

## Does the Mundell-Fleming Model apply to Poland?

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**Abstract.** *Applying an extended IS-LM model to Poland, this paper finds that fiscal expansion does not raise output but causes real appreciation and that monetary expansion increases output and leads to real depreciation. Besides, a lower real interest rate, a higher real stock price or a lower expected inflation rate helps raise output; and a higher real interest rate, a higher real stock price or a lower expected inflation rate results in real appreciation. Hence, the predictions of the Mundell-Fleming model are applicable to Poland.*

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

**JEL Classification:** E52, E62, F41.

## 1. Introduction

Poland's authorities have engaged in fiscal policy, monetary policy and other macroeconomic measures to stimulate or stabilize its economy. During the global financial crisis, the Polish government used expansionary fiscal policy by raising the government deficit from 3.8% of GDP in 2008 to 5.3% of GDP in 2009 and 5.6% of GDP in 2010. As the economy continued to improve, the deficit-to-GDP ratio declined to a low of 0.6% in 2018. Central government debt as a percent of GDP also rose from 44.5% in 2008 to a high of 53.1% in 2013, and then declined to a low of 47.6% in 2018. These statistics suggest that after the passage of the stabilizing expenditure rule in 2014, the Polish authorities have maintained fiscal discipline and met the EU standards of the government deficit-to-GDP ratio and debt-to-GDP ratio of 3% and 60%, respectively (Korniluk, 2016).

During the global financial crisis, the National Bank of Poland lowered the interbank rate from 6.35% in 2008 to 4.34% in 2009 and 1.71% in 2018. M1 and M3 money supply rose 10.97% and 8.11%, respectively, during 2008-2009 to provide more liquidity to the banking and financial systems.

The Central Bank of Poland has pursued a floating exchange rate system since April 2000 and does not set any predetermined exchange rate target. However, the National Bank of Poland may intervene in the exchange rate market in order to meet the goal of the inflation target and maintain the criterion of exchange rate stability before joining the euro zone.

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 Poland 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 Poland. 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.

## 2. Literature survey

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

Lopez-Villavicencio and Mignon (2016) studied exchange rate pass-through (ERPT) using a sample of 15 emerging economies including Poland 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 declining ERPT significantly, and that transparent monetary policy or adopting exchange rate targeting reduced ERPT.

Heryán and Tzeremes (2017) analyzed the bank lending channel for EU countries during 1999-2012. There are two major findings. Before the global financial crisis, the short-term interest rate had more pronounced effect on the bank lending channel in the old EMU countries. During the global financial crisis, M2 money was more important in the old EMU countries. In new EU countries, banks responded to monetary shocks differently.

Forte and Magazzino (2016) estimated impacts of different fiscal measures on growth for 18 EMU countries during 1980-2015. Cutting government spending instead of raising taxes increased economic growth. Reducing investment spending caused growth to decline. Public investment and tax cuts were more likely to increase growth than current government spending.

Ślusarczyk (2018) assessed fiscal policy on foreign direct investment (FDI) in Poland. Poland provided government assistance in Special Economic Zones and exemption of property taxes by the local government. Empirical results showed that fiscal policy had a positive significant impact on the increase in the value of FDI.

Brady and Magazzino (2018) evaluated the issue of fiscal sustainability in the 28 EU countries during 1980-2015. They found a long-term relationship between government spending and revenue and between government debt and the primary deficit and that government revenue does not cause government spending, and vice versa. The absence of fiscal sustainability was found in the PIIGS countries.

Brady and Magazzino (2018) examined fiscal sustainability for 19 EMU countries during 1970-2016. They found that average government debt level in recent years was much higher than that in the 1970s. These countries have satisfied the solvency condition mainly because austerity programs taken by these countries were effective.

Bökemeier and Stoian (2018) evaluated debt sustainability for 10 East and Central European economies during 1998-2015. They found that public debt was greater than the stabilized debt ratio in these 10 countries. But, public debt was relatively stable, less than the turning point, and far less from fiscal fatigue.

Afonso, Huart, Jalles, and Stanek (2018) studied the subject of the twin deficit using a sample of 193 countries including Poland during 1980-2016. 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.

Da Silva and Vieira (2017) examined monetary and fiscal policy for 113 advanced and developing countries including Poland 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.

Afonso, Alves, and Balhote (2019) investigated the interaction between fiscal and monetary policies based on a sample of 28 EU countries during 1970-2015. There were

several major findings. Monetary policy was significantly impacted by inflation. The government increased primary balance when government debt rose. Central banks took a more active role when the government debt level was relatively high, suggesting that there was substitution between monetary policy and fiscal policy.

### 3. 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 real effective 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:

$$Y = W(Y, T, G, R, S, \varepsilon) \quad (1)$$

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

Where:

Y – real GDP in Poland;

T – government tax revenue;

G – government spending;

R – the real interest rate;

S – the real stock price;

$\varepsilon$  – the real effective exchange rate (An increase means real appreciation);

M – the money supply;

P – the price level, and

$\pi^e$  – the expected inflation rate.

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

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

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

Assume that  $X_\varepsilon < 0$  and that  $W_G > W_T$ . The Jacobian for the two endogenous variables is given by:

$$|J| = [-X_\varepsilon(1 - W_Y) - W_\varepsilon X_Y] > 0. \quad (5)$$

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

$$\partial \bar{Y} / \partial G - \partial \bar{Y} / \partial T = -(W_G - W_T) X_\varepsilon / |J| > 0, \text{ and} \quad (6)$$

$$\partial \bar{\varepsilon} / \partial G - \partial \bar{\varepsilon} / \partial T = (W_G - W_T) X_Y / |J| > 0. \quad (7)$$

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,  $X_\varepsilon = 0$ , 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  $Y$  and  $\varepsilon$  with respect to the money supply can be expressed as:

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

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

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.

#### 4. Empirical results

The data were collected from the *International Financial Statistics* and the *Eurostat*. Real GDP is measured in million zloty. Government borrowing 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 M3 money 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 interbank rate minus the expected inflation rate is selected to represent the real interest rate. Other types of interest rates do not have adequate data. The financial stock index is divided by the consumer price index to derive the real financial stock index. The expected inflation rate is estimated as the average of lagged inflation rates in the past three years. Real GDP, real M3, and the real stock index are transformed to a log scale. The government borrowing-to-GDP ratio, the real interbank 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 2018.

**Figure 1.** Scatter Diagram between Real GDP (RGDP) and the Government Borrowing-to-GDP Ratio (BY)

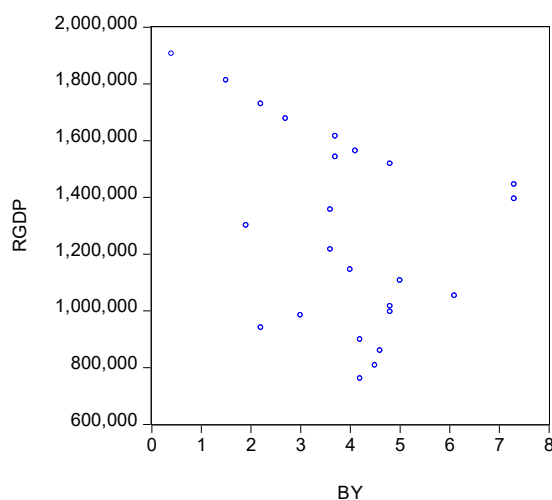
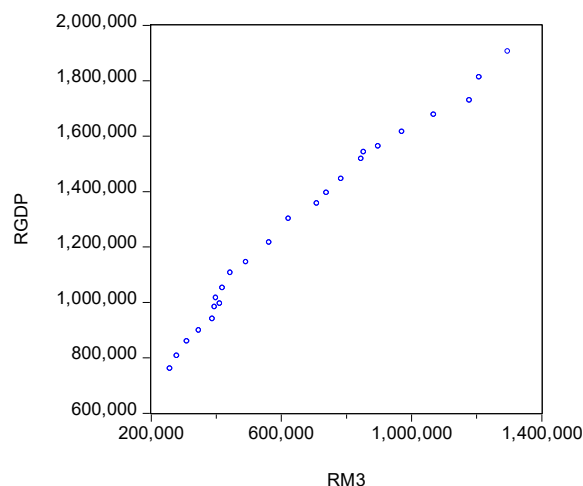


Figure 1 shows that real GDP and the government borrowing-to-GDP ratio seemed not to exhibit a consistent pattern during 1995-2010 and that their relationship seemed to be negative during 2011-2018. Figure 2 indicates that real GDP and real M3 had a strong positive relationship during the sample period of 1995-2018.

**Figure 2.** Scatter Diagram between Real GDP (RGDP) and Real M3 (RM3)



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 exogenous variables with significant coefficients can explain approximately 99.72% of the variation in real GDP. Except for the coefficient of the borrowing-to-GDP ratio, other the estimated coefficients are significant at the 1% level. Real GDP has a positive relationship real M3 money and the real stock price and a negative relationship with the real interest rate and the expected inflation rate. A possible reason for the insignificant effect of fiscal expansion on real GDP is that the positive effect of fiscal expansion on aggregate demand is cancelled out by the negative crowding-out effect on private spending.

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

Specifically, a 1% increase in real M3 money would raise real GDP by 0.4895%. If the real stock price rises 1%, real GDP would increase by 0.0230%. 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).

**Table 1.** *Estimated regressions for real GDP and the real effective exchange rate*

	Log(real GDP)	Log(REER)
Constant	7.4437 (610.7170)	4.4623 (150.7197)
Government borrowing as a percent of GDP	0.0016 (1.3724)	0.0205 (4.4615)
Log(real M3)	0.4895 (521.3166)	-0.0265 (-4.3571)
Real interest rate	-0.0021 (-11.3284)	0.0095 (7.4274)
Log(real stock price)	0.0230 (23.6321)	0.0867 (5.2870)
Expected inflation rate	-0.0033 (-28.3855)	-0.0039 (-6.1238)
R-squared	0.9972	0.6823
Adjusted R-squared	0.9964	0.5940
Akaike information criterion	-5.4289	-3.2090
Schwarz criterion	-5.0361	-2.8163
Sample period	1995-2018	1995-2018
Number of observations	24	24

**Notes:**

REER: the real effective exchange rate.

Figures in the parentheses are z-statistics.

In the estimated regression for the real effective exchange rate, approximately 68.23% 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% level. The real effective exchange rate is positively affected by the government borrowing-to-GDP ratio, the real interest rate and the real stock index and negatively influenced by real M3 money and the expected inflation 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 attract international capital inflows, increase the demand for the zloty, and cause real appreciation. A higher real stock value tends to attract foreign investors to purchase Poland's stocks, increase the demand for the zloty, and cause real appreciation.

## 5. Summary and conclusions

This paper has examined whether the Mundell-Fleming model may apply to Poland's economy. For Poland, fiscal expansion does not raise output but causes real appreciation whereas monetary expansion raises output and leads to real depreciation. The findings are consistent with the predictions of the Mundell-Fleming model. In addition, a lower real interest rate or a higher real stock price would raise output; and a higher real interest rate or a higher real stock price would result in real appreciation.

There are several policy implications. Fiscal discipline may need to be exercised as deficit-financed spending has little 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 little impact on output. Real appreciation hurts exports. A higher real interest rate hurts output and causes real appreciation. Hence, if the macroeconomic goal is to stimulate exports and output, a lower real interest rate would be

a better strategy because it tends to lead to real depreciation. A healthy stock market is important as a higher real stock value would lead to more output and real appreciation. Real appreciation tends to increase international capital inflows but hurt exports.

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