6. RESPONSES OF REAL OUTPUT IN SERBIA TO THE FINANCIAL AND GLOBAL ECONOMIC CONDITIONS

Yu HSING[*]
Wen-jen HSIEH[**]

Abstract

Applying and extending Taylor (1993, 1999) and Romer (2000, 2006), this paper examines output fluctuations for Serbia based on a simultaneous equation model consisting of the open-economy IS function, the monetary policy function, and uncovered interest parity. The GARCH(1,0) model is employed because the residual variance is affected by the past variance. Real GDP is positively affected by the real stock price and real government deficit and negatively influenced by expected real depreciation of the dinar, the world real interest rate, and the inflation rate. There are significant seasonal effects. Therefore, a healthy stock market, a stronger dinar, a lower world real interest rate, a lower inflation rate, and an active fiscal policy will play important roles in the recovery of the Serbian economy.

Keywords: monetary policy function, uncovered interest parity, exchange rate, world interest rate, inflation rate, government deficit

JEL Classification: O52, E52, F41

1. Introduction

Due to the global financial crisis and worldwide economic recession, the Serbian economy experienced setbacks or slower growth in real GDP, exports, imports, consumption spending, investment spending, foreign direct investments, financial stock values, etc. According to the forecast of the Serbian economy in 2009 made by the International Monetary Fund (2009), its real GDP, household consumption spending, private investment spending, and exports of goods and services are expected to decline 2%, 3.1%, 1.6%, and 10.9%, respectively. Structural fiscal balance would reach -3.9% of the GDP. Government gross debt as a percent of the

[*] *College of Business, Southeastern Louisiana University, Hammond, LA 70402, USA. Email: yhsing@selu.edu.*
[**] Department of Economics, College of Social Sciences, National Cheng Kung University, No.1, University Road, Tainan City, Taiwan.

GDP would increase from 31.6% in 2008 to 34.8% in 2009. The current account trade deficit is expected to reach 13% of the GDP. The real effective exchange rate would depreciate 8.9%. The IMF (2009) provides the following consultations. Serbia is subject to downside risks and external imbalance. It needs to pursue agreed fiscal adjustment measures of cutting the wage bill in the public sector, reducing discretionary spending and raising certain taxes so that government deficit as a percent of GDP is within the 3% level; implement a financial sector support program to assist the restructuring of household and business loans and encourage major foreign banks to continue their exposure to the country and to be liquid and well capitalized; conduct monetary easing and contain inflationary expectations; secure additional funds from the IFI and the EU; and pursue the structural reform.

There are several other studies examining Serbia's economy in the area of economic development challenges (Rovcanin and Grzinic, 2008), inflation targeting (Fabris, 2006), exchange rates (Marinkovic, 2006; Josifidis, Allegret and Pucar, 2009), macroeconomic stability (Rostowski, 1998), EU integration (Dominese, 2006), stock markets (Zikovic, 2008), and self-sustainability (Milenkovic and Knezevic, 2004). These works have made significant contributions to the understanding of Serbia's macroeconomic relations and policies. To the authors' best knowledge, few of the previous studies have applied the monetary policy function and uncovered interest parity simultaneously in an open-economy model in examining output fluctuations in Serbia.

This paper attempts to examine short-term output fluctuations for Serbia with several focuses. First, the paper considers a simultaneous equation model consisting of the open-economy IS function, the monetary policy function, and uncovered interest parity. The choice of the monetary policy function is consistent with the formal adoption of inflation targeting by the Monetary Policy Committee of the National Bank of Serbia (2009) in December 2009. The incorporation of uncovered interest parity suggests that the exchange rate is influenced by the domestic interest rate, the world interest rate, and the expected exchange rate. Second, comparative static analysis is employed in order to determine the theoretical sign of a change in one of the exogenous variables on the equilibrium real GDP. The sign of a coefficient may be ambiguous, suggesting that empirical work will determine its sign and significance.

2. The Model

In the simultaneous equation model, we specify that in the IS function, aggregate output equals aggregate spending, that aggregate spending is positively determined by real income, government spending, the real financial stock value, or real depreciation of the dinar and negatively affected by the real interest rate or government tax revenues, that the real interest rate is positively influenced by the inflation rate, real GDP, real depreciation of the dinar, or the world real interest rate, and that a lower domestic real interest rate, a higher world real interest rate, or a higher expected real exchange rate leads to real depreciation of the dinar. Applying and extending Taylor (1993, 1999), Romer (2000, 2006), and Hsing (2006), we can express the open-economy IS function, the monetary policy function, and uncovered interest parity as:

$$Y = V(Y, R, G, T, S, E) \quad (1)$$
$$+ \; - \; + \; - \; + \; +$$

$$R = R(\pi, Y, E, R') \quad (2)$$
$$+ \; + \; + \; +$$

$$E = E(R, R', E^e) \quad (3)$$
$$- \; + \; +$$

where: Y = real GDP for Serbia,

R = the real interest rate,

G = government spending,

T = government taxes;

S = the real stock price index,

E = the real exchange rate (units of the dinar per U.S. dollar times relative prices in the U.S. and Serbia),

π = the inflation rate,

R' = the world real interest rate, and

E^e = the expected real exchange rate.

Note that the sign below each of the independent variables shows the positive or negative relationship of the partial derivative of the dependent variable with respect to each of the independent variables.

There are several major differences between this article and Hsing (2006). First, this article specifies the aggregate spending function in a more advanced and generalized manner (Romer, 2006) whereas Hsing (2006) formulates the aggregate spending function in a conventional manner. Second, Hsing (2006) does not include uncovered interest parity in the model and does not consider the real exchange rate in the monetary policy function. Third, Hsing (2006) estimates the regression with the Newey-West method whereas this article estimates the parameters with the GARCH model to be detailed in the next section.

Solving for the three endogenous variables (Y, R, and E) simultaneously, we can express the equilibrium real GDP as:

$$\overline{Y} = \overline{Y}(S, E^e, R', \pi, G, T) \quad (4)$$

The condition that equation (4) can be solved is that the following Jacobian for the three endogenous variables is non-zero:

$$|J| = (1 - V_Y) - E_R R_Y V_E - E_R R_E (1 - V_Y) - R_Y V_R > 0. \quad (5)$$

The impact of a higher real stock value on the equilibrium real GDP is expected to be positive:

$$\partial \overline{Y} / \partial S = (V_S - E_R R_E V_S) / |J| > 0. \quad (6)$$

The effect of an increase in the expected real exchange rate on the equilibrium real GDP is ambiguous because of the potential negative effect due to a higher real interest rate caused by monetary tightening in response to expected real depreciation and the potential positive effect due to expected real depreciation of the dinar:

$$\partial \overline{Y} / \partial E^e = (E_{E^e} R_E V_R + E_{E^e} V_E) / |J| > or < 0. \quad (7)$$

Note that if the monetary policy function is not included in the model, the first term in the parenthesis will vanish, and expected real depreciation will have a positive impact on the equilibrium real output.

The impact of a higher world real interest rate on the equilibrium real GDP is uncertain because the first three terms in the parenthesis are negative whereas the fourth term in the parenthesis is positive:

$$\partial \overline{Y} / \partial R' = (E_{R'} R_E V_R + E_R R_{R'} V_E + R_{R'} V_R + E_{R'} V_E) / |J| > or < 0. \quad (8)$$

Note that without uncovered interest parity in the model, the partial derivative of the equilibrium real GDP with respect to the world real interest rate would have a clear negative sign.

A higher inflation rate is expected to reduce the equilibrium real GDP because the National Bank of Serbia is expected to raise the real interest rate, which, in turn, causes the dinar to experience real appreciation:

$$\partial \overline{Y} / \partial \pi = (R_\pi V_R + E_R R_\pi V_E) / |J| < 0. \quad (9)$$

More government spending would raise the equilibrium real GDP whereas more government taxes would reduce the equilibrium real GDP:

$$\partial \overline{Y} / \partial G = (V_G - E_R R_E V_G) / |J| > 0. \quad (10)$$

$$\partial \overline{Y} / \partial T = (V_T - E_R R_E V_T) / |J| < 0. \quad (11)$$

Note that deficit-financed government spending may have a neutral or an uncertain effect due to Ricardian equivalence hypothesis (Barro, 1989), crowding-out, impact lags, etc. (Taylor, 2000).

3. Empirical Results

The data were taken from the *International Financial Statistics*, which is published by the International Monetary Fund. The latest figure for real GDP in 2008.Q4 was obtained from the National Bank of Serbia. The latest figure for the EU refinancing rate in 2008.Q4 was collected from the European Central Bank. Real GDP is measured in million dinars. The stock price index has a base year in 2005. The expected real exchange rate is represented by the lagged real exchange rate. The real exchange rate is equal to the nominal exchange rate (units of the dinar per U.S. dollar) times the relative price in the U.S. and Serbia. Hence, an increase of the real exchange rate means real depreciation, and vice versa. The world real interest rate is represented by the EU refinancing rate minus the inflation rate in the EU. To reduce a high degree of multicollinearity, real government deficit (G-T) is used. The inflation rate is the percent change in the consumer price index. The stock value and real government deficit spending are lagged one period in order to account for potential time or impact lags. Due to significant seasonal effects, three seasonal dummy variables, Q1, Q2, and Q3, are added to the estimated regression. A logarithmic scale is used except for variables with zero or negative values. The sample consists of

quarterly data during 2004.Q3-2008.Q4. Earlier data for the stock price are not available.

The ADF unit root test shows that except for the EU real refinancing rate and real government deficit, other variables have unit roots. To determine whether the variables in equation (4) are cointegrated, the ADF test on the regression residuals in equation (4) is performed. Based on the AIC, a lag length of 3 is selected. The test statistic is estimated to be -3.5102, which is greater than the critical value of -2.7406 in absolute values at the 1% level. Hence, the variables in equation (4) are cointegrated and have a long-term stable relationship.

There are two approaches to estimate the parameters. In the structural-form approach, parameters in equations (1), (2), and (3) are estimated separately. In the reduced-form approach, parameters in equation (4) are estimated. The parameters generated by the structural-form approach do not include the indirect impacts whereas the parameters generated by the reduced-form approach include both the direct and indirect impacts. Hence, the reduced-form approach is employed in empirical work.

Table 1 presents estimated coefficients, t-statistics, adjusted R^2, and other related results. The GARCH(1,1) model is considered to determine whether the residual variance would be affected by the past squared residual and the past variance. The paper finds that the residual variance follows the GARCH(1,0) process, is not affected by the past squared residual, but influenced by the past variance. The estimated variance equation with the t-statistic in the parenthesis is reported below:

$$\begin{matrix} GARCH = -3.92E\text{-}05 + 0.949\ GARCH(-1) \\ (-29.485) \quad (35.048) \end{matrix}$$

Table 1

Estimated Regression of log(Y) for Serbia

Variable	Coefficient	t-statistic
Log(S)	0.044	3.269
Log(E^e)	-0.157	-3.435
Log(R')	-0.157	-3.435
π	-0.006	-1.695
DEFICIT	3.07E-06	2.044
Q1	-0.199	-10.961
Q2	-0.047	-3.375
Q3	-0.074	-5.746
Constant	12.898	81.764
Adj. R^2	0.949	
AIC	-3.850	
Schwarz criterion	-3.306	
MAPE	1.853	
Sample period	2004.Q3	– 2008.Q4

Notes: DEFICIT is real government deficit.
MAPE is the mean absolute percent error.

As shown, the right-hand side variables can explain 94.9% of the variation in real GDP. The estimated coefficients of the real stock price, the expected real exchange rate, the EU real refinancing rate, and the three seasonal dummy variables are significant at the 1% level, the coefficient of DEFICT is significant at the 5% level, and the coefficient of the inflation rate is significant at the 10% level. A higher stock value, a lower expected real exchange rate, a higher EU real refinancing rate, a lower inflation rate, and more government deficit would help increase real GDP. All the coefficients for the three dummy variables are negative and significant at the 1% level, suggesting that the data for real GDP are seasonal and that real GDP in the fourth quarter is greater than those in the other three quarters.

Several comments can be made. Recent substantial decline in the stock value due to the global financial crisis is expected to reduce aggregate spending and real GDP. The conventional approach of real depreciation of the currency would not apply to Serbia. It is interesting to note that a higher EU real refinancing rate would have a positive effect on real GDP partly because it would cause the dinar to depreciate and exports to rise. The negative effect of a higher inflation rate suggests that the National Bank of Serbia may have used monetary tightening to contain inflation. Expansionary fiscal policy seems to be effective in raising aggregate spending and real output and may be considered during an economic downturn.

Several different versions are tested in order to determine whether the above results may change. When the U.S. real federal funds rate replaces the EU real refinancing rate, its coefficient is positive and significant at the 5% level. However, the use of the U.S. real federal funds rate causes the coefficients of the inflation rate and government deficit spending to become insignificant at the 10% level probably due to a high degree of multicollinearity. If the ordinary least squares method is employed in empirical work, the coefficient of the EU real refinancing rate and the three dummy variables are significant whereas the coefficients of other variables are insignificant at the 10% level. Hence, the selection of an appropriate estimation method would lead to better outcomes.

4. Summary and Conclusions

This paper has examined the determinants of short-term output fluctuations for Serbia. The open-economy IS function, the monetary policy function, and uncovered interest parity are incorporated in the simultaneous equation model. The GARCH model is applied. Major findings are that real GDP is positively influenced by the real stock value, the EU real refinancing rate, real government deficit spending and negatively affected by the expected real depreciation of the dinar against the U.S. dollar, the inflation rate, and seasonal dummy variables. Hence, higher real stock values, real appreciation of the dinar real exchange rate, a higher EU real refinancing rate, a lower inflation rate, and expansionary fiscal policy would help raise real GDP. Comparing with recent economic indicators, estimated regression parameters based on the GARCH model suggest that relatively moderate inflation rates, active fiscal policy, and low EU refinancing rates would help raise real GDP whereas relatively high interest rates, low stock values, and a weak dinar would hurt real GDP.

The results in the study should be regarded as preliminary because of the relatively small sample size. The regression should be re-estimated when the sample has more observations. The expected real exchange rate may be constructed by more sophisticated techniques. If complete data are available, the real effective exchange rate may be considered. Fiscal policy may be represented by government debt as a percent of nominal GDP when the complete data are available. The money market as represented by the money supply and the money demand may be considered in formulating a different model.

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