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Impacts of Macroeconomic Policies on the Estonian Output: An Application of the Taylor Rule and the IS-MP-AS Model

Yu Hsing [*]

Professor of Economics, SLU 10813, College of Business
Southeastern Louisiana University, Hammond, LA 70402, U.S.A.

Email: yhsing@selu.edu

Abstract: Extending the Taylor rule (1993, 1998, 1999) and the IS-MP-AS model (Romer, 2000), this article finds that real output in Estonia is negatively influenced by the expected inflation rate, the government deficit/GDP ratio, the world interest rate and country risk, and positively affected by real depreciation. Policy implications are that fiscal discipline pursued by the Estonian government is appropriate, that depreciation of the kroon to promote net exports would help the Estonian output, and that maintaining a sound fiscal, political and financial environment would reduce country risk and increase investment spending.

Keywords: IS-MP-AS model, Taylor rule, deficit spending, real depreciation, world interest rates, country risk

JEL Classifications: O52, E52, E62

1. Introduction

Since the early 1990s, Estonia has encountered many challenges and made progress. The Estonian government has shown fiscal discipline. After the ratio of government deficit to GDP reached a record high of 4.3% in 1999, Estonia had a fiscal surplus of 2.4% in 2003 and is projected to continue to have fiscal surpluses in 2004 and 2005. Its public sector debt/GDP ratio declined from 6.1% in 1999 to 5.3% in 2003, which is well below the Maastricht criterion of 60%. Following expansionary monetary policy of decreasing money market rates, the lending rate declined from a record high of 33.66% in 1993 to a low of 5.51% in 2003, thus encouraging households and businesses to borrow and spend. After rapid growth of the money supply in the early 1990s, the growth of M1 money slowed down to 9.32% in 2002 and 12.95% in 2003. As a result, the inflation rate continued to decline and reached a record low of 1.33% in 2003, which falls within the EU standard of close to and below 2.00%. The exchange rate in terms of kroons per U.S. dollar increased

[*] Yu Hsing is Department Head and Charles Blackwell Endowed Professor in Economics.

from 12.91 in 1992 to 17.69 in 2001 and then declined to 12.41 in 2003. It may be interesting to examine whether the recent decline in the exchange rate or appreciation of the kroon would help or hurt the Estonian economy. The stock market showed spectacular fluctuations and can be represented by a bowl-shaped curve, as the stock index started at 200.48 in 1997, reached to the bottom of 75.91 in 1999, and then gradually climbed to 171.05 in 2003. The transition to a market economy and very high inflation rates in 1993 and 1994 led real GDP to decline 1.6% in 1994. However, the economy made quick adjustments, and real GDP continued to grow more than 4.0% annually except for 1999.

There are several areas that may need improvements. The ratio of government revenues and grants to GDP reached 38.5% in 2003 and is forecast to remain at this level for 2005. The relatively high ratio may suggest that the government sector is larger than many other countries and may not enhance efficiency and productivity as some would expect. Trade deficit continued to widen from 773 million euros in 1999 to 1,397 million euros in 2003 and is expected to reach 1,500 million euros in 2005. How to increase global competitiveness and develop an exchange rate policy that would reduce trade deficit may need to be examined. The domestic private saving rate declined from 20.7% in 1999 to 12.5% in 2003, suggesting that the supply of loanable funds may not be adequate to support the demand for loanable funds. The International Monetary Fund (2004) evaluated the Estonian economy and recommended to balance the budget by the business cycle instead of annually, to pursue budget surplus via a tight fiscal policy to help reduce current account deficit which was largely financed by debt instead of foreign direct investment, to avoid off-budget financial operations, to pursue tax cuts with corresponding spending cuts, to use budget surplus to finance pension for an aging population, to grant wage increases based on productivity, and to monitor credit growth closely.

Several recent studies on Estonia and some of the accession countries include the evaluation of the transition to a market economy (Reardon, 1996), trade and budget deficits (Izak, 2002), banking crises and financial integration (Fleming, Chu, and Bakker, 1996; Cavalcanti and Oks 1999), challenges and effects of the EU accession (Weber and Taube, 1999; Ross and Lattemae, 2004), the currency board (Sorg, 1998; Gurtner, 2003), Estonian efforts to reform the kroon, privatize public assets, seek bank reform, enhance trade

liberalization, and move swiftly to a market economy (Reed, 1999); challenges and macroeconomic effects of the EU accession such as lower prices, more consumption of consumer goods, and more business opportunities (Campoy and Rhoads, 2004); among others.

This paper attempts to examine how deficit spending, the interest rate policy, the depreciation or appreciation of the kroon, the world interest rate, and country risk would affect real output for Estonia. The Eesti Pank (the central bank of Estonia) indicated that its major objectives are to protect the value of the Estonian kroon, to enhance efficiency and stability, to assist the development and expansion of the financial institution, and to satisfy the public demand for money. Therefore, the study of the relationships between real output and macroeconomic variables based on a general equilibrium approach would be helpful for Estonia to pursue price stability, full employment, and fiscal sustainability. This paper has several different aspects. First, the IS-MP-AS model (Romer, 2000) is applied and extended in developing a macroeconomic model in that the goods market, the monetary policy reaction function based on an extended Taylor rule (1993, 1998, 1999), and aggregate supply are considered simultaneously. Second, the exchange rate is considered in the net exports sector and the inflation adjustment function to determine whether depreciation of the kroon would help the Estonian economy. Third, country risk is considered and estimated to determine whether it would affect the economy negatively.

2. Theoretical Model

Suppose that household consumption is affected by output, taxes and the real interest rate, that business investment is influenced by output, the real interest rate, and country risk, that net exports are determined by the real exchange rate, that the short-term real interest rate targeted by the central bank is a function of the inflation gap, the output gap, and the world interest rate, and that the inflation rate is a function of the expected inflation rate, the output gap, and the nominal exchange rate. Extending Romer (2000) and Taylor (1993, 1998, 1999), the goods market equilibrium, the monetary policy reaction function (MP), and the expectations-augmented aggregate supply function (AS) can be expressed as

$$Y = C(Y,T,R)+I(Y,R,S)+G+NX[e(P/P^*)], \quad (1)$$

$$0<C_Y<1, C_T<0, C_R<0, I_Y>0 \text{ and}$$

$$(1-C_Y-I_Y)>0, I_R<0, I_S<0, NX_e>0$$

$$R = R(\pi-\pi^*, Y-Y^*, R^W), \quad R_\pi>0, R_Y>0, R_{R^W}>0 \quad (2)$$

$$\pi = \pi^e+\phi(Y-Y^*)+\theta e, \quad \pi_Y>0, \pi_e>0, \phi>0, \theta>0 \quad (3)$$

where, Y = real GDP for Estonia, C = household consumption spending, T = government taxes, R = the real interest rate, π^e = the expected inflation rate, S = country risk, I = business investment spending, G = government spending, NX = net exports, e = the nominal exchange rate (kroons per U.S. dollar), P = the price level in the U.S., P^* = the price level in Estonia, π = the inflation rate, π^* = the target inflation rate, and Y^* = potential output.

In equation (1), country risk is included in the investment function to test its potential negative impact. Equation (2) represents an extended Taylor rule that the dependent variable is the short-term real interest rate controlled by the central bank. In the conventional IS-LM model, the LM function is based on the equilibrium between the money supply and the money demand, which is determined by the nominal interest rate, real output, and other relevant variables. The slopes of (1) and (2) are

$$\left.\frac{dR}{dY}\right|_{IS} = -\frac{1-C_Y-I_Y}{-(C_R+I_R)}<0 \quad (4)$$

$$\left.\frac{dR}{dY}\right|_{MP} = -\frac{-R_Y}{1}>0 \quad (5)$$

Applying the implicit-function theorem and solving for the equilibrium values for real output, the real interest rate, and the inflation rate, we can write equilibrium real output as

$$\overline{Y} = \overline{Y}[\pi^e, G, T, e(P/P^*), R^W, S; \pi^*, Y^*, \phi, \theta] \quad (6)$$

Equilibrium output is expected to have a positive relationship with government spending and a negative relationship with the expected inflation rate, taxes, the world interest rate,

and country risk. The relationship between equilibrium output and the exchange rate is unclear. Deficit-financed government spending may have a neutral impact on output in the long run (Barro, 1989). Discretionary fiscal policy was criticized due to implementation and impact lags, irreversible constraints, and uncertainty about its magnitude and the economic theory that fiscal policy would work (Ramsey and Shapiro, 1998; Blanchard and Perotti, 1999; Burnside, Eichenbaum, and Fisher, 2000; Taylor, 2000). Large government debt would reduce national saving, capital stock, and economic growth in the future (Elmendorf and Mankiw, 1999). The impact of currency devaluation or depreciation depends on the theoretical model, the regression technique, the country under study, the length of time periods, etc (Bahmani-Oskooee and Miteza, 2003).

Applying comparative-static analysis, the impact of depreciation of the kroon on equilibrium output is given by

$$\begin{aligned} &\frac{\partial \bar{Y}}{\partial e} = [\, NX_e(P/P^*) + \theta R_\pi (C_R + I_R)] \,/ \left|J\right| \\ &> 0 \; if \; \left|NX_e(P/P^*)\right| > \left|\theta R_\pi (C_R + I_R)\right| \\ &< 0 \; if \; \left|NX_e(P/P^*)\right| < \left|\theta R_\pi (C_R + I_R)\right| \end{aligned} \tag{7}$$

where $\left|J\right| = (1 - C_Y - I_Y) - \phi R_\pi (C_R + I_R) - R_Y (C_R + I_R) > 0$ is the Jacobian for the endogenous variables. As shown, the net impact depends on whether the positive effect of the depreciation on net exports would be greater or less than the negative impacts of reduced consumption and investment expenditures due to a higher interest rate.

As equation (8) indicates, increased country risk would reduce investment expenditures and lower equilibrium output. Equation (9) reveals that a higher world interest rate is expected to raise the domestic interest rate and cause consumption spending, investment spending and equilibrium GDP to decline.

$$\frac{\partial \bar{Y}}{\partial S} = I_S \,/ \left|J\right| < 0 \tag{8}$$

$$\frac{\partial \overline{Y}}{\partial R^{W}} = [\, R_{R^{W}} (C_R + I_R)] / |J| < 0. \qquad (9)$$

3. Empirical Results

The data came from the Ministry of Financial Affairs in Estonia and the *International Financial Statistics* that is published by the International Monetary Fund. The sample ranges from 1996.Q3 to 2003.Q4. Earlier data for government deficits are unavailable. Real output, real M1, real government expenditure, and real taxes are expressed in million kroons. The lagged inflation rate is used to represent the expected inflation rate. To reduce a high degree of collinearity, the government deficit/GDP ratio which is defined as DY = (G-T)/GDPx100 is employed in empirical work. The real exchange rate is the nominal exchange rate in terms of kroons per U.S. dollar adjusted for relative prices for the U.S. and Estonia. The U.S. federal funds rate is chosen to represent the world interest rate due to its worldwide influence. Country risk is measured by the difference between the Estonian lending rate and the U.S. prime lending rate. Except for real GDP, the consumer price index (CPI) is employed to calculate real values. Due to seasonal variations in GDP, three seasonal binary variables – Q1, Q2, and Q3 - are considered. Empirical tests show that only the first and third seasonal binary variables are significant. Hence, the second seasonal binary variable is deleted from the estimated regression. Real GDP, the real exchange rate, and the federal funds rate are measured in the logarithmic scale. Other variables are measured in levels due to negative or zero values.

The unit root test indicates that in levels, real output and the real exchange rate are stationary and other variables have unit roots and that in first difference, all the variables are stationary. The ADF cointegration test shows that the test statistic with p = 2 is estimated to be 4.83 compared with the critical value of 3.77 at the 1% level. Hence, these variables are cointegrated. The Newey-West (1987) method is employed to find heterosekdasticity and autocorrelation consistent estimates for standard errors and covariance. As shown in Table 1, the right-hand side variables can explain 88.4% of the variation in real output. All the coefficients are significant at the 1% or 5% level. Real GDP has a negative relationship with the expected inflation rate, the government deficit/GDP

ratio, the world interest rate, and country risk and a positive relationship with real depreciation. Specifically, an increase in the expected inflation rate by 1 percentage point would result in a decline in real GDP in log scale by 0.022 million kroons. If the real exchange rate depreciates by 1%, real GDP will rise by 0.251%. An increase in the U.S. federal funds rate by 1% is expected to cause real GDP to decline by 0.136%.

Table 1: Estimated Least Squares Regression for the Estonian Output -1996:3 2003:4

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	9.629614	0.324918	29.63709	0.0000
π^e	-0.021580	0.009046	-2.385681	0.0261
DY	-0.003596	0.001583	-2.271759	0.0332
LOG(ε*)*	0.251274	0.125377	2.004147	0.0575
LOG(R^W*)*	-0.136247	0.025986	-5.243077	0.0000
S	-0.009190	0.004449	-2.065732	0.0508
Q1	-0.102982	0.017568	-5.861916	0.0000
Q3	-0.047275	0.015100	-3.130745	0.0049
R-squared	0.884074	Mean dependent var		10.04987
Adjusted R-squared	0.847189	S.D. dependent var		0.128973
S.E. of regression	0.050417	Akaike info criterion		-2.913795
Sum squared residual	0.055921	Schwarz criterion		-2.540143
Log likelihood	51.70693	F-statistic		23.96805
Durbin-Watson stat	0.813055	Prob (F-statistic)		0.000000

Notes: Dependent Variable is *LOG(*$\overline{Y}$*)*, number of observations is 30, $\overline{Y}$ is equilibrium GDP, π^e is the expected inflation rate, *DY* is real government deficit/GDP ratio, ε is the real exchange rate defined as e(P^*/P), R^W is the world interest rate, S is country risk, *Q1* and *Q3* are dummy variables for the first and third quarters, respectively. Newey-West HAC Standard Errors and Covariance lag truncation is 3.

Several comments can be made. First, the central bank of Estonia needs to continue to contain inflation because of the cost of a higher expected inflation. The small inflation rate of 1.33% in 2003 suggests that the inflation rate was mild and in line with the guideline of

the EU. Second, government deficit spending may not be an effective tool to stimulate the economy due to its negative impact on the economy. The interesting finding that real depreciation would raise real output may indicate that the often used trade policy to devalue a currency to stimulate net exports and aggregate demand may apply to Estonia. The recent currency appreciation from 18.65 in 2000.M10 to 12.96 in 2004.M8 suggests that it might move to the opposite direction and would not help raise the Estonian output.

Several different variables are considered. When the euro interest rate replaces the U.S. federal funds rate, the coefficient is negative and significant at the 5% level. The adjusted R-square declines from 88.4% to 76.9%, suggesting that the U.S. federal funds rate may be more influential. When the amount of real government deficit replaces the government deficit/GDP ratio, the coefficient of real government deficit is negative and significant at the 5% level, and the coefficient of the real exchange rate is positive and significant at the 5% level. Other results are similar. To save space, these results are not presented in this study and will be available upon request.

4. Summary and Conclusions

Applying and extending the IS-MP-AS model (Romer, 2000) model and the Taylor rule (1993, 1998, 1999), this paper has examined the impacts of macroeconomic policies and country risk on real output for Estonia. The research finds that a lower expected inflation rate, a lower government deficit/GDP ratio, real depreciation, a lower world interest rate, and lower country risk would raise real output. Hence, the central bank needs to continue to maintain price stability and enhance credibility. The conventional approach of deficit spending to stimulate the economy may not apply to Estonia, and pursuing fiscal discipline would be appropriate. The government surplus in 2003 reflects the effort and improvement over previous budgets. Although real depreciation would help raise output, its potential negative impacts such as higher import prices and domestic inflation need to be considered. The Estonian government needs to pursue a stable political, economic and financial atmosphere to reduce country risk and help attract foreign investment. The government may focus more on enhancing human capital, capital equipment, and worker productivity so that the living standard would rise and that its product would be more competitive in the world market.

There may be areas for further research. When more sample observations are available, regression parameters may be re-estimated and compared with the results in this study. The LM function or the money market equilibrium may be considered and compared to determine whether the model would fit Estonia better. The expected inflation rate may be constructed in different manners.

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