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EU accession of Macedonia – assessment of Balassa-Samuelson Effect

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Introduction

The Balassa-Samuelson effect is a well established ground for analyzing the catch up period for price level convergence between countries with different levels of development. During the catch up period, transition countries that are in process of accession to EU, face appreciation of their currencies compared to the euro, caused by the relative productivity increases in the tradable sector, and reflected trough increases in the prices of non-tradable sector. Most of the studies that were investigating this effect, over the time found results in favor of the effect, and in compliance with the theory. The effect was interpreted as a signal for increased inflation as a result of the productivity growth in the transition economies.

The purpose of our research is to investigate the presence of Balassa-Samuelson effect and its influence in the process of the fulfillment of the Maastricht criteria and price convergence in Macedonia compared to Euro zone. We investigate the domestic and international Balassa-Samuelson effect: for the domestic effect we test if the changes in the productivity differentials between tradable and non tradable sectors cause changes in price levels differentials between the two sectors; whereas, the investigation of the international effect is conducted by applying two models: first one tests the changes in the real exchange rate as a result of the changes in the productivity differentials between Macedonia and Euro zone; the second tests the changes in the price levels differentials between Macedonia and Euro zone, as a result of the changes in the productivity differentials between Euro zone and Macedonia and the changes in the nominal exchange rate.

Literature Review on Balassa-Samuelson effect

Balassa (1964) was the first to analyse the price levels and income levels in 12 countries, using cross-section OLS analysis. Bahmani-Oskooee (1992) was the first to use the E/G technique, and Bahmani-Oskooee and Rhee in (1996) were the first to introduce the Johansen cointegration test, which has become the most used technique in the empirical analysis of the B-S effect (for example Deloach 2001; Egert 2002a; 2002b and many other studies). Since 2000, the De Broeck and Slok (2001), paper introduced the autoregressive distributed lag (ARDL) technique. From the late nineties until the present time for testing the effect were also used fully modified OLS (Egert 2002b; Egert, Drine, Lommatzsch and Rault 2003), as well as Generalised Least Squares (GLS) in Bahmani-Oskooee and Nasir 2001. Also the fixed effects panel model has been used in Fischer 2002 and the generalized method of moments (GMM) (for example Arratibel, Rodriguez-Palenzuela and Thimann 2002 paper). As suggested by Tica and Druzic (2006) interesting is the fact that the OLS technique has been sustained over 50 years not only in cross-country analyses but also in time series and panel tests (Mihaljek and Klau 2003; Jazbec 2002; Funda et al. 2007). Even though econometric development decreases the relative use of OLS in empirical studies, still overall, OLS survived from the very beginning of the development of the Balassa-Samuelson theory. These studies indicated homogeneous results regarding the strength of the Balassa-Samuelson effect in the observed countries, along different time periods. Moreover, most of the studies obtained statistically significant coefficients, and the theoretically predicted signs were confirmed.

As already mentioned, the first empirical paper using cross-section analysis, Balassa (1964), indicated strong empirical evidence in support of the relationship among productivity and price levels. Over time the studies were including bigger numbers of countries in the cross section analyses as a strong argument in support of the B-S effect and its impact on economic policy (Tica and Druzic, 2006).

Rogoff (1996) investigated number of data sets, and concluded that the relationships among the income and the price levels is noticeable over the complete data set, but if we are interested separately in developed or developing countries that relationship is far less noticeable. In the panel data analysis conducted in the paper, most of the coefficients were significant and the theoretically anticipated signs were confirmed as correct. In the Bahmani-Oskooee and Rhee (1996) study, time series analyses also confirmed the theoretically estimated signs and the coefficients were found to be significant.

The disturbance between the EMU criteria and the B-S effect was detected in the studies De Broeck and Slok (2001) and Lojschova (2003). The studies of Coricelli and Jazbec (2001), Egert (2002a, 2002b), Egert, Drine, Lommatzsch and Rault (2003) are suggesting significant cointegration among productivity and price levels, but at the same time this is not the sufficiently large to threat EMU rules with respect to inflation, whereas Arratibel, Rodriguez-Palenzuela and Thimann's (2002) study haven't detected any evidence on the B-S effect in the transition economies. As Arrabel et al. (2002) are explaining Balassa-Samuelson effect can appear to be insignificant because the inflation may appear as a result of a different market structures in tradable and non-tradable sector, rather than from different levels of productivity growth in both sectors.

The basic Balassa-Samuelson model for European transitional economies

For almost 30 years, the mathematical B-S model was used in its very simple linear form, explained and used in one of the original papers, Balassa's, with focus only on the supply side, and explaining the relationship between the price and productivity levels.

The first mathematical formulation of the general B-S model in terms of general equilibrium was made by Rogoff (1992), following the basic assumptions of the B-S theory and built in the standard production Cobb-Douglas function: three production factors (capital-K, labour-L and productivity-A); applying for the production of two types of goods (tradable and non-tradable). Hence, the production functions for each sector separately are:

$$Y_T = A_T K_T^{\alpha} K_T^{1-\alpha} \qquad (1)$$

$$Y_{NT} = A_{NT} K_{NT}^{\beta} K_{NT}^{1-\beta} \qquad (2)$$

For that purpose, the aggregated price levels were divided into tradables and non-tradables, presented with lower letters[1] in order to distinguish for logarithms:

$$p_t = \alpha p_t^T + (1-\alpha) p_t^{NT} \qquad (3)$$

$$p_t = \alpha^* p_t^T + (1-\alpha^*) p_t^{NT} \qquad (4)$$

[1] Natural logarithms of the variables are denoted by lower case letters.

Where, p_t^T denotes the prices in the tradable sector, p_t^{TN}-denotes the prices in the non-tradables sector and α-denotes the share of the tradables in the economy. The (*) – denotes the price level in the foreign economy.

And the real exchange rate (q) is described as the relationship of the relative prices between the tradables produced in the foreign country to tradables produced in the home country:

$$q_t = (e_t + p_t^*) - p_t \qquad (5)$$

Where e_t denotes the nominal exchange rate described as the amount of domestic currency per one unit of the foreign currency. If there is a decrease in q_t, then there is real appreciation of the domestic currency, following that logic an increase in q_t, indicates real depreciation of the domestic currency. If we reorder equation 5, with substituting the equations 3 and 4 in it, we will get the value of the real exchange rate in terms of percentage changes in the price levels:

$$\Delta q_t = (\Delta e_t + \Delta p_t^{T*} - p_t^T) + [(1-\alpha^*)(\Delta p_t^{NT*} - p_t^{T*}) - (1-\alpha)(\Delta p_t^{NT} - p_t^T)] \qquad (6)$$

,
Under assumption that the law of one price holds for the tradable sector, then the first part of the right side of the equation 6 will equal zero:

$$\Delta p^T = \Delta e + \Delta p^{T*} \qquad (7)$$

Following this logic, and referring to the equations 1 and 2, under the assumption that there is perfect competition on the market and perfect mobility of the production factors, profit maximization implies:

$$W = A^T \chi \left(\frac{K^T}{L^T}\right)^{1-\chi} \qquad (8)$$

$$W = \left(\frac{P^{NT}}{P^T}\right) A^{NT} \delta \left(\frac{K^{NT}}{L^{NT}}\right)^{1-\delta} \qquad (9)$$

$$R = A^T (1-\chi) \left(\frac{K^T}{L^T}\right)^{-\chi} \qquad (10)$$

$$R = \left(\frac{P^{NT}}{P^T}\right) A^{NT} (1-\delta) \left(\frac{K^{NT}}{L^{NT}}\right)^{-\delta} \qquad (11)$$

Where: W denotes the wage rates, measured in terms of the tradables; R denotes the rental rate on capital, determined on the world market and $\frac{P^{NT}}{P^T}$ indicates the relationship between the relative prices of non-tradables to tradables; and, $\boldsymbol{\delta}$ and χ are coefficients for factor intensities.
For obtaining the domestic Balassa-Samuelson hypothesis, we should rearrange the equations (8)-(11), and we will get:

$$\Delta p^{NT} - \Delta p^T = \left(\frac{\delta}{\chi}\right) \Delta a^T - \Delta a^{NT} \qquad (12)$$

This indicates that if productivity growth in the tradable sector outpaces the growth in the non-tradable sector the prices of non-tradables will rise faster than the prices of tradables. This is based on the assumption of equal factor intensity of tradables and nontradables ($\boldsymbol{\delta} = \chi$). But as suggested by Froot and Rogoff (1994) and Mihaljek and Klau (2004), the neglected point in the hypothesis is that if non traded goods are more labour intensive ($\delta > \chi$), than even a balanced growth of productivity ($\Delta a^T = \Delta a^{NT}$) will lead to appreciation of the relative prices of non-traded goods. Further they point out that the change in relative prices will be equivalent to the productivity growth differential only if the degree of labour intensity is equal in the two sectors. This, domestic version of the Balssa-Samuelson effect, very often is equalized to the Baumol-Bowen effect, which examine if there is a broad trend for the prices of service-intense good to rise over time as historically, productivity growth in that activities has tended to be slower than more capital intensive manufacturing (Baumol-Bowen, 1966). Even though there is a significant overlap between the two effects, it can be concluded that the equation 12 captures Baumol-Bowen effect, but Balassa-Samuelson includes more than just service intensive goods, on the non-tradable side. Further on, if we substitute the equation (12) into equation (6) using the (5), and we get a variant of relative PPP, the international Balassa-Samuelson hypothesis.

$$\Delta p - \Delta p^* = \Delta e + (1-\alpha)\left[\left(\frac{\delta}{\chi}\right)\Delta a^T - \Delta a^{NT}\right] - (1-\alpha^*)\left[\left(\frac{\delta^*}{\chi^*}\right)\Delta a^{T*} - \Delta a^{NT*}\right] \quad (13)$$

Or if we simplify the equation in terms of the real exchange rate, we get:

$$\Delta q = (1-\alpha^*)\left[\left(\frac{\delta^*}{\chi^*}\right)\Delta a^{T*} - \Delta a^{NT*}\right] - (1-\alpha)\left[\left(\frac{\delta}{\chi}\right)\Delta a^T - \Delta a^{NT}\right] \quad (14)$$

Under assumption that the factor intensity is equal in both sectors, at home and abroad, and that factor intensity ratios are equal at home and abroad, equation (13) and (14) can be simplified to:

$$\Delta p - \Delta p^* = \Delta e + (1-\alpha)(\Delta a^T - \Delta a^{NT}) - (1-\alpha^*)(\Delta a^{T*} - \Delta a^{NT*}) \quad (15)$$

or:

$$\Delta q = (1-\alpha^*)(\Delta a^{T*} - \Delta a^{NT*}) - (1-\alpha)(\Delta a^T - \Delta a^{NT}) \quad (16)$$

Estimating the Balassa-Samuelson effect for Macedonia

Data

For the purposes of the research we use time series data for productivity and prices, both for Macedonia and the euro-zone, for 15 years (1997-2011). The periods are chosen by the availability of published data via official sources; For Macedonia: exchange rate data are taken from the reports of the National Bank of the Republic of Macedonia, whereas consumer price index (in the further text referred as CPI), wages and employees are taken from the national statistical office. The data for the euro-zone is taken from the European Central Bank and eurostat web pages. For the purposes of the research the author has applied own calculations.

For the purpose of the research and because of the lack of data for quantity of capital for Macedonia it was not convenient to calculate the total factor productivity. Hence, as suggested by Mihaljek and Klau (2004) and Funda et.al, (2007), the productivity was derived by dividing the value added with the number of employees by respective sectors.

CPI rates both for traded and non-traded goods are calculated as weighted averages of separate categories, where for weights are taken the shares of the individual categories in the CPI index.

Both the employment and the added value by sectors are obtained as cumulative of individual categories. Further on, the number of employees was used as a weight for determining the wages, taken as weighted sum of individual categories. Above mentioned variables measured at quarterly intervals and are thus subject to seasonal influence. Hence, they were seasonally adjusted using the census X-12 method, as suggested by Funda et. al (2007). The nominal exchange rates of domestic currencies against the euro, presented in quarterly averages are taken from the reports of NBRM.

The goods were divided into two general categories: tradable and non-tradable. In tradable are included manufacturing, tobacco and beverages, cosmetics and fragrances, fuels and oils. On the other side in non-tradable are included house (rents, water supply and other communal expenditures), socio-cultural life and leisure, infrastructure maintenance, PTT services, car maintenance, hotels and restaurants and other services.

Econometric analysis

In the next sections will be presented the econometric analysis of the domestic and the international Balassa-Samuelson effect in Macedonia, based on the theoretical model presented in theoretical background. It should be mentioned that the data for Macedonia used in the model are limited, both by availability and consistency. As required for the empirical analysis, the data was transformed into natural logarithms, and then first differenced. As suggested by Rother (2000), the first differences of the variables give opportunity for monitoring the inflationary movements in the economy, that are related to the changes in the growth rates of the labour productivity. Before proceeding with the estimation of the Balassa-Samuelson effect, first we have conducted Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Dickey-Fuller-Generalised Least Squares test, for checking the stationarity of the variables. After confirming that the variables are of first order integrated, I(1), meaning they need to be differenced only once to be stationary, the dynamic ordinary least squares (OLS) method was used to estimate a partial adjustment model to test the Balassa-Samuelson effect on the monetary policy in Macedonia. For small data samples, the use on OLS for estimating partial adjustment model (PAM) seems to be reasonable procedure (Doran, 1985). In compliance with the theory, after the static model, and before proceeding with partial adjustment model, for every equation we have estimated DLRM(1). Due to the diagnostics that the first lags of the independent variables in all three models are not significantly different from zero, more over they does not improve the model specification, we transformed the DLRM(1) into PAM.

Stationarity

Since it is known that even in the most optimistic situation, the stationarity test may not give definitive results (Besimi, 2006), which especially applies for transition economies as Macedonia, where we conduct analysis on short time series, we have to conduct unit root test on each of the series in order to increase the proofs for stationarity. In the table 1, we present the summarized results of the different methods for the unit root test of the variables:

Table 1: Unit root test for variables

Variable	Methodology	Integration	*p*-val	C	T	Lags*	DW**
LNCPINT_LNCPIT	ADF	I(1)	0.5511	✓	-	0	1.419
	ADF	I(1)	0.7200	✓	✓	0	1.367
	PP	I(1)	0.4745	✓	-	0	1.419
	PP	I(1)	0.5616	✓	✓	0	1.364
	DF-GLS	I(1)	>0.1	✓	-	1	1.318
	DF-GLS	I(1)	>0.1	✓	✓	0	1.359
LNPRODT_LNPRODNT	ADF	I(1)	0.0235	✓	-	0	2.014
	ADF	I(1)	0.1308	✓	✓	0	2.050
	PP	I(1)	0.0235	✓	-	0	2.014
	PP	I(1)	0.1308	✓	✓	0	2.051
	DF-GLS	I(1)	>0.05	✓	-	0	1.960
	DF-GLS	I(1)	>0.05	✓	✓	0	1.898
LNCPI_EZ	ADF	I(1)	0.4008	✓	-	4	1.909
	ADF	I(1)	0.0236	✓	✓	3	1.854
	PP	I(1)	0.4729	✓	-	0	1.005
	PP	I(1)	0.7	✓	✓	0	0.9

			463				88[1]
	DF-GLS	I(1)	>0.1	✓	-	4	1.883
	DF-GLS	I(1)	>0.1	✓	✓	4	1.902
LNPROD_EZ	ADF	I(1)	0.0735	✓	-	5	1.855
	ADF	I(1)	0.0852	✓	✓	5	1.915
	PP	I(1)	0.2665	✓	-	0	0.838[1]
	PP	I(1)	0.6124	✓	✓	0	0.833[1]
	DF-GLS	I(0)	>0.01	✓	-	1	2.181
	DF-GLS	I(0)	>0.01	✓	✓	1	2.2458
LNREER	ADF	I(1)	0.9323	✓	-	10	2.082
	ADF	I(0)	0.0003	✓	✓	4	1.802
	PP	I(1)	0.2133	✓	-	0	1.3757
	PP	I(1)	0.1298	✓	✓	0	1.2908
	DF-GLS	I(1)	>0.1	✓	-	0	1.3624
	DF-GLS	I(0)	>0.1	✓	✓	4	1.7803

*The number of lags is indicated by the information criteria in EViews 5.0
**the DW-statistics-testing for correlation, overall suggest satisfactory results, mostly around 2, which is considered as mostly favourable.
[1] on these three occasions PP-test indicates DW below 1, which according to the rule of thumb is a reason for alarm, still the other two tests are suggesting enough evidence for rejecting the possibility for positive correlation.

Source: Authors calculations in EViews 5.0

From the table, we can see that the variables are integrated of first order, so they have to be differenced only once in order to get stationary series, whose mean, variance and covariance do not vary with a sampling period (Holden and Thomson, 1992). The DW statistics presented in table 1, are not always around its most favorable value (around 2), yet ADF test indicates that most of the observations are between 1.7-2.3, which we find acceptable for rejecting the null of serial correlation in the residuals.

Estimation of the domestic Balassa-Samuelson effect

For the estimation of the domestic version of the Balassa-Samuelson effect, we use the following equation (see equation 12) (also used by Funda et.al, 2007):

$$\Delta d\log\left(\frac{CPINT}{CPIT}\right) = c + \beta_0 \Delta d\log\left(\frac{PRODT}{PRODNT}\right) + \varepsilon_i \qquad (a)$$

Where, CPINT and CPIT are denoting the price indices for tradables and non-tradable sectors, similarly PRODT and PRODNT are denoting the labour productivity in the tradable and non-tradable sectors. It is common knowledge that time series regression requires the residuals to be independent and normally distributed over the time. Therefore in table 2a, we present the estimates together with the diagnostic tests to check for the model specification.

Table 2a: Domestic Balassa-Samuelson effect for Macedonia: model diagnostics and estimated coefficients

Diagnostics	**Serial Correlation CHSQ(4)= 10.2914[.036]** **Functional Form CHSQ(1)= 2.5908[.107]** **Normality CHSQ(2)= 12.0878[.002]** **Heteroscedasticity CHSQ(1)= 0.83544[.361]**
	Dependent variable: $\Delta\,d\log\left(\frac{CPINT}{CPIT}\right)$
Independent variable	***Equation (a)***
C	**0.0002263 (p=0.738)**
$\Delta\,d\log\left(\frac{PRODT}{PRODNT}\right)$	**0.025206 (p=0.627)**
R^2	**0.0109**

Source: authors calculations

From the results presented in table 2a, we fail to reject the null hypothesis of no serial correlation in the residuals, with probability of 3.6% for making type one error. That is telling us that, over the time, the residuals are dependent. With 10.7% probability of making type I error, we fail to reject the null hypothesis linear relationship among residuals. We have enough evidence to reject the null hypothesis, for having problems with the normality of the model. Whereas, with 36.1% probability, of making type I error, we fail to reject the null hypothesis of homoscedasticity, which suggests that variances are equal. In order to reduce the problem of serial correlation in the model, we add the lagged value of the dependent variable to the left-hand side (among the independent variables):

$$\Delta \text{dlog}\left(\frac{CPINT}{CPIT}\right) = c + \beta_0 \Delta \text{dlog}\left(\frac{PRODT}{PRODNT}\right) + \Delta \text{dlog}\left(\frac{CPINT}{CPIT}\right)_{t-1} + \varepsilon_i \quad \text{(b)}$$

In table 2 b, we present the results of the OLS of the percentage changes in price levels differentials, productivity differentials, the lag of the price levels differentials:

Table 2b: Domestic Balassa-Samuelson effect for Macedonia: model diagnostics and estimated coefficients (with lagged dependent variable)

Diagnostics	**Serial Correlation CHSQ(4)= 5.8361[.212]** **Functional Form CHSQ(1)= 0.57051[.450]** **Normality CHSQ(2)= 2.3451[.310]** **Heteroscedasticity CHSQ(1)= 0 .43838[.508]**
	Dependent variable: $\Delta \text{dlog}\left(\frac{CPINT}{CPIT}\right)$
Independent variable	***Equation (b)***
C	**0.0001468 (p=0.979)**
$\Delta \text{dlog}\left(\frac{PRODT}{PRODNT}\right)$	**0.053490 (p=0.231)**
$\Delta \text{dlog}\left(\frac{CPINT}{CPIT}\right)_{t-1}$	**0.56821 (p=0.004)**
R^2	**0.3734**

Source: authors calculations

The results presented are suggesting improvement in the model specification regarding serial correlation in the residuals, and with probability of 21.2% for making type one error we have enough evidence to reject the null. That is telling us that over the time, residuals are independent. With 45% probability of making type I error, we fail to reject the null hypothesis of no misspecification of the functional form. With 31% probability of making type I error, we fail to reject the null hypothesis, of having problems with the normality of the model, contrary this indicates that residuals are normally distributed. Whereas, with 50.8% probability, of making type I error, we fail to reject the null hypothesis of homoscedasticity, which suggests that variances are equal. Since the second model is better specified, namely, with including the lagged dependent variable, the overall diagnostics improved, which is also suggested by the increase of the R^2, we proceed with economic interpretation of the results. The signs of the estimated coefficients are positive, as expected, but the only significant variable in the regression is the lag of the dependent variable. Yet, economic implication of the model is that in each period the Balassa-Samuelson effect adjusts only partially to changes in labour productivity differentials among tradables and non-tradables and the lag of the change of the price levels differential, by increasing or decreasing the change of the price levels differentials towards the desired new level.

Estimation of the international Balassa-Samuelson effect

In order to get better insight in the international Balassa-Samuelson effect for Macedonian economy, we will use two different model specifications marked as (c) and (d) (see equations 16 and 15 respectively) (also used by Funda et.al, 2007):

$$\Delta \operatorname{dlog} REER = c + \beta_0 \Delta \operatorname{dlog}\left(\frac{PRODez}{PRODmkd}\right) + \varepsilon_i \qquad (c)$$

where REER is denoting the real denar-euro exchange rate, whereas PRODez and PRODmkd are denoting the labour productivity ratios in the tradable and non-tradable sectors, both in the Euro zone and in Macedonia.
The second model specification is:

$$\Delta \operatorname{dlog}\left(\frac{CPImkd}{CPIez}\right) = c + \beta_0 \Delta \operatorname{dlog}\left(\frac{PRODmkd}{PRODez}\right) + \Delta \operatorname{dlog} NEER + \varepsilon_i \qquad (d)$$

Where, CPImkd and CPIez denote the ratios of the price indices for tradables and non-tradable sectors, both in Macedonia and in the Euro zone; PRODez and PRODmkd denote the labour productivity ratios in the tradable and non-tradable sectors, both in Euro zone and in Macedonia; and NEER-denotes the nominal denar-euro exchange rate.
As already mentioned the requirement of the time series independent and normally distributed residuals over the time, again, in table 3a, we present the estimates together with the diagnostic tests, to check for the model specification.

Table 3a: International Balassa-Samuelson effect for Macedonia compared to Euro zone: model diagnostics and estimated coefficients

Diagnostics	**A:Serial Correlation*CHSQ(4)= 9.3124[.054] B:Functional Form *CHSQ(1)= 6.9768[.008] C:Normality *CHSQ(2)= .95701[.620] D:Heteroscedasticity*CHSQ(1)= .12345[.725]**	**Serial Correlation*CHSQ(4)= 16.5498[.002] Functional Form *CHSQ(1)= 2.0578[.151] Normality *CHSQ(2)= 4.0569[.132] Heteroscedasticity*CHSQ(1)= .77833[.378]**
	Dependent variable: $\Delta \operatorname{dlog} REER$	**Dependent variable:** $\Delta \operatorname{dlog}\left(\frac{CPImkd}{CPIez}\right)$
Independent variable[2]	***Equation (c)***	***Equation(d)***
C	**-0.0042639 (p=0.146)**	**-0.0001583 (p=0.907)**
$\Delta \operatorname{dlog}\left(\frac{PRODez}{PRODmkd}\right)$ $\Delta \operatorname{dlog}\left(\frac{PRODmkd}{PRODez}\right)$	**-0.0064619 (p=0.056)**	**-0.0001531 (p=0.406)**
$\Delta \operatorname{dlog} NEER$		**0.084248 (p=0.437)**
R^2	**0.0156**	**0.0534**

Source: authors calculations

From the results presented in table 3 a, regarding the first specification of the international Balassa-Samuelson model (equation c), with probability of 5.4% for making type one error, we have enough evidence to reject the null hypothesis, of no serial correlation in the residuals. Whereas regarding the second specification of the international Balassa-

[2] Regarding productivity proxy for equation (c) it is used the $\Delta \operatorname{dlog}\left(\frac{PRODez}{PRODmkd}\right)$ proxy, where as for equation (d) $\Delta \operatorname{dlog}\left(\frac{PRODmkd}{PRODez}\right)$ proxy.

Samuelson model (equation d), with probability of 0.2% for making type one error, we have enough evidence to reject the null hypothesis, of no serial correlation in the residuals. That is telling us that in both model specifications, over the time, the residuals are dependent. With probability of 0.8% for making type I error, in the first model (equation c), we fail to reject the null hypothesis of no misspecification of the functional form, whereas in the second model specification, equation d, we have enough evidence to reject the null. Regarding the normality in the residuals, in both model specifications (equation c and equation d), we fail to reject the null for the normal distribution of the residuals in the model. With 72.5% and 37.8% probabilities, for model (c) and model (d) respectively, of making type I error, we fail to reject the null hypothesis of homoscedasticity, which suggests that variances are equal. In order to reduce the problem of serial correlation in both models, we add the lagged value of the dependent variable to the left-hand side (among the independent variables):

$$\Delta \, \text{dlog} \, \text{REER} = \text{c} + \beta_0 \Delta \, \text{dlog} \left(\frac{\text{PRODez}}{\text{PRODmkd}}\right) + \Delta \, \text{dlog} \, REER_{t-1} + \varepsilon_i \qquad \text{(e)}$$

and

$$\Delta \, \text{dlog} \left(\frac{\text{CPImkd}}{\text{CPIez}}\right) = \text{c} + \beta_0 \Delta \, \text{dlog} \left(\frac{\text{PRODmkd}}{\text{PRODez}}\right) + \Delta \, \text{dlog} \, \text{NEER} + \Delta \, \text{dlog} \left(\frac{\text{CPImkd}}{\text{CPIez}}\right)_{t-1} + \varepsilon_i \qquad \text{(f)}$$

, hence in table 3b, we present the models with lagged dependent variables and the obtained results:

Table 3b: International Balassa-Samuelson effect for Macedonia compared to Euro zone: model diagnostics and estimated coefficients (with lagged dependent variable)

Diagnostics	**Serial Correlation* CHSQ(4)= 8.3357[.180]** **Functional Form *CHSQ(1)= 6.6981[.110]** **Normality *CHSQ(2)= .85104[.653]** **Heteroscedasticity*CHSQ(1)= .10255[.749]**	**Serial Correlation *CHSQ(4)= 9.9208[.142]** **Functional Form *CHSQ(1)= .5039E-4[.994]** **Normality *CHSQ(2)= .57914[.749]** **Heteroscedasticity *CHSQ(1)= .34810[.555]**
	Dependent variable: $\Delta \text{dlogREER}$	**Dependent variable:** $\Delta \, \text{dlog} \left(\frac{CPImkd}{CPIez}\right)$
Independent variable[3]	***Equation (e)***	***Equation(f)***
C	**-0.0031860 (p=0.307)**	**-0.0010508 (p=0.311)**
$\Delta \, \text{dlog} \left(\frac{PRODez}{PRODmkd}\right)$	**-0.0060275 (p=0.046)**	**-0.00007633 (p=0.570)**

[3] Regarding productivity proxy for equation no it is used the $\Delta \, \text{dlog} \left(\frac{PRODez}{PRODmkd}\right)$ proxy, where as for equation $\Delta \, \text{dlog} \left(\frac{PRODmkd}{PRODez}\right)$ proxy.

$\Delta\,\mathrm{dlog}\left(\frac{PRODmkd}{PRODez}\right)$		
$\Delta\,\mathrm{dlog}\,REER_{t-1}$	**0.060841 (p=0.061)**	
$\Delta\,\mathrm{dlog\,NEER}$		**0.24360 (p=0.010)**
$\Delta\,\mathrm{dlog}\left(\frac{CPImkd}{CPIez}\right)_{t-1}$		**0.79596 (p=0.000)**
R^2	**0.1527**	**0.5481**

Source: authors calculations

The results presented are suggesting improvement in the both model specifications of the international Balassa-Samuelson model regarding serial correlation in the residuals, and with probability of 18% and 14.2%, for equations (e) and (f) respectively, for making type one error, we have enough evidence to reject the null. That is telling us that over the time, residuals in both models are independent.

Regarding the equation (e), with 11% probability of making type I error, we fail to reject the null no misspecification of the functional form. With 65.3% probability of making type I error, we fail to reject the null hypothesis, for having problems with the normality of the model, contrary this indicates that residuals are normally distributed. Whereas, with 74.9% probability, of making type I error, we fail to reject the null hypothesis of homoscedasticity, which suggests that variances are equal. The diagnostics of the equation (f), are further suggesting that with 99.4% probability of making type I error, we fail to reject the null hypothesis linear relationship among residuals. With 74.9% probability of making type I error, we fail to reject the null hypothesis, of having problems with the normality of the model, contrary this indicates that residuals are normally distributed. And, with 55.5% probability, of making type I error, we fail to reject the null hypothesis of homoscedasticity, which suggests that variances are equal. From the diagnostics of the both models, we can see that with including the lagged dependent variables on the right side, the overall diagnostics improved, which is also suggested by the increase of the R^2 in both models, we proceed with economic interpretation of the results.

The signs of the estimated coefficients obtained from the regression of the first model specification for testing the international Balassa-Samuelson effect for Macedonia (equation e) are mixed, namely some confirmed and some are opposite of the a priori expected. The economic implication of the first model for estimating the international B-S effect is that in each period the Balassa-Samuelson effect adjusts only partially to changes in the labour productivity differentials among Euro zone and Macedonia, by increasing or decreasing the change in REER towards some new desired level. Whereas, the lagged dependent variable suggest appreciation of the REER on the long run.

In the equation (f), the second model specification for testing the international Balassa-Samuelson effect for Macedonia, there are two statistically significant variables with a priori expected signs. The economic implication of the second model for estimating the international B-S effect is that in each period the Balassa-Samuelson effect adjusts only partially to changes in NEER and the lag of the differences in the price levels between the Euro zone and Macedonia, by increasing or decreasing the change in the differences in the price levels between the Euro zone and Macedonia towards some new desired level.

From the findings obtained about the domestic and international Balassa-Samuelson effect in Macedonia, in relation to the underlying theory, it is easy to explain that in Macedonia, due to the low productivity growth, there is no significant productivity driven inflation. Which indicates that the level of the prices of the non-tradables in Macedonia are not under pressure of the productivity increase in the tradables. Moreover, since there is no increase in the productivity differentials in Macedonia, that cannot influence the REER to appreciate. Indications of the significant lagged dependent variables are only suggesting that the price levels, and the REER appreciation will need more time to get close to the desired level, compared to similar transition economies.

Conclusion and Policy implications

The interest for conducting this research was initiated by the ongoing process of EU integrations of Macedonia, and the fulfillment of the economic criteria set by the union. Moreover, there is not much research conducted on this effect for Macedonia, partly due to the fact that Macedonia has pegged currency toward the euro, low productivity growth, which does not push the inflation to the non-accepted margins. The high interest for the implications of the Balassa-Samuelson effect for Macedonia, as in all EU accessing countries, results from its indication of the level of economic compliance of the country of interest with the EU/EMU requirements. However, Mihaljek and Klau (2003) suggested that we have to be aware that sometimes even though Balassa-Samuelson effect may be very small, or insignificant, yet the country may not be in compliance with the requirements. This paper investigates several aspects of the Balassa-Samuelson effect in Macedonia, namely we tested if there is a positive or negative impact of the increase in the productivity growth differentials in traded and non-trades sector, on the increases of the overall price levels in the country.

There are numerous empirical studies of the Balassa-Samuelson effect, but applying different econometric techniques for its estimation. Most of them suggest results in favour of the Balassa-Samuelson effect in the transition economies. However, the results are different depending on the countries of interest; the time spans, data frequency and data quality are different. Following the example of the most of the empirical studies for transitional economies, similar to Macedonia, our study applies the analysis on the quarterly data. Our study begins with investigating the hypothesis by conducting OLS estimation technique. Diagnostic test from the OLS estimation indicates serial correlation in the residuals, which increase the suspicion of the power of the results, and suggests that the model lacks dynamics. For that purpose, to remedy for serial correlation, we include lagged dependent variable as independent variable in the model, and we obtain dynamic OLS model, which diagnostics are highly improved.

The highly significant lagged dependent variables both in domestic and international estimation of the model, indicates larger long-run effect of the Balassa-Samuelson effect on the Macedonian economy, than on short run, which may prolong the transition period for the country. Other significant variables in REER, but since denar has depreciating trend, its effect is negative. Loko and Tlundar (2006) suggested depreciation of the REER in Macedonia results from relatively low improvements of the production processes and unsatisfactory quality of the goods and services. The aforementioned arguments together with trembling political situation in the country reduce the interest for FDI in the country. Thus, the country is not competitive on the foreign market. Overall productivity growth is small, which can possibly lead to extended transitional period for Macedonia, compared to its partner countries. Moreover, the productivity growth differentials, which are of particular interest for our model, do not have significant influence on the inflation in the model.

The implication of Balassa-Samuelson Effect on Macedonian EU accession plans and fulfillment of the Maastricht criteria are very low and with opposite effect than the expected. First of all, Macedonia has pegged currency with depreciating trend, which is opposite of the expectations for the economies in transition, for having appreciating currencies, which is a result of very small productivity growth in the country. Furthermore, Macedonia fulfils the inflation criteria for accessing EU, which is again partly because of the low productivity. However, as Egert (2002) suggested, most of the EU accessing countries fulfill this inflation criterion because they do not fully employ the production capacities in the country (sometimes countries employ only 50% of their full production capacities), so the increase of the inflation in the transition countries should be expected after their accession to EU, in the catch up process, where on short run while the price convergence takes place, the inflation differentials will also be higher.

Overall, we want to point out that more investigation should take place in investigating the Balassa-Samuelson effect for Macedonia. Since the productivity in very low, there is no application of the price and wage transmission mechanism. In other words, the rise in price levels in tradables as well as in non-tradables, is not caused by increase in productivity growth in the tradable sector. Here rises question for further research, what causes the rise in the overall price levels in Macedonia. One of the possible reasons might be the structural changes from one to another economic system.

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