

Does the Mundell-Fleming Model Apply to South Africa?

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Abstract: Applying an extended IS-LM model to South Africa, this paper finds that fiscal expansion reduces output and causes real appreciation and that monetary expansion increases output and leads to real depreciation. Besides, a lower real interest rate or a higher stock price helps raise output; and a higher real interest rate or a higher stock price results in real depreciation. Hence, except for the negative impact of fiscal expansion on output, the predictions of the Mundell-Fleming model are applicable to South Africa.

INTRODUCTION

South Africa's authorities have conducted fiscal policy, monetary policy and other macroeconomic measures to stimulate or stabilize its economy. During the recent global financial crisis, the South African government used expansionary fiscal policy by raising the government deficit from -0.1818% of GDP in 2008 to -5.1611% of GDP in 2009 and -4.9682% of GDP in 2010. As the economy continued to improve, the deficit-to-GDP ratio declined to a low of -3.2718% in 2018 (IMF, 2019). Central government debt as a percent of GDP also rose from 26.5061% in 2008 to 30.0785% in 2009 and 34.6752% in 2010, and it continued to rise to a high of 56.9962% in 2018 (IMF, 2019). These statistics suggest that South African authorities have met or attempted to meet the EU standards of the government deficit-to-GDP ratio of 3% and debt-to-GDP ratio of 60%, respectively. During the recent global financial crisis, the Reserve Bank of South Africa lowered the lending rate from 15.125% in 2008 to 11.7083% in 2009 and 9.8333% in 2018 (IMF, 2019). The Reserve Bank of South Africa has pursued a floating exchange

rate system since 2000 and allows the rand exchange rate to be determined by market demand and supply. However, the Reserve Bank of South Africa may intervene in the exchange rate market in order to reduce unjustified large short-term fluctuations and depreciation of the rand.

To the author's knowledge, few of previous studies have examined the effects of monetary policy and fiscal policy on output and the real effective exchange rate in South Africa within the framework of an extended Mundell-Fleming model. This paper attempts to test if the predictions of the Mundell-Fleming model may apply to South Africa. According to the Mundell-Fleming Model (Mundell, 1963, 2001; Fleming, 1962; Romer, 1996; Obstfeld, 2001; Mankiw, 2019), under a floating exchange rate system, fiscal expansion is ineffective in raising output and causes real appreciation whereas monetary expansion is effective in raising output and causes real depreciation. This paper differs from previous studies partly because the real effective exchange rate is included in the money demand function. Hence, the LM^* curve may not be vertical, and fiscal expansion may affect output.

LITERATURE SURVEY

Several recent studies have examined the effects of fiscal policy, monetary policy, and exchange rate movements on output and other related variables for South Africa and other related countries.

Using a sample of 44 countries including South Africa, Ilzetzki, Mendoza, and Végh (2010) showed that the impact of fiscal expansion depended on the exchange rate system, government debt, trade openness, and the development stage. The fiscal multiplier was relatively large under a predetermined exchange rate but was zero under a floating exchange rate. The fiscal multiplier was negative in countries with a high level of debt and was greater in closed economies and industrialized countries.

Applying the panel data technique including the fixed effect and the random effect and based on a sample of 61 countries including South Africa and, Karras (2011) revealed that the estimated long-run fiscal multiplier was between 1.21 and 1.53 in the full sample, between 1.44 and 2.43 for countries with fixed exchange rates, and between 0.98 and 1.39 for countries with floating exchange rates. Hence, fiscal multipliers were more effective under fixed exchange rates than under floating exchange rates. Based on a sample of 179 developing and developed countries including South Africa during 1970-2011, Karras (2014) also reported that the domestic multiplier was much higher in the least open economies than in the most open economies, that the spillover effect was 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.

Studying the subject of the twin deficit based a sample of 193 countries including South Africa during 1980-2016, Afonso, Huart, Jalles, and Stanek (2018) indicated that the twin deficit relationship was confirmed if the fiscal rules were absent. The estimated coefficient for the effect of the budget balance on the current account balance was between 0.68 and 0.79. If fiscal rules were adopted, the coefficient would be 0.1.

Kabundi and Ngwenya (2011) examined monetary policy in South Africa based on the factor-augmented vector autoregressive model during 1985.M2-2007.M11. They found no support for the price puzzle and that monetary policy was effective in stabilizing the price level. Real or financial variables responded negatively to monetary tightening.

Evans (2019) studied the impacts of money on inflation and output in South Africa and Nigeria within the framework of Friedman and Schwartz using the ARDL method during 1970-2016. He showed that money growth affected output in the short run but not in the long run, suggesting that the theory advocated by Friedman and Schwartz is correct. He also found that money growth influenced the price level in the short and long run. Inflation is a monetary phenomenon everywhere both in the short and long run.

Swanepoel (2004) assessed the monetary-fiscal mix in South Africa during 1972/73 – 2002/03. They indicated that fiscal policy was mostly procyclical whereas monetary policy was mainly countercyclical during this time period. These two policies were uncoordinated. The magnitude of automatic fiscal stabilizers should be estimated in order to find out the accuracy and timing of discretionary fiscal policy.

Du Plessis, Smit and Sturzenegger (2007) evaluated the cyclical nature of fiscal and monetary policy in South Africa after 1993. The structural model consisted of demand shocks from fiscal and monetary policy and supply shocks. They confirmed that monetary policy has been mostly countercyclical since 1994 and that fiscal policy has been procyclical especially in recent years. The procyclical fiscal policy had little impact of destabilizing real output.

da Silva and Vieira (2017) examined monetary and fiscal policy for 113 developing and advanced countries including South Africa during 2001-2008 and 2009-2012. Monetary policy seemed to be countercyclical in advanced countries before the global financial crisis. Fiscal policy appeared to be procyclical before the crisis. Smoothing of interest rates looked like 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 relationship between government spending and the output gap was found.

Lopez-Villavicencio and Mignon (2016) studied exchange rate pass-through (ERPT) using a sample of 15 emerging economies including South Africa during 1994-2015 period. They showed that more anti-inflationary and stable policy led to declining ERPT, that most countries adopting inflation targeting resulted in significant decline in ERPT, and that transparent monetary policy or adopting exchange rate targeting reduced ERPT.

Kabundi (2018, 2019) investigated exchange rate pass-through (ERPT) in South Africa during 1994-2014. ERPT was complete in the first stage but incomplete in the second stage, suggesting that retail businesses did not pass through all the costs to consumers. The first-stage ERPT declined slightly since the 2008-2009 global financial crisis. Evidence of asymmetry was found in the first and second stage ERPT. The second stage ERPT has declined considerably since the adoption of inflation targeting. Major reasons for the decline in ERPT were the adoption of inflation targeting, increased credibility of the Reserve Bank of South Africa through transparency, independence, and better communications.

THE MODEL

Suppose that aggregate expenditures are a function of real income, government tax revenues, government spending, the real interest rate, the stock price, and the realeffective exchange rate and that real money demand is determined by the nominal interest rate, real GDP, the stock price, and the real effective exchange rate. Extending Romer (1996) and Mankiw (2019), we can express the IS and LM functions as:

$$Y = g(Y, T, G, R - \pi^e, S, \varepsilon) \quad (1)$$

$$M/P = h(R, Y, S, \varepsilon)$$

where

Y = real GDP in South Africa,

T = government tax revenue,

G = government spending,

R = the nominal interest rate,

π^e = the expected inflation rate,

S = the stock price,

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

M = the money supply, and

P = the price level.

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

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

$$\varepsilon = \bar{\varepsilon}(G - T, M/P, R - \pi^e, S) \quad (4)$$

Assume that $h_\varepsilon < 0$, $0 < g_Y < 1$, $g_\varepsilon < 0$, $h_Y > 0$, and $g_G > g_T$. The determinant of the Jacobian matrix for the two endogenous variables is given by:

$$|J| = [-h_\varepsilon(1 - g_Y) - g_\varepsilon h_Y] > 0. \quad (5)$$

h_ε is defined as the partial derivative of real money demand with respect to the real effective exchange rate. The assumption of a negative h_ε suggests that real appreciation of the rand would reduce real money demand. An analysis of the sample confirms that real money demand and the real effective exchange rate have a negative significant relationship. Because we assume that $h_\varepsilon < 0$, $0 < g_Y < 1$, $g_\varepsilon < 0$, and $h_Y > 0$, the determinant of the Jacobian will be strictly positive. If $h_\varepsilon > 0$, the sign of the determinant of the Jacobian will be unclear, and LM* will be downward sloping. Because IS* is also downward sloping, the equilibrium will be unstable.

The impacts of fiscal expansion on equilibrium \bar{Y} and $\bar{\varepsilon}$ can be shown as:

$$\partial \bar{Y} / \partial G - \partial \bar{Y} / \partial T = -(g_G - g_T) h_\varepsilon / |J| > 0, \quad (6)$$

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

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 real effective exchange rate in the money demand function. In the conventional Mundell-Fleming model, because the real effective exchange rate is not included, $h_\varepsilon = 0$, and the partial derivative of equilibrium real GDP with respect to the government deficit is zero, suggesting that fiscal expansion does not affect real GDP.

The partial derivatives of equilibrium \bar{Y} and $\bar{\varepsilon}$ with respect to the money supply can be expressed as:

$$\partial \bar{Y} / \partial M = -P^{-1} g_\varepsilon / |J| > 0. \quad (8)$$

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

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 the *International Financial Statistics*, the World Economic Outlook, the Reserve Bank of South Africa, and the Federal Reserve Bank of St. Luis. Real GDP is measured in millions. Government deficit as a percent of GDP is chosen to represent fiscal policy. The real effective exchange rate is a trade-weighted index. An increase means real appreciation. Real money supply is represented by M2 money in millions adjusted for the consumer price index. M1 money is relatively narrow as it does not include saving accounts, small time deposits, money market accounts, and money market deposit accounts. The lending rate minus the expected inflation rate is selected to represent the real interest rate. The expected inflation rate is estimated as the average of lagged inflation rates in the past four years. The financial stock price is represented by an index with 2010 as the base year. Real GDP, real M2, and the stock index are transformed to a log scale. The government deficit-to-GDP ratio, the real lending rate and the expected inflation rate are not transformed to a log scale due to potential negative values before or after the transformation. The sample consists of annual data ranging from 1980 to 2018. Earlier data for the real effective exchange rate were not available.

Figure 1 shows that real GDP and the government deficit-to-GDP ratio seemed to exhibit a negative relationship during 19980-2008 and that there appeared to be an upward shift during 2009-2018. Hence, an intercept binary variable and an interactive slope binary variable are included in the estimated regression. Figure 2 indicates that real GDP and real M2 had a strong positive relationship during the sample period of 1980-2018.

The EGARCH 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 EGARCH process is appropriate.

In the estimated regression for real GDP in Table 1, the six exogenous variables can explain approximately 99.55% of the variation in real GDP. All the estimated coefficients are significant at the 1% level. Real GDP has a positive relationship real M2 money and the stock price and a negative relationship with the government deficit-to-GDP ratio and the real interest rate. During 2009-2018, the slope coefficient of the deficit-to-GDP ratio

Figure 1: Scatter Diagram between Real GDP (RGDP) and the Government Deficit-to-GDP Ratio (DY)

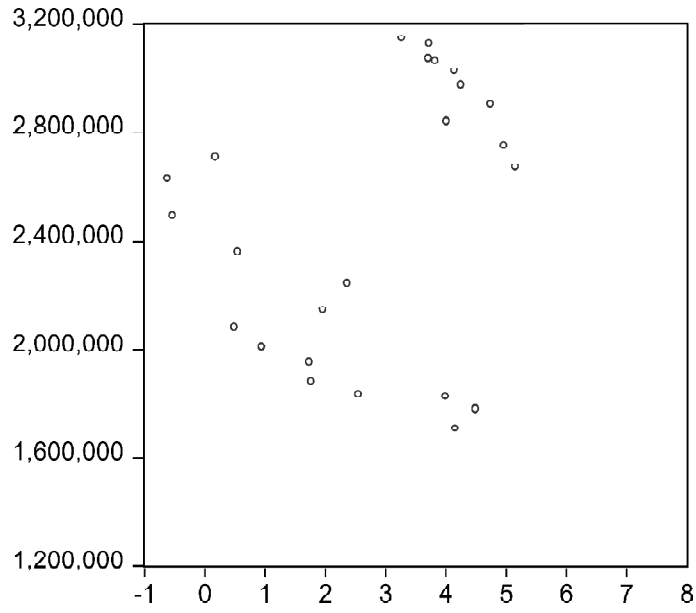
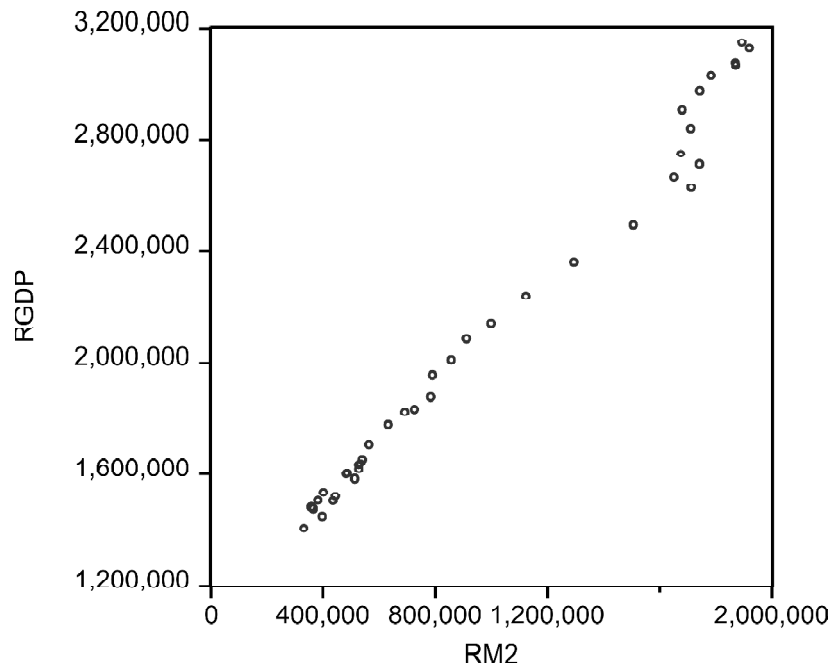


Figure 2. Scatter Diagram between Real GDP (RGDP) and Real M2 (RM2)



became steeper and increased 0.0222 in absolute values, and the intercept shifted upward by 0.2394. A possible reason for the negative significant effect of fiscal expansion on real GDP is that the negative crowding-out effect on private spending outweighed the positive effect on aggregate demand.

Table 1: Estimated Regressions for Real GDP and the RealEffective Exchange Rate

	<i>Log (real GDP)</i>	<i>Log (REER)</i>
Constant	9.8214 (4858.070)	8.4326 (68541.73)
Government deficit/GDP ratio	-0.0065 (-8.8707)	0.0053 (42.2000)
Government deficit/GDP ratio * binary variable	-0.0222 (-3.5519)	
Binary variable	0.2394 (9.3566)	
Log(real M2)	0.3362 (362.4534)	-0.2601 (-35819.15)
Real interest rate	-0.0027 (-13.1869)	-0.0002 (-15.2575)
Log(stock price)	0.0289 (11.5566)	-0.0496 (-2773.613)
R-squared	0.9955	0.7869
Adjusted R-squared	0.9947	0.7618
Akaike information criterion		-5.1588
-1,8472		
Schwarz criterion		-4.7749
-1.5486		
Sample period	1980-2018	1980-2018
Number of observations	39	39

Notes:

REER: the realeffective exchange rate. Figures in the parentheses are z-statistics.

The positive significant coefficient of the stock price suggests that the wealth effect dominates the substitution effect (Friedman, 1988). The wealth effect indicates that a higher stock price would increase real money demand whereas the substitution effect shows that a higher stock price would reduce real money demand. If the wealth effect dominates the substitution effect, the LM* curve will shift to the right.

Specifically, a 1% increase in real M2 money would raise real GDP by 0.3362%. If the stock price rises 1%, real GDP would increase by 0.0289%. A higher 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).

In the estimated regression for the real effective exchange rate, approximately 78.69% 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 government deficit-to-GDP ratio and negatively influenced by real M2 money, the real interest rate, and the stock price. These results indicate that fiscal expansion results in real appreciation whereas monetary expansion leads to real depreciation. A higher real interest rate tends to attract international capital inflows and increase the demand for the rand. On the other hand, a higher real interest rate tends to hurt private spending, reduces aggregate demand, and shift IS^* leftward. The net impact is unclear. The empirical result suggests that the negative effect is greater than the positive effect. The negative significant coefficient of the stock price implies that the rightward shift of LM^* is greater than the rightward shift of IS^* , leading to real depreciation of the rand.

SUMMARY AND CONCLUSIONS

This paper has examined whether the Mundell-Fleming model may apply to South Africa's economy. For South Africa, fiscal expansion reduces output and causes real appreciation whereas monetary expansion raises output and leads to real depreciation. Except for the negative impact of fiscal expansion on output, other findings are consistent with the predictions of the Mundell-Fleming model. In addition, a lower real interest rate or a higher stock price would raise output; and a higher real interest rate or a higher stock price would result in real depreciation.

There are several policy implications. Fiscal discipline may need to be exercised as deficit-financed spending has a negative effect on output. Monetary expansion would be a better strategy than fiscal expansion as the former leads to more output and real depreciation whereas the latter results in real appreciation and a negative impact on output. Real appreciation hurts exports. The interest rate policy poses a tradeoff. A lower real interest rate stimulates consumption and investment spending and aggregate demand but causes real appreciation, which in turn hurts exports. How to find a balance would be a challenge for policy makers to consider.

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