

A Simultaneous Equation Model of Output and Exchange Rate Determination for Romania

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Abstract: According to the conventional Mundell-Fleming model (Romer, 2006; Mankiw, 2019), under a floating exchange rate regime, fiscal expansion does not affect output and causes real appreciation whereas monetary expansion raises output and results in real depreciation. Applying an extended IS-LM model to Romania, 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 higher real interest rate, a higher real oil price or a higher expected inflation rate reduces output; and a higher real interest rate or a higher expected inflation rate 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 Romania.

1. Introduction

Romania's authorities have strived to pursue fiscal policy in stimulating or stabilizing its economy. During the global financial crisis, general government gross debt as a percent of GDP rose from 13.004% in 2008 to 22.452% in 2009 and 30.861% in 2010, and then reached 36.761% in 2019. The government borrowing-to-GDP ratio rose from 1.36% in 2006 to 6.858% in 2009 and then reached 4.557% in 2019. These statistics suggest that Romanian authorities have not met the EU standard of the government deficit-to-GDP ratio of 3.0% but have met the EU standard of the debt-to-GDP ratio of 60.0%.

During the global financial crisis, the central bank of Romania lowered its policy rate from 10.25% in 2008. M8 to 8.00% in 2009. M9. Broad money supply rose 28.1% during 2007-2009 to provide more liquidity to the financial and banking systems. The National Bank of Romania (NBR) has pursued a managed floating exchange rate system under inflation targeting and allows a flexible response to external shocks that may affect the economy.

To the author's knowledge, few of previous studies have examined the effects of monetary policy and fiscal policy on output and the real exchange rate for

Romania 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 Romania. According to the Mundell-Fleming Model (Mundell, 1963, 2001; Fleming, 1962; Romer, 2006; Obstfeld, 2001; Mankiw, 2019), under a floating exchange rate system, fiscal expansion tends to be ineffective in raising output and cause real appreciation whereas monetary expansion tends to be effective in raising output and lead to real depreciation. This paper differs from previous studies partly because the real exchange rate is included in the money demand function. Hence, the LM^* curve may not be vertical, and fiscal expansion may affect output.

2. Literature Survey

Several studies have examined potential impacts of fiscal policy and monetary policy for Romania and related countries.

In examining the impacts of macroeconomic policies for Romania before and after the Crisis, Gabriela (2015) concluded that the government should take measures to support the private sector, absorption of new technology to enhance the labor productivity and global competitiveness, the efficient resource utilization, creating job opportunities and modernize social security systems, fast absorption of European funds, and support of the financial system.

Boiciuc (2015) used the SVAR model to study the impacts of fiscal policy on Romania's economy. Both the government expenditure shock and the tax revenue shock were explored. He found that the effect of fiscal policy on major macroeconomic variables declined, and the magnitude of the fiscal multiplier was relatively small. In another paper, Boiciuc and Oran (2020) applied the synthetic control method to calculate the impact of fiscal expansion in Romania since 2015. They found that expansionary fiscal measures ranged the growth rate of real GDP by 4.4 – 5.5 percentage points over a three-year period, with the largest impact in the last year of 2017. They attempted to reconcile very small or insignificant fiscal impacts derived from the standard macroeconomic model and the current methodology they employed.

Barbu (2016) investigated whether fiscal policy in Romania would be procyclical during 2000-2013 based on measures of the fiscal impulse and the structural deficit. He found that Romania's fiscal policy was highly procyclical during 2006-2008 and generally procyclical during 2009-2012 due to the efforts to reduce budget deficits and financial limitations. This procyclical fiscal policy

during economic expansions would have negative long-run effects on fiscal sustainability.

Feldkircher, Huber and Moder (2016) studied monetary policy rules for four Eastern European countries including Romania. They showed that there was less evidence of output stabilization but strong evidence of inflation stabilization. Domestic inflation expectations and Euro area short-term interest rates also played significant roles in monetary policy reaction functions. However, their weight has decreased in part because of the unconventional monetary policies used by some other countries.

Applying the SVAR model, Potjagailo (2017) examined the effects of monetary policy of the Euro area on 14 European countries including Romania without adopting the euro. After engaging in monetary expansion by the Euro area, output increased in most countries whereas financial uncertainty declined. Spillover effects differed by country. Those countries adopting fixed exchange rates showed stronger spillover impacts on output and the interest rate. Prices declined or did not respond in the Central and Eastern Europe but increased in Western European countries outside of the Eurozone.

Mirdala and Kameník (2017) applied the threshold vector autoregression technique to assess impacts of fiscal policy in three Central European countries. They found that spending fiscal shocks generally had higher multiplier effects whereas revenue fiscal shocks had much less robust results. In addition, empirical results varied during economic expansions and recessions and the pre-crisis and post-crisis periods.

Kameník, Ruščáková and Semančíková (2018) employed the VAR model to investigate the effects of fiscal policy shocks on real GDP in Hungary and Slovakia. They found that government spending shocks had more effect on real GDP than government revenue shocks, that government spending shocks had a positive impact in the short run, and that real GDP in Hungary responded negatively to government revenue shocks, but real GDP in Slovakia reacted positively to government revenue shocks

Sousa (2020) examined interplays between fiscal and monetary policies in the EU during 1995-2019. There are several major findings. In making monetary policy decisions, central banks were impacted by the inflation rate. Monetary policy reaction functions did not appear to consider cyclically adjusted primary balance (CAPB). Fiscal policy via the CAPB appeared to be impacted negatively by short-term interest rates. The CAPB had a positive response to rising government debt.

3. Theoretical model

It is postulated that aggregate spending is determined by real income, government tax revenues, government spending, the real interest rate and the real effective exchange rate and that real money demand is a function of the nominal interest rate, real GDP, and the real effective exchange rate. Extending the analysis by Romer (2006) and Mankiw (2019), we can write the IS* and LM* functions as:

$$Y = E(Y, T, G, R, X) \quad (1)$$

$$M/P = Z(R + \pi^e, Y, X) \quad (2)$$

where

Y = real GDP in Romania,

T = government tax revenue,

G = government spending,

R = the real interest rate,

X = the real exchange rate (An increase means real depreciation of the Romanian leu.),

M = the money supply,

P = the price level, and

π^e = the expected inflation rate.

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

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

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

Assume that $Z_X > 0$ and that $E_G > E_T$. The Jacobian matrix for the two endogenous variables is given by:

$$|J| = [-Z_X(1 - E_Y) - E_X Z_Y] < 0 \quad (5)$$

The effects of expansionary fiscal policy on \bar{Y} and \bar{X} can be expressed as:

$$\partial \bar{Y} / \partial G - \partial \bar{Y} / \partial T = -(E_G - E_T) Z_X / |J| > 0, \text{ and} \quad (6)$$

$$\partial \bar{X} / \partial G - \partial \bar{X} / \partial T = (E_G - E_T) Z_Y / |J| < 0. \quad (7)$$

In equations (6) and (7), more government deficit spending would raise output and result in real appreciation. The sign in equation (6) differs from the original Mundell-Fleming model because the realexchange rate is incorporated in the money demand function. In the original Mundell-Fleming model, the realexchange rate is not included. Hence, $Z_X = 0$, and $\partial \bar{Y} / \partial G - \partial \bar{Y} / \partial T = 0$.

The partial derivatives of and with respect to can be written as:

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

$$\partial \bar{X} / \partial M = -P^{-1} (1 - E_Y) / |J| > 0. \quad (9)$$

In equations (8) and (9), more money supply would raise output and result in real depreciation. More money supply shifts the LM* curve to the right, equilibrium real GDP rises, and equilibrium realexchange rate rises.

4. Empirical Results

The data were collected from the *International Financial Statistics* and the *Eurostat*. Real GDP is measured in million lei. Government borrowing as a percent of GDP is chosen to represent fiscal policy. The real exchange rate is measured by the nominal exchange rate (units of the leu per U.S. dollar) times relative prices in the U.S. and Romania. An increase in the real exchange rate means real depreciation of the Romanian leu. The exchange rate of units of the leu per euro is not used due to lack of adequate data. Real money supply is represented by M3 money adjusted for the consumer price index. The lending rate minus the expected inflation rate is selected to represent the real interest rate. The expected inflation rate is represented by the lagged inflation rate. Other types of interest rates do not have adequate data. Real GDP, real M3, and the real exchange rate are transformed to a log scale. The government borrowing-to-GDP ratio, 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 consisting of annual data ranging from 1995 to 2019.

Figure 1 shows that the government borrowing-to-GDP ratio reached a high of 6.858% in 2009, exhibited a declining trend since 2009, and dropped to a low of 1.352% in 2015, and then rose and reached 4.557% in 2019. Figure 2 indicates that real M3 declined below the 2009 level during 2010-2013 and continued to rise after 2013.

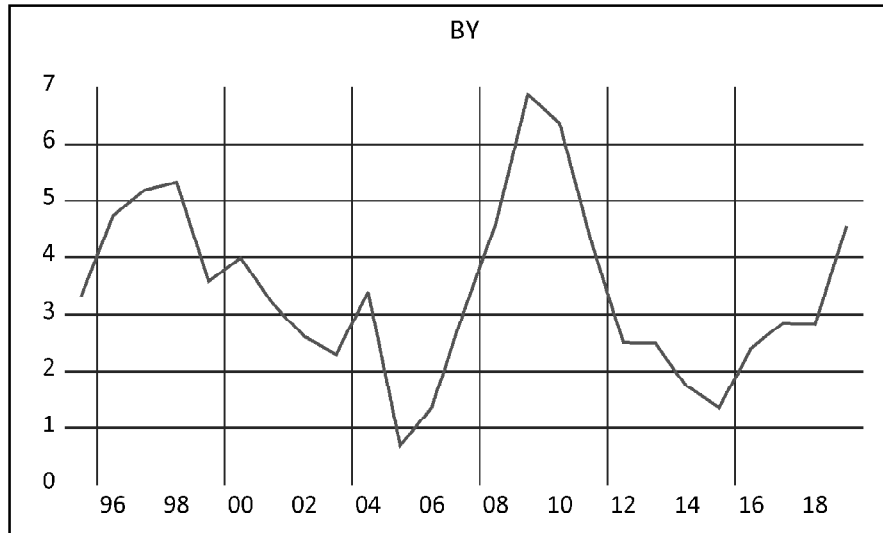


Figure 1: The Government borrowing-to-GDP Ratio (BY) over Time

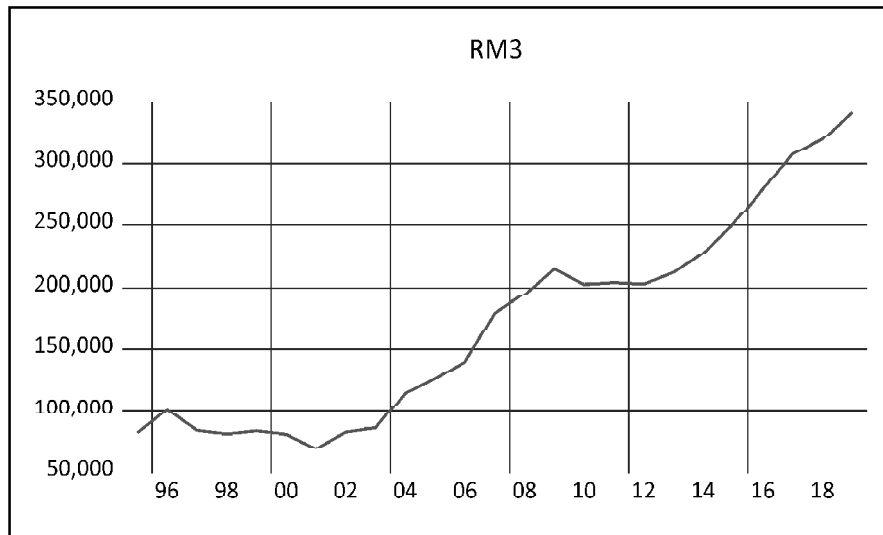


Figure 2: Real M3 (RM3) over Time

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 exogenous variables with significant coefficients can explain approximately 98.26% of the variation

in real GDP. All the estimated coefficients are significant at the 1% or 5% level. Real GDP has a positive relationship with real M3 money and a negative relationship with the government borrowing/GDP ratio, the real interest rate, the real crude oil price, and the expected inflation rate. A possible reason for the negative effect of fiscal expansion on real GDP is that the negative crowding-out effect on private spending is greater than the positive effect of fiscal expansion.

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

	<i>Log (real GDP)</i>	<i>Log (RER)</i>
Constant	8.7075 (0.0000)	1.5338 (0.0023)
Government borrowing as a percent of GDP	-0.0086 (0.0050)	-0.0363 (0.0837)
Log (real M3)	0.3924 (0.0000)	0.1236 (0.0000)
Real interest rate	-0.0027 (0.0000)	0.0113 (0.0000)
Log(real oil price)	-0.0362 (0.0373)	-0.3316 (0.0000)
Expected inflation rate	-0.0029 (0.0000)	0.0096 (0.0000)
R-squared	0.9826	0.7580
Adjusted R-squared	0.9780	0.6943
Akaike information criterion	-3.5443	-0.9164
Schwarz criterion	-3.1543	-0.4776
Sample period	1995-2019	1995-2019
Number of observations	25	25

Notes:

RER: the realexchange rate.

The figure in the parenthesis is the probability.

In the estimated regression for the real exchange rate, approximately 75.80% of the change in the dependent variable can be explained by the five right-hand side variables. All the coefficients are significant at the 1% or 10% level. The realexchange rate is positively affected by real M3 money, the real interest rate and the expected inflation rate and negatively influenced by the government

borrowing-to-GDP ratio and the real crude oil 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 leu. On the other hand, a higher real interest rate tends to reduce private spending, increase borrowing costs and risk premium, and shift IS* to the left and cause real depreciation. The finding is consistent with the revisionist view (Furman and Stiglitz, 1998) that a higher interest rates results in currency depreciation.

5. Summary and Conclusions

This paper has examined whether the Mundell-Fleming model may apply to Romania's economy. For Romania, fiscal expansion reduces output and causes real appreciation whereas monetary expansion increases output and leads to real depreciation. Except for the impact of fiscal expansion on output, the findings are consistent with the predictions of the Mundell-Fleming model. In addition, a higher real interest rate tends to reduce output and result in real depreciation.

There are several policy implications. Whether monetary policy or fiscal policy is a better macroeconomic option depends on Romania's goal. Monetary expansion leads to real depreciation whereas fiscal expansion results in real appreciation. Real depreciation tends to cause a higher domestic inflation whereas real appreciation tends to hurt exports. A higher real interest rate hurts output and causes real depreciation. Hence, if the macroeconomic goal is to stimulate exports, a lower real interest rate would be a better strategy.

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