since the central bank of Taiwan adopts the monetary aggregate rule by setting the target for the M2 growth rate, we will specify the rules for managing the money growth rate and nominal exchange rate depreciation as below:

$$\frac{1+g_{m,t}}{1+g_m} = \left(\frac{1+g_{m,t-1}}{1+g_m}\right)^{h_0} \left(\frac{\Pi_t}{\Pi^T}\right)^{h_1} \left(\frac{Y_t}{Y}\right)^{h_2} \left(\frac{e_t}{e}\right)^{h_3} \exp(\sigma^m \varepsilon_t^m), \tag{29}$$

$$\frac{\Delta S_t}{\Delta S} = \left(\frac{\Delta S_{t-1}}{\Delta S}\right)^{k_0} \left(\frac{\Pi_t}{\Pi^T}\right)^{k_1} \left(\frac{Y_t}{Y}\right)^{k_2} \left(\frac{e_t}{e}\right)^{k_3} \left(\frac{r_t / Y_t}{r}\right)^{k_4} \exp(\sigma^S \varepsilon_t^S), \tag{30}$$

where $g_{m,t} \equiv (M_t - M_{t-1}) / M_{t-1}$ and g_m are the growth rate of monetary aggregate and the targeted growth rate of money. S_t and S are the nominal exchange rate depreciation and its target, π^T is the inflation target, Y is the steady-state output, e is the steady-state real exchange rate and r is the steady-state foreign reserve ratio to GDP. ε_t^m and ε_t^S are the disturbances of monetary policy while σ^m and σ^S measure the magnitude of these shocks to the policy. $h_0,\ h_1,\ h_2,\ h_3 < 0$ and $k_0,\ k_1,\ k_2,\ k_3 < 0$ are the policy parameters of these two rules. The negative values of these policy parameters imply that the central bank conducts the monetary policies to stabilize the macroeconomic fluctuations.

2.5 Market clearing condition

The market clearing condition of the goods market can be written as:

$$Y_t = C_t + I_t + G_t \tag{31}$$

2.6 Exogenous shocks

There are exogenous shocks underlying this model which include shocks to productivity, government spending, export demand, foreign inflation, foreign interest rate and financial friction on international capital market.

$$Z_t = (1-\rho^Z)\bar{Z} + \rho^Z Z_{t-1} + \varepsilon_t^Z \tag{32}$$

$$\ln G_t = (1-\rho^G)\ln\bar{G} + \rho^G \ln G_{t-1} + \varepsilon_t^G \tag{33}$$

$$\ln X_t^* = (1-\rho)\ln\bar{X}^* + \rho \ln X_{t-1}^* + \varepsilon_t^X \tag{34}$$

$$\Pi_t^* = (1-\rho^*)\Pi^* + \rho^* \Pi_{t-1}^* + \varepsilon_t^\Pi \tag{35}$$

$$i_t^* = (1-\rho^i)i^* + \rho^i i_{t-1}^* + \Pi\varepsilon_t^i \tag{36}$$

$$\varphi_t = (1-\rho^\varphi)\varphi + \rho^\varphi \varphi_{t-1} + \varepsilon_t^\varphi \tag{37}$$

3. Calibration

Most of the parameters are chosen following the conventional settings in the literature. In the steady state, we assume that the current account is balanced. The share of the home produced goods in the foreign consumption X^* is adjusted to assure the balanced current account. The market price of capital goods is assumed to be $q = 1$, and the real exchange rate is specified as 1 in the steady state. β is assumed to be 0.99, following most literature.

The share of import goods in the aggregate consumption α^f is set to 0.3. We set the capital share in production $\chi = 0.3$. The elasticity of intertemporal substitution, inverse of elasticity of labor supply and elasticity of real money demand is set as $\sigma^C = 1$, $\sigma^N = 0$ and $\sigma^M = 1$ for simplicity. Disutility of labor supply ξ^N is assumed to be 1. The depreciation rate of capital is specified as $\delta = 0.025$ (reflecting the annual depreciation rate to be 10%). The adjustment cost of investment is specified as 15. The financial

friction parameter ϕ_t is assumed to be 0.0019 in the steady sate. The elasticity of substitution among goods ν is assumed to be 1.1, such that the markup is about 11%. The elasticity of substitution between the domestic and imported goods and , θ , is set to 5 The degree of price stickiness α is specified as 0.75, implying the average duration of price adjustment around 4 quarters.

We assume that the steady-state foreign reserve ratio to GDP is 0.76 which is the averaged foreign reserve ratio from 2003 to 2016 in Taiwan. As for the monetary aggregate rule, we assume that the policy parameter $h_0 = 0.6$, $h_1 = -0.35$, $h_2 = -0.1$, and $h_3 = -0.02$, following the estimation for Taiwan by Hwang(2012). The policy parameters for the managed floating exchange rate rule are assumed to be $k_0 = 0.03$, $k_1 = -0.07$, $k_2 = -0.08$, $h_3 = -0.43$ and $h_4 = -0.08$.

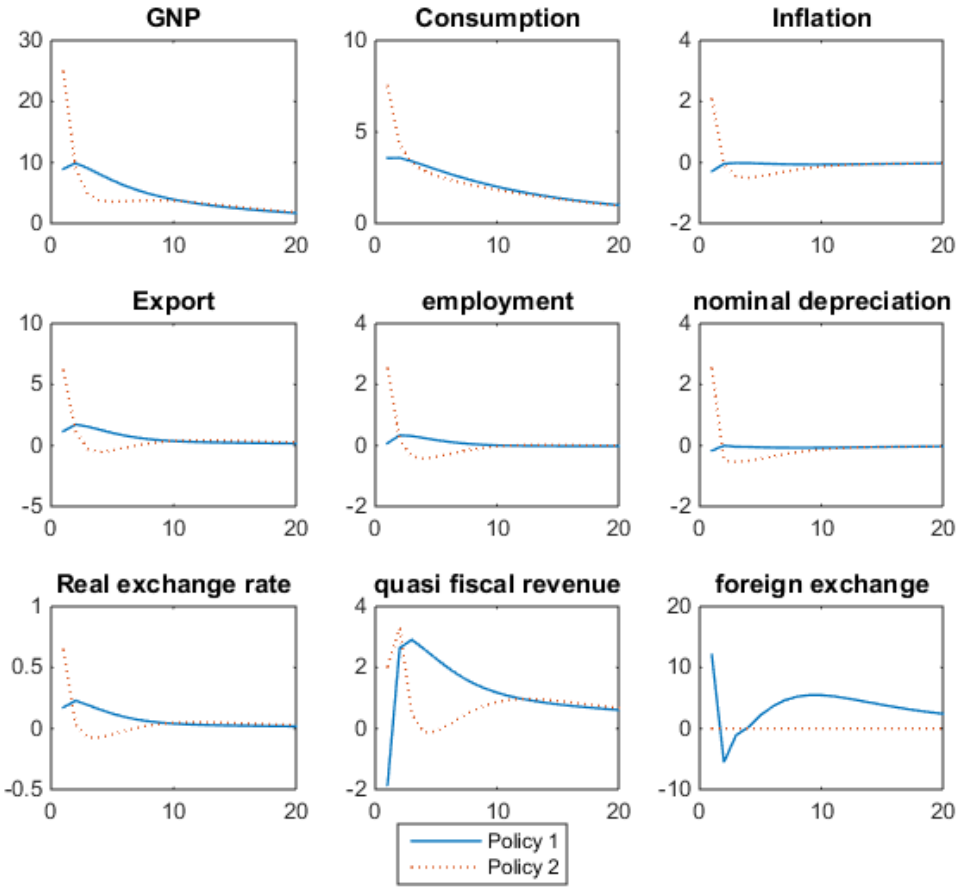
4. Analyses

In the following analyses, we numerically examine the dynamics of alternative monetary policies under productivity shock and foreign interest rate shock respectively.

First, we consider a 1% positive shock to productivity with the AR(1) coefficient as 0.9. Figure 2 shows the impulse response functions under managed floating exchange rate and flexible exchange rate regime where the foreign reserve is held constant respectively while the monetary aggregate rule is in place. We can see that, under flexible exchange rate regime, there is greater depreciation rate in nominal and real exchange rates which benefits the export more, and thus leads to greater increase in output, consumption and employment than the managed floating exchange rate regime. Under managed floating exchange rate regime, in order to contain the exchange rate depreciation, the central bank has to intervene on the foreign exchange market. This has led to a temporary decrease in the foreign reserves. However, the quasi-fiscal revenues may benefit from the nominal depreciation of the home currency.

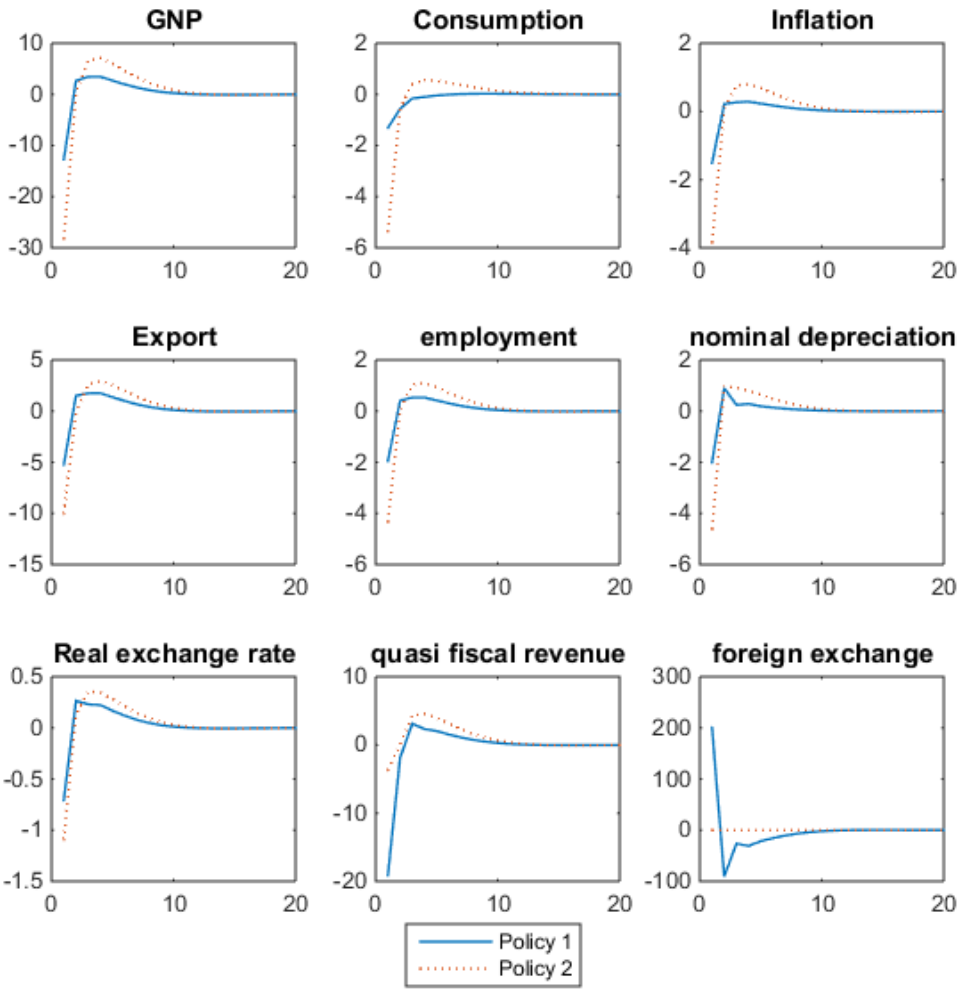
In face of the global trend of interest rate rise in the near future in the aftermath of the global financial crisis, we consider a quarterly 0.25% increase in the foreign interest rate. The impulse response functions under these two policies are outlined in Figure 3. The nominal exchange rate may appreciate upon shock, but depreciate right after. The depreciation helps the increase in export. However, under monetary aggregate rule, the central bank may conduct contractionary monetary policy in response to the increase in

the foreign interest rate. The rise in the interest rate leads to the decline in consumption. However, the central bank will intervene in the foreign exchange market to dampen the exchange rate depreciation under managed floating exchange rate regime. As a result, the increase in export fails to offset the decline in consumption under managed floating exchange rate regime. The output expansion is smaller if central bank conducts managed floating exchange rate regime. Again, to avoid the greater depreciation of home currency, the foreign exchange intervention will lead to a decline in foreign exchange. The quasi-fiscal revenue benefits from the higher foreign interest rate. It declines in the beginning due to home currency depreciation, but rises after the home currency starts to appreciate. In both cases of shocks, the managed floating exchange rate dampens the home depreciation and helps stabilizes the inflation. The inflation stabilization can be the potential benefits of managed floating exchange rate regime.



Note: Policy 1: monetary aggregate rule with managed floating exchange rate regime; Policy 2: monetary aggregate rule with flexible exchange rate regime.

Figure 1: impluse responses under 1% productivity shock



Note: Policy 1: monetary aggregate rule with managed floating exchange rate regime; Policy 2: monetary aggregate rule with flexible exchange rate regime.

Figure 2: impluse responses under 1% foreign interest rate shock

Conclusion

In this study, we use a small-open-economy DSGE model to evaluate the monetary policy in Taiwan. We emphasize the balance sheet of the central bank and thus the foreign exchange changes under foreign exchange intervention. Under this framework, the central bank may conduct policy coordination which involves the monetary aggregate rule and managed floating exchange rate regime. The simulation results show that the managed floating exchange rate regime which dampens the exchange rate fluctuation also helps stabilize the inflation.

In the future, we may further consider whether or not the monetary policy should respond to the change in asset price. This has become an important issue after the financial crisis. Moreover, while most emerging economies tend to accumulate great amount of foreign reserves to avoid drastic exchange rate depreciation, which is the lesson learned from the Southeast Asian financial crisis in 1997, it may worth a while for us to examine the foreign reserves more carefully in the future.

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國科會補助專題研究計畫項下出席國際學術會議心得報告

日期：106 年 10 月 15 日

計畫編號	MOST 105-2410-H-004-006 -		
計畫名稱	最適貨幣政策協作與景氣循環		
出國人員 姓名	黃俞寧	服務機構 及職稱	政治大學經濟系副教授
會議時間	105 年 11 月 11 日至 105 年 11 月 13 日	會議地點	Durham, North Carolina, USA
會議名稱	(中文) (英文) Duke Forest Conference, 2016 (Economics in the Era of Natural Computationalism and Big Data)		
發表論文 題目	(中文) (英文) Implications of the Chinese Monetary Policy Reform: A Dynamic Stochastic General Equilibrium Approach		

一、參加會議經過

本人於當地時間 11 月 11 日抵達美國紐約，繼又轉機至會議地點 Hilton, Durham, North Carolina 參加會議，於 11 月 13 日下午報告" Implications of the Chinese Monetary Policy Reform: A Dynamic Stochastic General Equilibrium Approach"一文，會議中就中國經濟改革現況與模型建置與與會專家進行許多討論。除了全程參與會議之外，並利用會議期間中午、晚餐時間與來自美國各地，如 Arizona State University 的 Hang Liu、George Mason University 的 Robert Axtell，以及大陸、台灣的學者進行交流。由於 Durham 該地為美國著名的 research triangle，附近有 North Carolina State University, Duke University, University of North Carolina at Chapel Hill 等三所知名大學，我便在 11 月 12 日下午與在該

會議地點巧遇、正在參加另一會議的高雄大學王學亮校長與丁一賢國際長一同前往杜克大學參訪。

二、與會心得

此會議為一專門探討大數據、實驗經濟學、computational economics 的研討會，會議中聆聽諸多學者談論關於大數據的發展、實驗經濟學的演進，收穫甚豐。且由於該會議採取小型、有特定主題的工作坊形式，與其他學者有更多機會有更進一步的討論與互動。

三、考察參觀活動(無是項活動者略)

四、建議

五、攜回資料名稱及內容

六、其他

Welfare Implications of the Chinese Monetary Policy Reform: A Dynamic Stochastic General Equilibrium Approach

Yu-Ning Hwang*

Department of Economics
National Chengchi University

Oct. 2016

Abstract

In this study, we establish an open-economy DSGE model with the frictional domestic credit market to conduct the welfare analyses of monetary policy reform plans of China. Currently, both the domestic credit market and international capital market are under various regulations. The progress of the gradual removal of these market regulations, which may crucially alter the transmission mechanism of domestic as well as foreign shocks, is important for the economic transformation of the Chinese economy. The welfare analyses generate important policy implications for the progress of policy reforms. The results suggest that, compared with domestic deregulations, opening capital account can be most critical as it makes the international transmission mechanism of shocks feasible.

Keyword : dynamic stochastic general equilibrium (DSGE), Chinese economy, economic transformation

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105年度專題研究計畫成果彙整表

計畫主持人：黃俞寧	**計畫編號：**105-2410-H-004-006-
計畫名稱：最適貨幣政策協作與景氣循環	

成果項目					量化	單位	質化 （說明：各成果項目請附佐證資料或細項說明，如期刊名稱、年份、卷期、起訖頁數、證號...等）
國內	學術性論文	期刊論文			0	篇	
		研討會論文			0		
		專書			0	本	
		專書論文			0	章	
		技術報告			0	篇	
		其他			0	篇	
	智慧財產權及成果	專利權	發明專利	申請中	0	件	
				已獲得	0		
			新型/設計專利		0		
		商標權			0		
		營業秘密			0		
		積體電路電路布局權			0		
		著作權			0		
		品種權			0		
		其他			0		
	技術移轉	件數			0	件	
		收入			0	千元	
國外	學術性論文	期刊論文			0	篇	
		研討會論文			0		
		專書			0	本	
		專書論文			0	章	
		技術報告			0	篇	
		其他			0	篇	
	智慧財產權及成果	專利權	發明專利	申請中	0	件	
				已獲得	0		
			新型/設計專利		0		
		商標權			0		
		營業秘密			0		
		積體電路電路布局權			0		
		著作權			0		
		品種權			0		
		其他			0		

	技術移轉	件數	0	件	
		收入	0	千元	
參與計畫人力	本國籍	大專生	0	人次	
		碩士生	4		協助相關資料收集、文獻回顧與模型建構
		博士生	1		協助模型建構
		博士後研究員	0		
		專任助理	0		
	非本國籍	大專生	1		協助相關資料收集
		碩士生	0		
		博士生	0		
		博士後研究員	0		
		專任助理	0		
其他成果 （無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。）					

科技部補助專題研究計畫成果自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現（簡要敘述成果是否具有政策應用參考價值及具影響公共利益之重大發現）或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估
   ■達成目標
   □未達成目標（請說明，以100字為限）
   　□實驗失敗
   　□因故實驗中斷
   　□其他原因
   說明：

2. 研究成果在學術期刊發表或申請專利等情形（請於其他欄註明專利及技轉之證號、合約、申請及洽談等詳細資訊）
   論文：□已發表　□未發表之文稿　■撰寫中　□無
   專利：□已獲得　□申請中　■無
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   其他：（以200字為限）

3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性，以500字為限）
   本研究主要是因應金融危機之後，由於先進國家的量化寬鬆政策，小型開放經濟體系大多面臨較大規模的資金流入與匯率波動。我們藉由一小型開放經濟體系的動態隨機一般均衡架構來探討貨幣政策協作，亦即央行同時採取貨幣成長率法則與管理浮動匯率之影響。研究結果顯示，管理浮動匯率有助於穩定匯率與通貨膨脹率波動。此研究亦是呼應學術界與實務界在金融危機之後對於貨幣政策施行方式的反思與討論，確有更進一步發展的潛力。

4. 主要發現
   本研究具有政策應用參考價值：■否　□是，建議提供機關
   （勾選「是」者，請列舉建議可提供施政參考之業務主管機關）
   本研究具影響公共利益之重大發現：□否　□是
   說明：（以150字為限）