# Keynesian macroeconomics without the LM curve: IS-MP-IA model and Taylor rule applied to some CESEE economies

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# Keynesian macroeconomics without the LM curve: IS-MP-IA model and Taylor rule applied to some CESEE economies

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## Abstract

Applying IS-MP-IA model and the Taylor rule, this study finds that for selected CESEE economies (Albania, Bosnia and Herzegovina, Macedonia and Serbia), lower expected inflation rate, real exchange rate appreciation, a lower world interest rate which is calculated like a federal funds rate minus inflation in US, and more world output would help to increase output of the selected economies in the sample. A lower ratio of government consumption spending to GDP would also increase the output of the selected economies. Hence, fiscal prudence is needed, and the conventional approach of real depreciation to stimulate exports and raise real output does not apply to the selected CESEE economies. When private household consumption is in the model the coefficient on government spending to nominal GDP is insignificant implying that Ricardian equivalence does hold for the selected countries. These results are robust because they are controlled in the period of four decades from 1969 to 2013. Study uses 4 decadal dummies that control for each decade.

Keywords: IS-MP-IA, Taylor Rule, Inflation targeting, monetary policy function, government spending to nominal GDP, world interest rates

JEL: E52, F41

## 1. Introduction

Romer (2000)[1], proposed an alternative to the IS-LM model and AS-AD model. This model makes assumption that Central banks in the world follow interest rate rule rather than targeting money supply. This model is known as AD-IA, or aggregate demand inflation adjustments model. This assumption is known as interest rate rule, that is also known as Taylor rule[2] which states that federal funds rate, (which usually is taken as proxy world interest rate after we subtract Producer Price Index in US manufacturing form it ) is set by Central banks according to:

$$i_t = 2 + \pi_t + \gamma(\pi_t - \pi_t^*) + \vartheta(y_t - y_t^*) \qquad \textbf{(1)}$$

In the previous expression $i_t$ is the prescribed interest rate in the period t, $\pi_t$ is the actual inflation rate and $\pi_t - \pi_t^*$ is the deviation of actual inflation from its target rate $\pi^*_t$, and

[1] Romer, D.,(2000),***Keynesian macroeconomics without the LM curve***, *Journal of Economic Perspectives—Volume 14, Number 2—Spring 2000—Pages 149*

[2] Taylor, John B. (1993). ***"Discretion versus Policy Rules in Practice"***. *Carnegie-Rochester Conference Series on Public Policy* **39**: 195–214. (The rule is introduced on page 202.)

$y_t - y_t^*$ is the deviation of actual output to its potential output (output gap). In the previous expression $\gamma > 0; \vartheta > 0$. The assumption that central banks follow a interest rate rule is far more realistic than assumption that central banks target money supply. In the Romer's approach aggregate demand relates to output and inflation. According to Romer (2000), target rate equals to last period inflation $\pi_t^* = \pi_{t-1}$.This assumption also means that inflation rises when output is above its own natural rate, and inflation falls when output is below its natural rate. We apply this models to Central and Eastern and South Eastern Europe (CESEE) countries from Balkan peninsula, namely Albania, Bosnia and Herzegovina, Macedonia and Serbia. Albanian economic policy in the previous two decades aimed at maintaining macroeconomic stability, and non-inflationary policies and achieving fiscal consolidation through public debt reduction. Albania reduced its budget deficit for the 2010 to 3.2% of GDP and previously in 1990's budget deficit was 9.6%[3]. Fiscal policy has been more prudent in the last 20 years and as a result, total public debt to GDP ratio has shown declining tendency from 35% in 1990's to 29% in 2010. Current expenditures to GDP ratio have also diminished from 29% in 1990's to 24% in 2010. About the exchange rate which is one of the most important macroeconomic variables, Albania opted for flexible exchange rate regime in the beginning of the transition process, rationale for this decision was to avoid costly adjustments of possible exchange rate misalignments that usually characterize pegged rate regimes, Ljuci, Vika(2011)[4]. Bosnia and Herzegovina is a small open economy, that its GDP was deteriorated and reduced during the Bosnian war (1992-1995), according to Causevic (2012)[5], country's GDP had been reduced from 10.7 US billion dollars in 1992 to 3.2 US billion dollars in 1996. And from 2000 tom 2010 succeed in increasing its' own GDP per capita 3 times. In this small open economies fiscal policy is the only active segment of macroeconomic policy. In Bosnia and Herzegovina exchange rate and interest rate are passive instruments[6], and money supply is determined by the currency board. The only monetary instrument which is available to the Central bank of Bosnia which is established as a currency board is required reserves ratio. The bank cannot influence the interest rates and the money supply. Bosnia and Herzegovina had an average budget surplus of 2.2% of GDP

[3] Shijaku,G.,Gjokuta,A.,(2013), ***Fiscal policy and economic growth: the case of Albania***, Bank of Albania
[4] Ljuci, E.,Vika, I.,(2011), The equilibrium real exchange rate of lek vis-à-vis euro: is it much misaligned?, Bank of Greece discussion papers
[5] Causevic, F.,(2012), ***Economic perspectives on Bosnia and Herzegovina in the period of global crisis,*** St Antony's College University of Oxford
[6] Exchange rate in Bosnia and Herzegovina is determined by a hard peg.

for the period 2003-2005, and this country compared to other Central and Eastern and South Eastern Europe (CESEE) had highest public spending that averaged 44.7% of GDP, *i.e.* 18% above from the regional average. In Macedonia the aim of NBRM (National Bank of the Republic of Macedonia), is price stability, low and stable inflation. Its operational target are interest rates and liquidity, intermediate target is exchange rate this are identified channels by the economic literature through which central bank affects price stability, Besimi, Pugh Adnett (2006)[7].Exchange rate in Macedonia is fixed, Balassa- Samuelson effect, in the process of catching up with the level of productivity causes higher inflation rate, and if there is fixed exchange rate, cause real appreciation of the domestic currency; Besimi, (2004)[8]. In Serbia, for the last decades experienced macroeconomic but also political instability. Serbia hasn't achieved one digit rate of inflation which is a key indicator for macroeconomic stability. Public spending to GDP is 43.6% of GDP in 2009. This is due to increased revenues from privatization which lead to larger government spending, Pavlovic, Zivkov, Kolar(2011)[9]. Fiscal deficit in Serbia as percentage has increased from -0.9% to -4.2%. About the monetary policy in Serbia, core purpose of National bank is to provide monetary and financial stability, by which is meant stable financial system. The National bank of Serbia manages interest rates in order to provide low and stable inflation rate, also NBS (National Bank of Serbia) protects the citizen's living standard, and NBS also manages foreign exchange reserves.

## 2. Mathematical model

Now, like in Romer (2006)[10] let's suppose that aggregate demand spending is determined by the real output, real interest rate, government spending and government tax revenues, i.e.:

$$E = E(Y, i - \pi^e, G, T) \qquad (2)$$

In the previous expression E-denotes expenditures; they are expected value of the real output, and real interest rate which is derived when from the nominal interest rate one subtracts

[7] Besimi, F., Pugh, G., Adnett, N.(2006),***The monetary transmission mechanism in Macedonia: implications for monetary policy***, working papers : centre for research on emerging economies

[8] Besimi,F.,(2004), **The role of the exchange rate stability in a small and open economy: the case of the republic of Macedonia,** NBRM working paper

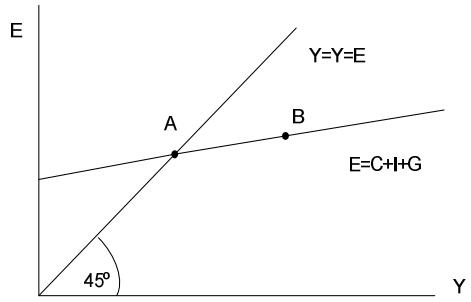
[9] Pavlovic, J.,Zivkov D.,Kolar, S.,(2011), ***Macroeconomic performance and political business cycles in Serbia (2000-2009)*** International Conference On Applied Economics – ICOAE 2011

[10] Romer, D.,(2006),***Advanced Macroecconomics***,3rd edition

expected inflation[11], and aggregate expenditures are function of government spending which is financed by the taxes. Planned real expenditure is presented as:

$$E = C(Y - T) + I(i - \pi^e) + G \tag{3}$$

In the previous expression C is a consumption function, I is investment. From the *Keynesian cross* in the equilibrium planned expenditure equals the actual expenditure:




So, if **E=Y** than we can rewrite the first expression as:

$$Y = E(Y, R - \pi^e, G, T) \tag{4}$$

The extended monetary policy function according to Hsing Yu et al, (2009)[12], can be presented as:

$$R = R(\pi - \pi^e, Y - \overline{Y}, ER - ER^e, \mathrm{i}^{\mathrm{W}}) \tag{5}$$

In the extended monetary policy model $\pi^e$ is targeted inflation or equilibrium inflation, $\overline{Y}$ is the potential output or this presents trend output, $ER^e$ represents expected exchange rate, or lagged real exchange rate, and $i^W$ represents world interest rate. For the Inflation adjustment we have:

$$\pi = \pi^e + \alpha(Y - \overline{Y}) + ER^{no\,\min al} \tag{6}$$

From the previous expression inflation equal targeted inflation + output gap+nominal exchange rate, its increase means appreciation. And for the real effective exchange rate model states that:

[11] Expected inflation one can derive by lagging inflation variable once.

[12] Hsing, Yu, Hsieh, W., (2009), ***Response of output in Romania to macroeconomic policies and conditions***, Preliminary paper.

$$ER = f(i - i^W, ER^e) \quad (7)$$

So, real effective exchange rate is a function of real interest rate minus world interest rate and expected exchange rate, i.e. lagged exchange rate. This is known as IS-MP-IA model originating in the work of David Romer (2000)[13], in his paper so inspiringly entitled: Keynesian macroeconomics without the LM curve.

### 3. From mathematical to econometric model

Econometric model that is being estimated in this paper in its general form is presented as:

$$\log Y_{it} = \log GY_{it} + \log ER^e{}_{it} + \log R^W + \log Y^W + \log \pi^e_{it} + \log POP_{it} + \log EMP_{it} + Dummy\,\text{var}\,iables + errorterm_{it} \quad (8)$$

In the previous expression $\log Y_{it}$ is logarithm of the output (real GDP where 2005=100, billions of US dollars from 2005 as base), $\log GY_{it}$ is ratio of government consumption spending $\log R^W$ is the world interest rate $\log Y^W$ is the logarithm of world output, $\log POP_{it}$ is the logarithm of population , $\log EMP_{it}$ is logarithm of employment , and Dummy variables are D1=1 if sample covered is from 1969-1980, otherwise 0; D2=1 if sample covered in the regression is 1981-1990,otherwise 0; D3=1 if sample covered in the regression is 1991-2001,otherwise 0; and D3=1 if sample covered in the regression is 2001-2013, otherwise 0. The ratio of logarithm of government consumption spending to nominal GDP ($\log GY_{it}$ ) is used as a proxy for fiscal policy. The effective real exchange rate is based on a trade weighted measure, and here is presented in the regression in its lagged form $\log ER^e{}_{it}$ , $\log \pi^e_{it}$ is logarithm of expected inflation. Expected inflation is also inflation at Lag=1. Expected inflation is used as a proxy for inflation adjustment in the model. $\log R^W$ is the world interest rate , this variable is in the model because of its influence on the monetary policy of the selected countries. World interest rate is derived when US Federal funds rate is subtracted by the Producer Price Index in US manufacturing, which proxies for US inflation. This variables proxies for monetary policy conditions, same as exchange rate does. $\log POP_{it}$ and $\log EMP$ variables serve as proxies for macroeconomic conditions. $\log POP_{it}$ is the logarithm of population in the selected countries, while $\log EMP$ is the logarithm of employment in the

[13] Romer, D.,(2000), ***Keynesian macroeconomics without the LM curve***, *Journal of Economic Perspectives—Volume 14, Number 2—Spring 2000—Pages 149–169*

selected countries, this variables are genuinely measured in millions and thousand persons respectively. Dummy variables serve to see whether macroeconomic policies and macroeconomic conditions differed throughout decades 1970's, 1980's, 1990's, and from 2001 to 2013.

## 4. Data and methodology

In this paper data for 4 countries are being used: Albania, Bosnia and Herzegovina, Macedonia, and Serbia. Data covers period from 1969 to 2013. Sources of the data are: World Bank development indicators, International financial statistics of IMF, Oxford economic forecasting. All of the data are converted to a 2005 base year[14]. Data on US federal funds rate and US Producer Price Index for all commodities (which served for world interest rate derivation) are obtained by the FRED (Federal Reserve Bank of St.Louis) data base[15].Constructed data base consists of 180 observations, for 4 countries. Panel is strongly balanced. This means that each panel contains exactly the same time points, i.e. $T_{ij} = T$, where T is the number of observations per panel. Main model has been tested for serial correlation by using Wooldridge test, and the result proved that there is very small probability of making type I error if we reject the null hypothesis, no first-order autocorrelation[16], Results from the test are also presented in Appendix 1. If there is no prersence of autocorrelation we can use OLS to obtain estimates otherwise we use Prais-Winsten estimation. This techniques in order to eliminate serial correlation multiplies the equation $y_{it} = a_i + \beta_1 X_{it} + u_{it}$ by $(1-\rho^2)^{1/2}$, this is because $\sigma_u^2 = \text{var}(u_{it}) = \sigma_e^2/(1-\rho^2)$ and so the result is:

$$y_{it}(1-\rho^2)^{1/2} = (1-\rho^2)^{1/2} a_i + \beta_1 (1-\rho^2)^{1/2} X_{it} + (1-\rho^2)^{1/2} u_{it} \quad (9)$$

When there are more than two periods in the panel one can write:

$$\begin{aligned} y_{it-1} &= a_i + \beta_1 X_{it-1} + u_{it-1} \\ y_{it} &= a_i + \beta_1 X_{it} + u_{it} \end{aligned} \quad (10)$$

If one multiplies by ρ the first equation and subtract first from second equation, result is:

$$y_{it} - \rho y_{it-1} = (1-\rho) a_i + \beta_1 (X_{it} - \rho X_{it-1}) + \varepsilon_{it}, t \geq 2 \quad (11)$$

[14] International macroeconomic data set, by d-r Mathew Shane

[15] Data on PPI are obtained also by U.S. department of labor: Bureau of labor statistics

[16] Probability of making type I error was only 0.0059

Because $\varepsilon_{it} = u_{it} - \rho u_{it-1}$ , one can write:

$$\tilde{y}_{it} = (1-\rho)a_i + \beta_1 \tilde{X}_{it} + \varepsilon_{it}, t \geq 2 \quad (12)$$

In Appendix 2 Graphically are depicted some of the variables.

## 5. Econometric results

In this section results from econometric estimations are presented. Dependent variable is logarithm of output, Real GDP in 2005 US dollars. In Table 1 it is presented the result form the estimation of the first model that takes into account all of the observations, i.e. takes observations from 1969 to 2013. In the next 4 models decadal dummies control for different decades; D1 controls for period from 1969 to 1980, D2 controls for period from 1981 to 1990, D3 controls for the decade 1990's , i.e. for period from 1991 to 2001. And finally the model augmented with the dummy variable D4 controls for period from 2001 to 2013.

**Table 1** Estimated Regression of log(Y) for the 4 countries Albania, Bosnia and Herzegovina, Macedonia and Serbia: 1969-2013

| **Dependent variable $logY_{it}$, Log of country's output** | **Variable description** | **Coefficient** |
|---|---|---|
| $logGY_{it}$ | Government consumption spending to GDP | -0.0002*** |
| $logER^{e}$ it | expected exchange rate ,log | 0.1007*** |
| $R^{W}$ | World interest rate | -0.0148*** |
| $Y^{W}$ | World output, log | 0.5186*** |
| log $\pi^{e}_{it}$ | expected inflation ,log | -0.0556*** |
| $logW_{it}$ | Gross fixed capital formation, i.e. country's wealth | 1.13e-06*** |
| $logPOP_{it}$ | Population , log | 0.1915*** |
| $logEMP_{it}$ | Employment , log | -0.0928*** |
| C | Constant | -4.0168*** |
| R-squared | | 0.5233 |
| Wald chi2(8) | | 0.0000 |

***Note*** **:***** statistical significance at all levels of significance;** statistical significance at 5%,*statistical significance at 10%.

From the Table 1 we can see that for the regression for the whole time period 1969-2013, government consumption in relation to nominal GDP does negatively and statistically significantly enters in the regression with the logarithm of output. In the first model all of the coefficients are significant at 1%,5%, and 10% levels of significance , i.e. all of the coefficients are significant at all levels of statistical significance. Table 1 presents estimated coefficients, t-statistics, $R^2$, and other related statistics. The equilibrium Real GDP is positively associated with the appreciation of expected real effective exchange rate

coefficient is 0.1007, and this coefficient is significant at all levels of statistical significance. Also positive and statistically significant relationship exists between world output and output of the countries members of the panel. Logarithm of the expected inflation is negatively associated with equilibrium output of the countries, the coefficient is of size -0.0556 and it is statistically significant at all levels of significance. Gross fixed capital formation which proxies for country's wealth i.e. productive and non-productive capacities of the country is positively associated with the output though the coefficient is of very small size 1.13e-06. World interest rate does negatively and statistically significantly enters in the relationship with the equilibrium output. Second, the conventional wisdom to devalue a currency to stimulate net exports and aggregate expenditures would not apply to these 4 countries. Instead appreciation of real effective exchange rate will increase output of these countries. Third a higher world interest rate would reduce Real GDP of the countries in the panel, because their National banks would respond positively to higher world interest rate by raising its own monetary policy rate. Inflation would reduce Real GDP of the selected countries mainly because National banks would raise real interest rates I order to pursue inflation targets. Increase in the logarithm of population would increase output, while increase in employment would reduce real GDP

**Table 2** Estimated Regression of log(Y) for the 4 countries Albania, Bosnia and Herzegovina, Macedonia and Serbia: 1969-1980

| **Dependent variable $logY_{it}$, Log of country's output** | **Variable description** | **Coefficient** |
|---|---|---|
| $logGY_{it}$ | Government consumption spending to GDP | -0.00015*** |
| $logER^{e}_{it}$ | expected exchange rate ,log | 0.105*** |
| $R^{W}$ | World interest rate | -0.001 |
| $Y^{W}$ | World output, log | 1.127*** |
| $\log \pi^{e}_{it}$ | expected inflation ,log | -0.073*** |
| $logW_{it}$ | Gross fixed capital formation, i.e. country's wealth | 9.58E-07*** |
| $logPOP_{it}$ | Population , log | 0.2491*** |
| $logEMP_{it}$ | Employment , log | -0.1242*** |
| D1 | Dummy variable =1 if years in the sample range from 1969-1980 | 0.6442*** |
| C | Constant | -10.53*** |
| R-squared | | 0.5573 |
| Wald chi2(8) | | 0.000 |

***Note* :***** statistical significance at all levels of significance;** statistical significance at 5%,*statistical significance at 10%.

In the decade 1970's, *i.e.* from 1969 to 1980 world interest rate does not influence log of real GDP ,the sign on the variable as expected is negative but insignificant. So, in the 1970's world interest rate did not influenced output of the 4 countries in the panel. Inflation did influenced negatively on the output of the countries in the panel, mainly through higher interest rate as response to higher inflation, so that consumption will be slowed down. In 1970's decade devaluation of currency for stimulation of net exports and aggregate expenditures does not hold for these four countries. Relationship between output and employment is a relationship between productivity and number of persons engaged in the manufacturing. For a individual companies, higher productivity leads to loss of jobs, for instance in typewriter industry introduction of computers lead to decline in employment, Nordhaus(2005)[17].But it is that employment does not lead to productivity or either way productivity does not determine employment rater macroeconomic policies determine rate of employment. Dummy variable that control for this decade is positive and statistically significant, meaning that controlling for 1970's we get more positive results for output. Next, results for the regression that controls for 1980's decade are given.

**Table 3** Estimated Regression of log(Y) for the 4 countries Albania, Bosnia and Herzegovina, Macedonia and Serbia: 1981-1990

| Dependent variable $logY_{it}$, Log of country's output | Variable description | Coefficient |
|---|---|---|
| $logGY_{it}$ | Government consumption spending to GDP | -0.000167*** |
| $logER^{e}$ it | expected exchange rate ,log | 0.0967*** |
| $R^{W}$ | World interest rate | -0.0139* |
| $Y^{W}$ | World output, log | 0.5376*** |
| log $\pi^{e}_{it}$ | expected inflation ,log | -0.0573*** |
| logW | Gross fixed capital formation, i.e. country's wealth | 1.15E-06*** |
| $logPOP_{it}$ | Population , log | 0.189*** |
| $logEMP_{it}$ | Employment , log | -0.096*** |
| D2 | Dummy variable =1 if years in the sample range from 1981-1990 | -0.039 |
| C | Constant | -4.175** |
| R-squared | | 0.5235 |
| Wald chi2(8) | | 0.000 |

***Note*** **:***** statistical significance at all levels of significance;** statistical significance at 5%,*statistical significance at 10%.

[17] Nordhaus, W.,(2005), ***The sources of the productivity rebound and the manufacturing employment puzzle***, NBER working paper

In 1980's decade government consumption ratio to nominal GDP has smaller coefficient with respect to the 1970's, negative coefficient and statistically significant on this variable to GDP suggests that prudent fiscal policy will be appropriate for this countries. In this countries in 1980's monetary policy has been more dependent on world interest rate and now the coefficient on this variable I statistically significant and negative to GDP at 10% level of statistical significance. Negative influence on expected inflation on GDP this decade is smaller than that of 1970's inflation. This coefficient is negative and statistically significant at all levels of significance. The influence on wealth of the countries on productivity is greater in this decade than in 1970's which is expected because of the building of new capacities in course of the years. But the coefficient on the dummy variable that controls for the 1990's is insignificant though positive. Employment is also negatively associated with the output but the coefficient is of smaller size. The sign on the excepted effective exchange rate is also positive and statistically significant, again implying appreciation as good policy for the output of Albania, Macedonia, Bosnia and Herzegovina and Serbia. R-squared of the regression is 0.5235, while the Wald test that tests the influence of the independent variables on the dependent variables has probability of type I error of 0.000 so one can reject the null hypothesis of independent variables insignificance.

**Table 4** Estimated Regression of log(Y) for the 4 countries Albania, Bosnia and Herzegovina, Macedonia and Serbia: 1991-2001

| Dependent variable $logY_{it}$, Log of country's output | Variable description | Coefficient |
|---|---|---|
| $logGY_{it}$ | Government consumption spending to GDP | -0.0002*** |
| $logER^{e}$ it | expected exchange rate ,log | 0.149*** |
| $R^{W}$ | World interest rate | -0.007 |
| $Y^{W}$ | World output, log | 0.250 |
| log $\pi^{e}_{it}$ | expected inflation ,log | -0.050*** |
| $logW_{it}$ | Gross fixed capital formation, i.e. country's wealth | 4.94E-07 |
| $logPOP_{it}$ | Population , log | 0.300*** |
| $logEMP_{it}$ | Employment , log | -0.085*** |
| D3 | Dummy variable =1 if years in the sample range from 1991-2001 | -0.35*** |
| C | Constant | -1.620*** |
| R-squared | | 0.5578 |
| Wald chi2(8) | | 0.000 |

***Note*** **:***** statistical significance at all levels of significance;** statistical significance at 5%,*statistical significance at 10%.

In the decade of 1990's one can see from the table of results that real GDP of the countries in the panel is not affected by the world interest rate and world output. The sign on the government spending to nominal GDP is negative and significant at all levels of significance, coefficient size is -0.0002. This is to say again that prudent fiscal policy is required for these countries that is that fiscal policy should be designed to maintain stable allocation of public sector resources[18] Expected inflation also negatively is associated with the economic growth as well as logarithm of employment. Coefficients on these variables are statistically significant as well. Coefficient on the gross capital formation is lower than its own size in 1980's this is due to the fact that some of the productive capacities were destroyed in wars in Bosnia and Herzegovina and privatization in Macedonia, and Albania and similar occasions in Serbia. But also this coefficient is statistically insignificant.

**Table 4** Estimated Regression of log(Y) for the 4 countries Albania, Bosnia and Herzegovina, Macedonia and Serbia: 2001-2013

| Dependent variable $logY_{it}$, Log of country's output | Variable description | Coefficient |
|---|---|---|
| $logGY_{it}$ | Government consumption spending to GDP | -0.000168*** |
| $logER^{e}$ it | expected exchange rate ,log | 0.11*** |
| $R^{W}$ | World interest rate | -0.01 |
| $Y^{W}$ | World output, log | 0.09 |
| log $\pi^{e}_{it}$ | expected inflation ,log | -0.06*** |
| $logW_{it}$ | Gross fixed capital formation, i.e. country's wealth | 8.07E-07*** |
| $logPOP_{it}$ | Population , log | 0.244*** |
| $logEMP_{it}$ | Employment , log | -0.099*** |
| D4 | Dummy variable =1 if years in the sample range from 2001-2013 | 0.352*** |
| C | Constant | 0.161 |
| R-squared | | 0.5410 |
| Wald chi2(8) | | 0.000 |

***Note* :***** statistical significance at all levels of significance;** statistical significance at 5%,*statistical significance at 10%.

All of the previous results apply for the time period 2001-2013, and the coefficients on world output and world interest rates are insignificant. Appreciation of exchange rate is again

[18] Golden rule states that during ups and downs of an economic cycle the government should borrow only to pay for the investment benefits of future generations.

suggested policy for output increase. The negative sign on the coefficient of the expected inflation is statistically significant at all levels of statistical significance. Dummy variable that controls for this decade has positive and statistically significant result.

**Table 5** Estimated Regression of log(Y) for the 4 countries Albania, Bosnia and Herzegovina, Macedonia and Serbia: 1969-2013

| Dependent variable $logY_{it}$, Log of country's output | Variable description | Coefficient |
|---|---|---|
| $logGY_{it}$ | Government consumption spending to GDP | -0.009 |
| $logER^{e}$ it | expected exchange rate ,log | 0.092*** |
| $R^{W}$ | World interest rate | -0.015*** |
| $Y^{W}$ | World output, log | 0.397 |
| log $\pi^{e}$ it | expected inflation ,log | -0.074 |
| $logW_{it}$ | Gross fixed capital formation, i.e. country's wealth | 6.57E-07*** |
| $logPOP_{it}$ | Population , log | 0.281*** |
| $logEMP_{it}$ | Employment , log | -0.074* |
| Log C | Logarithm of household consumption | 0.041* |
| C | Constant | -3.422 |
| R-squared | | 0.5428 |
| Wald chi2(8) | | 0.000 |

***Note*** **:***** statistical significance at all levels of significance;** statistical significance at 5%,*statistical significance at 10%.

In the presence of logarithm of household consumption government consumption spending to GDP is insignificant. Insignificance of this coefficient may suggest that ***Ricardian equivalence hypothesis*** may be applicable to the four countries in the panel. In presence of consumption, world output and expected inflation does not influence the dependent variable, i.e. their influence is statistically insignificant. World interest rate does have negative and statistically significant influence on the output.

## 6. Summary and conclusions

This paper has examined the long term output fluctuations to major macroeconomic variables. The estimation results suggest that the change of the effective exchange rate affects output positively, while the change of the world interest rate affects output negatively or it does not affect the output at all, i.e. that variable is insignificant. From the results also, relatively low world real interest rates and the expected world economic recovery would help increase real GDP whereas expected real depreciation of the national currencies of the countries in the panel would have negative effect on the real GDP. The ratio of government deficit to nominal GDP should be below 3% to meet the EU convergence criterion. These countries are not yet members of EU, but in some foreseeable future they may become and they will must fulfil the debt to GDP ratio criterion as well as inflation target range between 2.5% and 4.5%.

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## APPENDICES

### Appendix 1

Wooldridge test for autocorrelation in panel data

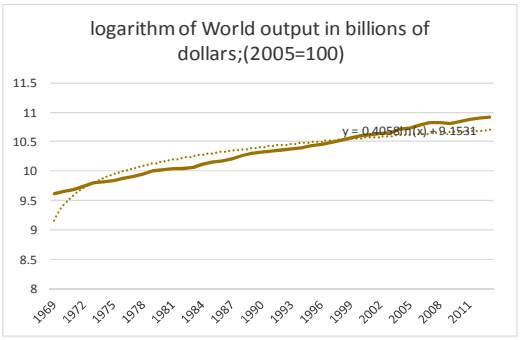
$H_0$: no first-order autocorrelation

F(1,3) =49.655

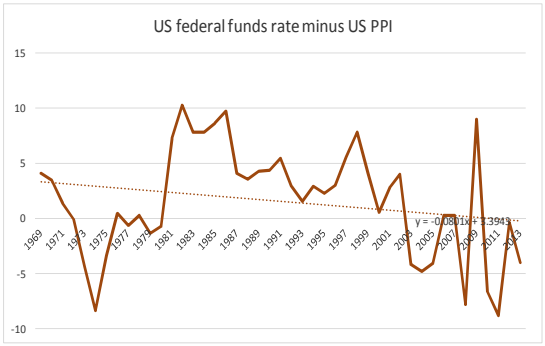
Prob > F =0.0059

Appendix 2

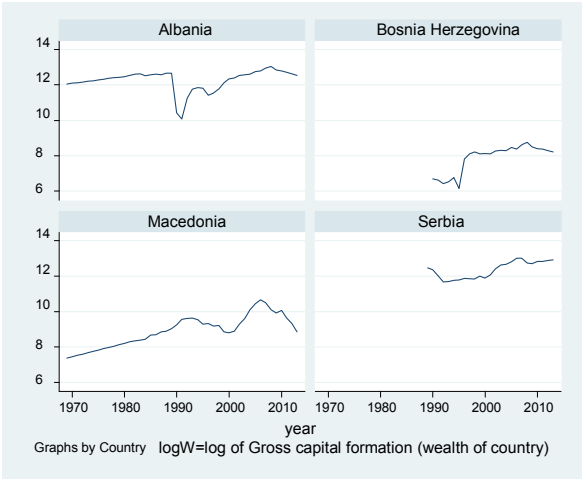
Logarithm of world output (2005=100)



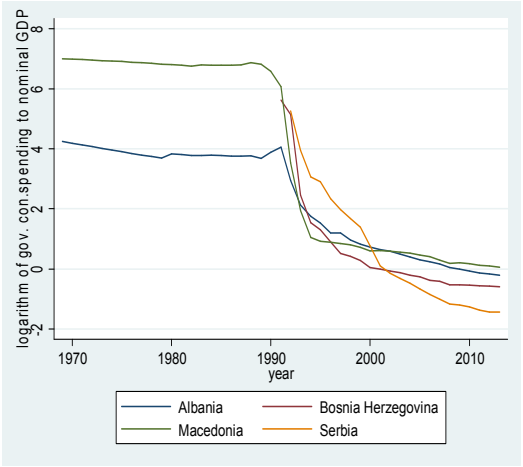

Logarithm of world interest rate




Logarithm of world capital formation




Log. of gov. spending to nominal GDP



## Natural (trend) and actual output plots