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Effectiveness of Fiscal and Monetary Policies on Output and the Exchange Rate in China: Test of the Mundell-Fleming Model

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Abstract: *Applying an extended IS-LM model, this study finds that fiscal expansion raises output and causes real appreciation and that monetary expansion increases output and causes real depreciation. In addition, a lower real interest rate or a higher real stock price increases output, and a lower real interest rate or a higher real stock price causes real appreciation. Therefore, except for the positiveimpact of fiscal expansion on output, the Mundell-Fleming model applies to China.*

Keywords: *fiscal expansion, monetary expansion, exchange rates, Mundell-Fleming model*

JEL Codes: *E52, E62, F41*

INTRODUCTION

China's government has engaged in fiscal policy, monetary policy and other macroeconomic measures to stimulate or stabilize its economy. During the global financial crisis, the Chinese government employedexpansionary fiscal policy by raising government borrowing as a percent of GDP from 0.025% in 2007 to 1.74% in 2008.Its government debt-to-GDP ratio also rose from 27.0% in 2008 to 34.346% in 2009.

During the global financial crisis, the People's Bank of China(PBC) engaged in monetary expansion. The discount rate dropped from 3.33% in 2007 to 2.79% in 2008 and 2009. The lending rate followed suit and declined from 7.47% in 2007 to 5.31% in 2008 and 2009. M1money supply rose 32.36% during 2008 - 2009to provide more liquidity to the banking and financial systems.The PBC also maintained a relatively stable exchange rate of 6.95 in 2008 and 6.83 in 2009 versus the U.S. dollar in order to stabilize international trade and capital mobility.

A review of the literature shows that few of previous studies have examined the effects of monetary and fiscal policies on output and the

exchange rate in China based on an extended Mundell-Fleming model. This paper attempts to test if the Mundell-Fleming model may apply to China. According to the Mundell-Fleming Model (Mundell, 1963, 2001; Fleming, 1962; Romer, 1996; Obstfeld, 2001; Mankiw, 2019), under a floating exchange rate system, expansionary fiscal policy tends to have no effect on output and cause real appreciation whereas expansionary monetary policy tends to raise output and cause real depreciation. This paper differs from previous studies partly because the realeffective exchange rate is included in the money demand function. Hence, the LM^* curve may not be vertical, and expansionary fiscal policy may affect output.

LITERATURE SURVEY

Several recent studies have examinedfiscal policy, monetary policy, exchange rates, and other relevant variables for Chinaand other related countries.

Based on a sample of 61 countries including many Asian developing countries and using the panel data technique including the fixed effect and the random effect, Karras (2011) found that the estimated long-run fiscal multiplier ranges from 1.21 to 1.53 in the full sample, from 1.44 to 2.43 for countries with fixed exchange rates, and from 0.98 to 1.39 for countries with floating exchange rates. Hence, fiscal multipliers are more effective under fixed exchange rates than under floating exchange rates. Based on a sample of 179 developing and developed countries including China during 1970-2011, Karras (2014) also showed that the domestic multiplier is much higher in the least open economies than in the most open economies, that the spillover effect is much greater in the most open economies than in the least open economies. These results suggest that there would be a tradeoff of the domestic multiplier and the spillover effect in the least open and most open economies.

Applying the PVAR model and using a sample of the five BRICS countries including China, Jawadi, Mallick, and Sousa (2016) found that monetary policy and fiscal policy accommodated to each other and that increased government spending resulted in significant Keynesian impacts whereas contractionary monetary policy led to declining economic activities in the real sector and less liquidity in the financial market.

Jeong, Kang, and Kim (2017) assessed the impacts of government spending on several macroeconomic variables for China, Japan, and South Korea. The multipliers for these three countries are estimated to be greater than one. The spending multiplier in China is greater than that in Japan. The impact of expansionary fiscal policy in China has not changed noticeably.

Xiaolin, Li, and Rong (2017) showed that the soft constraint of China's government debt is confirmed. Fiscal deficit does not have economic growth effect in the long run, and the short-run growth effect is the only one restrained by government debt. Although fiscal deficit can promote labor employment in the short run, external government debt has a hindering effect on employment. Government debt reduces the impact of inflation due to rising fiscal deficit. The relationship among fiscal deficit, government debt and inflation is hard to converge in the long run.

Studying the twin deficit hypothesis for China based on a sample during 1985-2016, Banday and Aneja (2019) showed that the results support the long-run relationship between budget deficit and current account deficit. A decrease in budget deficit results in a decline in current account deficit whereas an increase in budget deficit causes current account deficit to rise. Hence, the Keynesian hypothesis is validated.

Using a threshold SVAR model, Zhang, Zhang, Zheng, and Zhang (2019) examined the impact of government spending on output in China. They found that the fiscal multiplier appears to be procyclical, which is contrary to countercyclical fiscal multipliers found in advanced countries.

Wang and Wen (2019) found that the fiscal multiplier is found to be greater than one in aggregate time series data and in the data for provinces and that increased government spending causes output, private spending and inflation to rise.

Kong and Feng (2019) found that China's fiscal policy is countercyclical and achieves desired goals and that government investment spending in fixed assets increases economic growth. However, they also showed that economic growth has a positive relationship with taxes, possibly because the taxation is designed to enhance proper resource allocation.

In the area of monetary policy, Jun and Yuan (2002) revealed that the anticipated and unanticipated changes in the quantity of money affect China's output and that the impacts are asymmetric. These findings are in contrast with the policy ineffectiveness proposition. They attribute the significant impacts to price rigidity and the imperfect market.

da Silva and Vieira (2017) examined monetary and fiscal policy for 113 advanced and developing countries during 2001-2008 and 2009-2012. Monetary policy appeared to be countercyclical in advanced countries before the global financial crisis. Fiscal policy seemed to be procyclical before the crisis. Smoothing of interest rates appeared to be an important instrument in monetary policy. Central banks in advanced countries ceased to react to the output gap after the global financial crisis. No

significant relation between government spending and the output gap was found.

Examining China's monetary policy when survey expectations were employed along with alternative rules, Zhang and Dang (2018) showed that before 2008, there was little role for expectations whereas after 2008, expectations played an important role. The PBC stimulates growth pro-cyclically whereas it deals with inflation counter-cyclically.

Klingelhöfer and Sun (2018) revealed that there is strong evidence that China's monetary policy reaction function is asymmetric in the post-2000 period and changes through 3 different regimes. When the PBC expects a relatively high inflation rate,it engages in monetary tightening by changing various policy rules. The PBC employs monetary easing when economic slowdown is expected. The PBC tolerates economic overheating and low inflation and hardly reacts to them.

According to Yuseogi (2018), when the PBC pursues monetary tightening, the yuan appreciates. The quantitative monetary policy is more significant than the interest rate instrument. There is a delayed overshooting puzzle in the real effective exchange rate whereas no overshooting was found for the nominal effective exchange rate and the yuan-U.S. dollar exchange rate. On the other hand, some Asian currencies did not show depreciation against the yuan partly due to co-movements of interest rates in these countries.

Ji (2019) indicated that China's monetary policy transmission is expected to continue to improve because the impact of the policy instrument on the economy increases and stabilizes over time. Yuan appreciation is expected to reduce inflation along the distribution chain in China and cause strong pass-through effect to the consumer price. Fiscal expansion causes inflation to rise, and tax revenue causes output to rise. However, the impact of government spending appears to be neutral.

Sun (2020) found that market interest rates hardly react to the qualitative announcements of the MPC but respond significantly to the announced changes in the required reserve ratio and the regulated retail interest rate. The response is stronger for the short-term rates than the long-term rate.

THE MODEL

Suppose that aggregate expenditures are a function of real income,government tax revenues, government spending, the real interest rate, the real stock price, and the realeffective exchange rate and that real money demand is determined by the nominal interest rate, real GDP, the

real stock price, and the real effective exchange rate. Extending Romer (1996) and Mankiw (2019), we can express the IS and LM functions as:

$$Y = g(Y, T, G, R - \pi^*, S, E) \tag{1}$$

$$M/P = h\,(R, Y, S, E) \tag{2}$$

where

Y = real GDP in China,

T = government tax revenue,

G = government spending,

R = the nominal interest rate,

π^* = the expected inflation rate,

S = the real financial stock price,

E= the realeffective exchange rate (An increase means real appreciation.),

M= nominal money supply, and

P = the price level.

Solving for the two endogenous variables, Y and E, we can find equilibrium real GDP andreal effective exchange rate as:

$$\bar{Y} = \bar{Y}(G - T, M/P, R - \pi^*, S) \tag{3}$$

$$\bar{E} = \bar{E}(G - T, M/P, R - \pi^*, S) \tag{4}$$

Assume that $h_E < 0$ and that $g_G > g_T$. The determinants of the Jacobian matrix for the two endogenous variables is given by:

$$|J| = [-h_E(1 - g_Y) - g_E h_Y] > 0. \tag{5}$$

The impacts of fiscal expansion on equilibrium Y and E can be shown as:

$$\partial\bar{Y}/\partial G - \partial\bar{Y}/\partial T = -(g_G - g_T)h_E/|J| > 0. \tag{6}$$

$$\partial\bar{E}/\partial G - \partial\bar{E}/\partial T = (g_G - g_T)h_Y/|J| > 0. \tag{7}$$

Equations (6) and (7) suggest that more government deficit tends to raise output and lead to real appreciation. The prediction in equation (6) is different from the Mundell-Fleming model because of the inclusion of the realeffective exchange rate in the money demand function. In the Mundell-Fleming model, because the realeffective exchange rate is not included, $h_E = 0$, and the partial derivative of equilibrium real GDP with respect to

the government deficit is zero, suggesting that fiscal expansion does not raise real GDP.

The partial derivatives of equilibrium Y and E with respect to monetary expansion can be expressed as:

$$\partial \bar{Y} / \partial M = -P^{-1} g_E / |J| > 0. \tag{8}$$

$$\partial \bar{E} / \partial M = -P^{-1} (1 - g_Y) / |J| < 0. \tag{9}$$

Equations (8) and (9) indicate that more money supply tends to raise output and cause real depreciation. When the money supply increases, the LM^* curve shifts to the right, equilibrium real GDP rises, and equilibrium real effective exchange rate declines.

EMPIRICAL RESULTS

The data were collected from IMF's*International Financial Statistics*, the World Economic Outlook, andthe Federal Reserve Bank of St. Louis. Real GDP is measured in billion yuan. Government debt as a percent of GDP is chosen to represent fiscal policy as it is an accumulation of government deficit. The real effective exchange rate is a trade weighted index. An increase means real appreciation. Real money supply is represented by M1 money measured in million yuan adjusted for the consumer price index. The lending rate minus the expected inflation rate is selected to represent the real interest rate. Other types of interest rates do not have adequate observations. The nominal stock price is an index with the base year in 2010. It is adjusted for the consumer price index to derive the real stock price. The expected inflation rate is estimated as aweighted average of lagged inflation rates in the past four years. Real GDP, the debt-to-GDP ratio, real M1, and the real stock index are transformed to a log scale. The real lending rate and the expected inflation rate are not transformed to a log scale due to negative values before or after the transformation.The sample consistsof annual data ranging from 1998 to 2018. The data for real GDP in 2019 and M1 money before 1998are not available.

Figure 1 presents the scatter diagram between real GDP and the debt-to-GDP ratio and seems to suggest that a higher debt-to-GDP ratio leads to more output. Figure 2 displays the scatter diagram between real GDP and real M1 money and appears to indicate that more real M1 money causes real GDP to rise.

The GARCH process is employed in empirical work to correct for autoregressive conditional heteroscedasticity. The estimated coefficients in

the conditional variance equation are significant at the 1% level, suggesting that the GARCH process is appropriate. In the estimated regression for real GDP in Table 1, the four exogenous variables can explain approximately 99.29% of the variation in real GDP. All the estimated coefficients are significant at the 1% level. Real GDP has a positive relationship with the debt-to-GDP ratio, real M1 money, and the real stock price and a negative relationship with the real interest rate. Hence, both fiscal expansion and monetary expansion raise real GDP. A possible reason for the positive effect of fiscal expansion on real GDP is that the positive effect of fiscal expansion on aggregate demand is greater than the negative crowding-out effect on private spending. Specifically, if the debt-to-GDP ratio rises 1%, real GDP would increase by 0.1376%. A 1% increase in real M1 money would raise real GDP by 0.7356%. A higher real stock price raises real GDP mainly due to increases in consumption and investment expenditures through the wealth effect, the balance sheet channel and Tobin's q theory (Mishkin, 1995).

Figure 1: Scatter Diagram between Real GDP (RGDP) and the Debt-to-GDP Ratio (DEBTY)

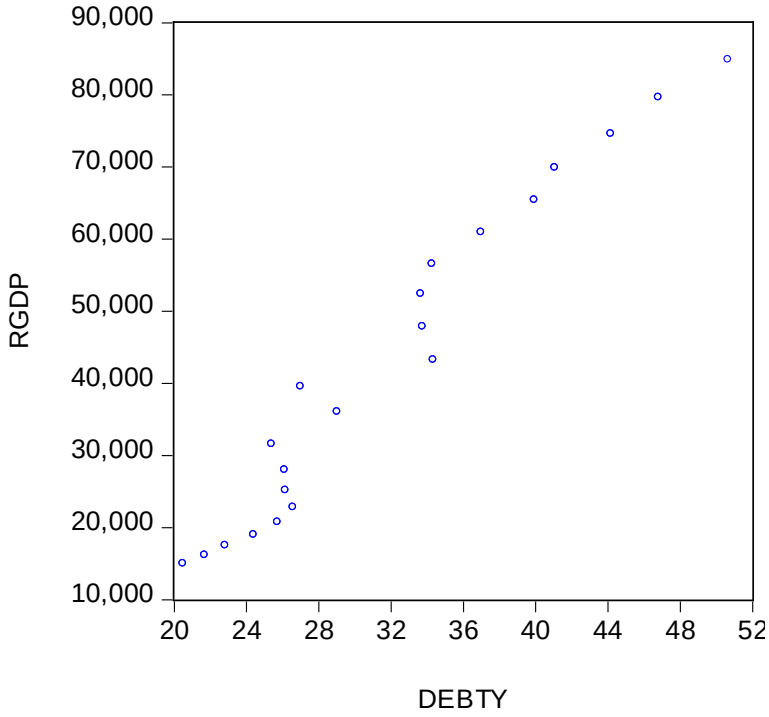
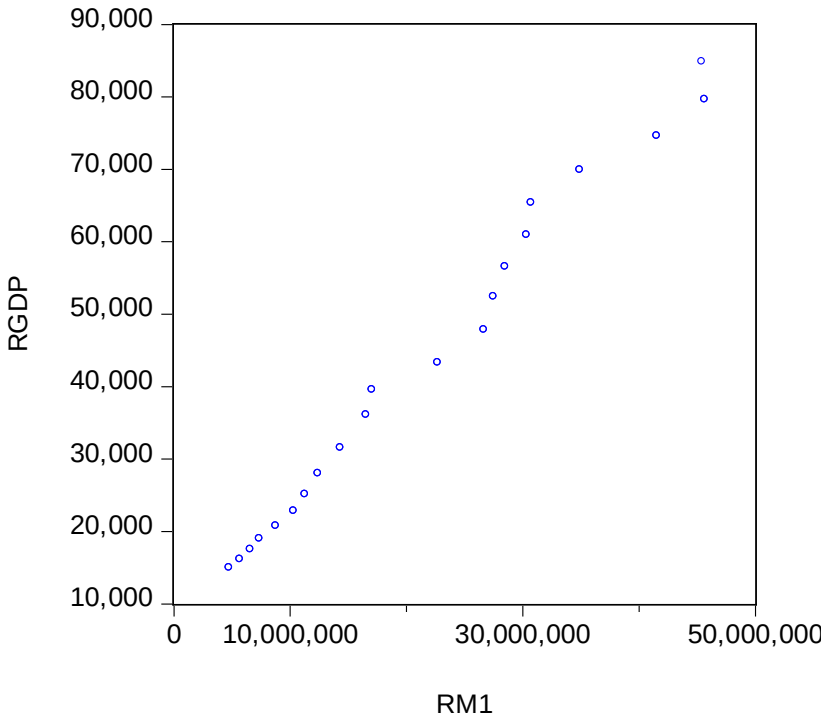


Figure 2: Scatter Diagram between Real GDP (RGDP) and Real M1 (RM1)



In the estimated regression for the real effective exchange rate, approximately 82.73% of the change in the dependent variable can be explained by the four right-hand side variables. All the coefficients are significant at the 1% level. The real effective exchange rate is positively affected by the debt-to-GDP ratio and the real stock price and negatively influenced by real M1 money and the real interest rate. These results indicate that fiscal expansion results in real appreciation whereas monetary expansion leads to real depreciation. A higher real interest rate tends to reduce consumption and investment spending, shift IS^* to the left, reduce equilibrium real GDP, and lead to real depreciation. On the other hand, a higher real interest rate tends to attract international capital inflows, increase the demand for the yuan, and cause real appreciation. It seems that the negative effect of real depreciation is greater than the positive effect of real appreciation. A higher real stock value tends to attract foreign investors to purchase China's stocks, increase the demand for the yuan, and cause real appreciation.

Table 1
Estimated Regressions for Real GDP and the RealEffective Exchange Rate (REER)

	Log (real GDP)	*Log (REER)*
Constant	-2.2433 (0.0000)	4.2376 (0.0000)
Log(government debt as a percent of GDP)	0.1376 (0.0000)	0.7466 (0.0000)
Log(real M1)	0.7355 (0.0000)	-0.1349 (0.0000)
Real interest rate	-0.0145 (0.0000)	-0.0282 (0.0000)
Log(real stock price)	0.0228 (0.0000)	0.0367 (0.0000)
R-squared	0.9929	0.8273
Adjusted R-squared	0.9836	0.3956
Akaike information criterion	-3.5721	-2.8428
Schwarz criterion	-3.2240	-2.4946
Sample period	1998-2018	1998-2018
Number of observations	21	21

Notes:
REER: the realeffective exchange rate.
Figures in the parentheses are probabilities.

SUMMARY AND CONCLUSIONS

This paper has examined the effectiveness of fiscal and monetary policies under the framework of an extended Mundell-Fleming model. For China, fiscal expansionraisesoutput and causes real appreciation, and monetary expansion increases output and causes real depreciation. Except for the impact of fiscal expansion on output, the findings are generally consistent with the Mundell-Fleming model. In addition, a lower real interest rate or a higherreal stock price would raise output; and a higherstock price would result in real appreciation. A higher real interest rate causes real depreciation.

There are several policy implications. If the macroeconomic goal is to increase exports, monetary expansion would be a better choice than fiscal expansion as the former leads to real depreciation whereas the latter results in real appreciation. Real depreciation tends to stimulate exports. Fiscal expansion such as huge government deficit or debt tends to raise the interest rate, cause real appreciation and hurt private spending and exports. A healthy stock market is important as a higher real stock value would lead to a higher output.

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