Shocking aspects of monetary integration (SVAR approach)

Mirdala, Rajmund

June 2009

SHOCKING ASPECTS OF MONETARY INTEGRATION (SVAR APPROACH)

Rajmund **MIRDALA**
Technical University of Kosice, Faculty of Economics, **Slovakia**
rajmund.mirdala@tuke.sk

Abstract:

One of the most challenging areas relating to the European Monetary Union (EMU) enlargement is the question of new member countries' vulnerability to exogenous shocks related to euro adoption. Even if well prepared, and also considering the business cycles of the EMU candidate countries became more correlated as the result of persisting convergence toward the old EU member countries, their real output will be still vulnerable to the exogenous structural disturbances. The responsiveness of the new EMU member countries' real output to the exogenous shocks may of course differ in intensity and durability. If we also assume a possibly low shocks correlation in these countries, the overall short-term wealth effect of the EMU membership may be rather low or even negative at all.

In the paper we analyze the impact of three common exogenous structural shocks on the real output development in the new EMU member countries (Cyprus, Malta, the Slovak Republic *and Slovenia) in the period 1999-2008 using SVAR (structural vector autoregression) approach. In order to meet this objective we decompose the variability of the real GDP in these countries to permanent and temporary shocks (we assume three types of shocks - nominal (liquidity), demand and supply shocks). Impulse-response functions will be also computed so that we can estimate the behaviour of the real output after structural one standard deviation innovations. The relevant outcomes of the analysis we compare with the results of the tests for the whole euro area (represented here by old EU member countries - EU-12 group). This approach helps us to understand the common as well as differing features of the real output determination in the new EMU member countries and old EU member countries.*

Keywords: exogenous shocks, real output, structural vector autoregression, variance decomposition, impulse-response function

JEL Classification: C32, E52

1. Introduction

One of the most challenging areas relating to the European Monetary Union (EMU) enlargement is the question of new EMU member countries' vulnerability to exogenous shocks related to euro adoption. While it is necessary for the candidate country to sustainably meet the criteria of nominal convergence it still doesn't reflect the neutrality of the country's economy to the unexpected structural shocks hitting the euro area. Another type of shocks resulting from the convergence of new EMU member countries toward the old EU member countries reveals from the risk of business cycles non-synchronization. The optimum currency area (OCA) theory introduced by the Mundell (1961) emphasizes the advantages of monetary integration among countries if the business cycles of these countries are highly correlated. Regardless of the fact whether EMU is a good example of the optimum currency area [*see* i.e. Isa and Okali, (2008)] the correlation of the business cycles among the countries significantly determines the overall effects of monetary integration. Fidrmuc and Korhonen (2001) emphasize the business cycles in the European transition economies, that later in 2004 have joined the single market of EU, were not very high correlated with the euro area during the 1990s, but the situation has slightly changed till the end of the decade.

Even if well prepared, and also considering the business cycles of the new EMU member countries became more correlated as the result of persisting convergence toward the old EU member countries, their real output will be still vulnerable to the exogenous structural disturbances. The responsiveness of the EMU candidate countries' real output to the exogenous shocks may of course differ in intensity and durability [Stazka, (2006)]. If we also assume a possibly low shocks correlation in these countries, the overall short-term wealth effect of the EMU membership may be rather low or even negative at all.

In the paper we analyze the impact of three common exogenous structural shocks (also known as primitive shocks) on the real output development in the new EMU member countries (Cyprus, Malta, the Slovak Republic and Slovenia) in the period 1999-2008 using SVAR (structural vector autoregression) approach. In order to meet this objective we decompose the variability of the real GDP in these countries to permanent and temporary shocks (we assume three types of shocks - nominal[1] (liquidity) shocks, demand[2] shocks and supply[3] shocks). Impulse-response functions will be also computed so that we can estimate the behaviour of the real output after structural one standard deviation innovations. The relevant outcomes of the analysis we compare with the results of the tests for the whole euro area (represented here by old EU member countries - EU-12 group). This approach helps us to understand the common as well as differing features of the real output determination in the new EMU member countries and old EU member countries.

2. Econometric model

The methodology we use in our analysis to recover nominal (liquidity), demand and supply shocks is based upon a SVAR model introduced by Clarida and Gali (1994), which implements a long-run identifying restrictions to the unrestricted VAR models pioneered by Blanchard and Quah (1989).

Unrestricted form of the model is represented by the following infinite moving average representation:

$$X_t = A_0\varepsilon_t + A_1\varepsilon_{t\text{-}1} + A_2\varepsilon_{t\text{-}2} + \dots = \sum_{i=0}^{\infty} A_i\varepsilon_{t\text{-}i} = \sum_{i=0}^{\infty} A_i L^i \varepsilon_t \tag{1}$$

where X_t is a vector of the endogenous macroeconomic variables, *A(L)* is a polynomial variance-covariance matrix (represents impulse-response functions of the shocks to the elements of X) of lag-length l, L is lag operator and ε is a vector of identically normally distributed, serially uncorrelated and mutually orthogonal white noise disturbances (vector of reduced form shocks in elements of X). The vector X_t of the endogenous variables of the model consists of the following three elements: real exchange rate (er_r), nominal exchange rate (er_n) and real output (y_r).

In our tri-variate model we assume three exogenous shocks that determine endogenous variables – nominal shock (ε_n), demand shock (ε_d) and supply shock (ε_s). Our model then becomes

$$\begin{bmatrix} \Delta er_{rt} \\ \Delta er_{nt} \\ \Delta y_{rt} \end{bmatrix} = \sum_{i=0}^{\infty} \begin{bmatrix} a_{11i} & a_{12i} & a_{13i} \\ a_{21i} & a_{22i} & a_{23i} \\ a_{31i} & a_{32i} & a_{33i} \end{bmatrix} \begin{bmatrix} \varepsilon_{nt} \\ \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} \tag{2}$$

The framework of the model implies that only supply shocks have a permanent effect on all endogenous variables. Demand shocks have permanent effect on the real and nominal exchange rate while its impact on the real output is only temporary. Nominal shocks have permanent effect only on the nominal exchange rate while its impact on the real exchange rate and the real output is considered to be temporary. Identification of temporary impacts of selected exogenous shocks on the endogenous variables is represented in the model by the following long-run identifying restrictions.

$$\sum_{i=0}^{\infty} a_{11i} = 0, \ \sum_{i=0}^{\infty} a_{31i} = 0, \ \sum_{i=0}^{\infty} a_{32i} = 0 \tag{3}$$

The model defined by equations (2) and (3) we estimate using a vector autoregression. Each element of X_t can be regressed on lagged values of all elements of X. Using B to represent these estimated coefficients, the estimated equation becomes

[1] Nominal shocks are usually associated with the changes in relative money supply, liquidity preference, velocity shifts, varying risk premium, effects of financial liberalization and speculative currency attacks. Higher exposure of the real output to the nominal shock would indicate its higher sensitivity to the unexpected effects of money demand disturbances, money supply disturbances or both, etc.

[2] Demand shocks are usually associated with sudden changes in exports, government expenditures, etc.

[3] Supply shocks are usually associated productivity and labour market shocks, sudden changes in the input prices, etc.

$$\begin{aligned} X_t &= B_1 x_{t-1} + B_2 x_{t-2} + \dots B_n x_{t-n} + e_t = \sum_{i=1}^{n} B_i L^i X_t + e_t = B(L) X_t + e_t \\ &= (I - B(L))^{-1} e_t \\ &= (I + B(L) + B(L)^2 + \dots) e_t \\ &= e_t + D_1 e_{t-1} + D_2 e_{t-2} + D_3 e_{t-3} + \dots \end{aligned} \quad (4)$$

where e_t represents the residuals from the equations in the vector autoregression.

In order to convert equation (4) into the model defined by the equations (2) and (3), the residuals from the vector autoregression, e_t, must be transformed into nominal, demand and supply shocks, ε_t. Imposing $e_t = C\varepsilon_t$, it is clear, that nine restrictions are necessary to define nine elements of the matrix C. Three of these restrictions are simple normalizations, which define the variance of the shocks ε_{nt}, ε_{dt} and ε_{st} (it follows the assumption, that each of the disturbances has a unit variance, $var(\varepsilon) = I$). Another three restrictions comes from an assumption that identified shocks are orthogonal. Normalization together with an assumption of the orthogonality implies $C'C = \Sigma$, where Σ is the variance covariance matrix of e_n, e_d and e_s. The final three restrictions, which allow the matrix C to be uniquely defined, reflect the long-run identifying restrictions mentioned in the equation (3). In terms of our vector autoregression model it implies

$$\sum_{i=0}^{\infty} \begin{bmatrix} d_{11} & d_{12} & d_{13} \\ d_{21} & d_{22} & d_{23} \\ d_{31} & d_{32} & d_{33} \end{bmatrix} \begin{bmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{bmatrix} = \begin{bmatrix} 0 & . & . \\ . & . & . \\ 0 & 0 & . \end{bmatrix} \quad (5)$$

Final three long-run restrictions allows the matrix C to be uniquely defined and the nominal, demand and supply shocks to be correctly identified - recovered from the residuals of the estimated VAR model. The system is now just-identified and can be estimated using structural vector autoregression, so that we can compute variance decomposition that represents the contribution of each shock to the variability in each endogenous variable (we do this for the real output only) and impulse-response functions that represent the short-run dynamics of each endogenous variable (we do this for the real output only) in response to all identified structural shocks.

If the exogenous structural shocks are correctly identified, we might expect the following results:

- Positive relative nominal shock leads to the relative output increase. In the long run, relative output returns to its old level.
- Positive relative demand shock increases relative demand. In the short run, the relative output increases. In the long run, relative output returns to its old level.
- Positive relative supply shock increases relative output. In the long run, relative output rises.

3. Data and results

In order to estimate our model consisting of three endogenous variables for new EMU member countries (Cyprus, Malta, the Slovak Republic and Slovenia) we use the quarterly data ranging from 1999Q1 to 2008Q3 (40 observations) for the nominal effective exchange rates[4], real effective exchange rates[5] and real GDP. Time series for the quarterly real GDP are seasonally adjusted.

Figure 1 shows the development of the endogenous variables for each of the new EMU member countries and the euro area.

[4] Nominal effective exchange rates are calculated as geometric weighted averages of bilateral exchange rates.

[5] Real effective exchange rates are the same weighted averages of bilateral exchange rates adjusted by relative consumer prices.

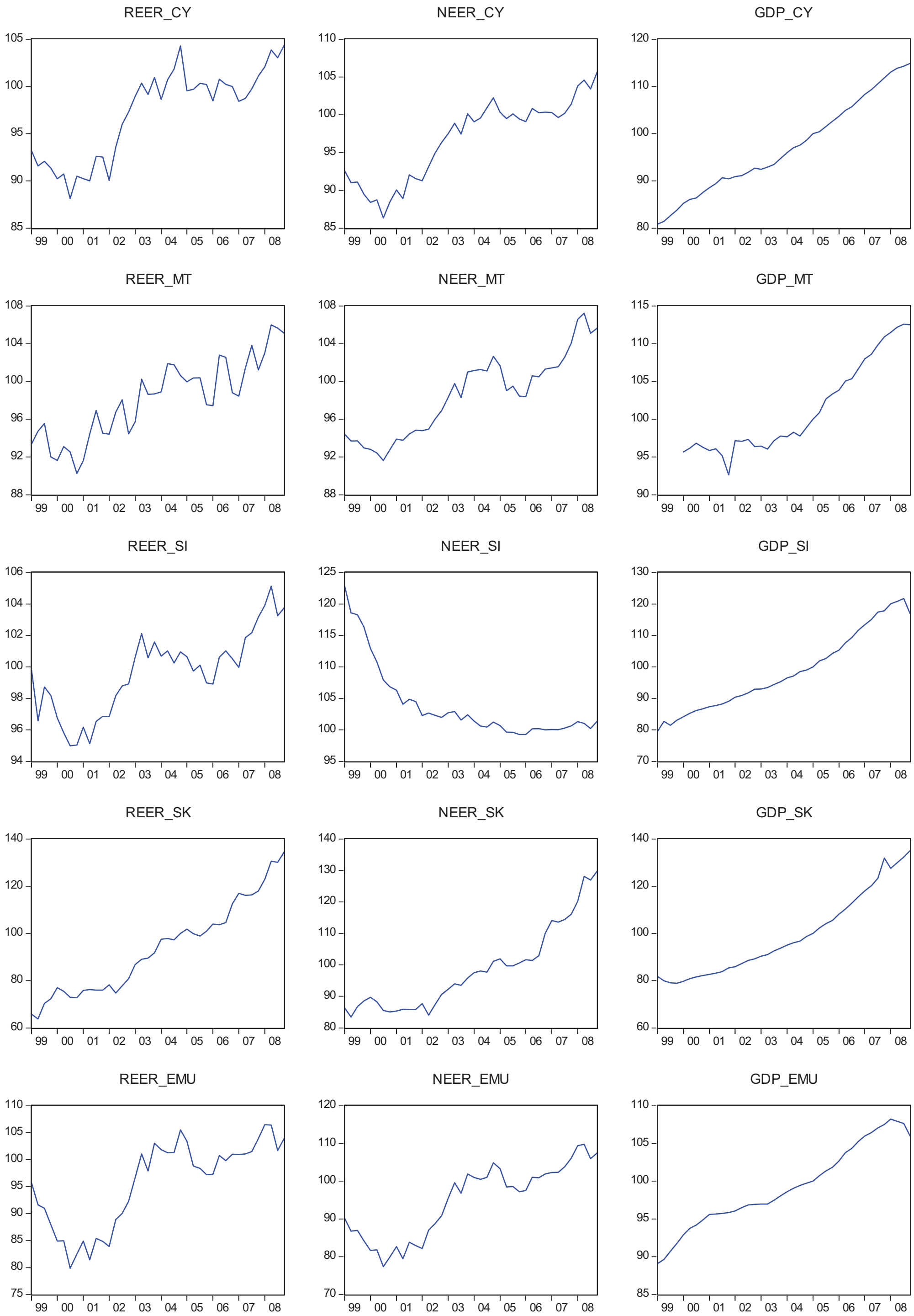

Figure 1. Variables

Source: *Bank for International Settlements, Mundell, R. (1961)*

The table 1 presents descriptive statistics for quarterly real effective exchange rates, nominal effective exchange rates and real GDP in Cyprus, Malta, the Slovak Republic, Slovenia and the euro area.

Table 1. Descriptive statistics (reer)

	reer_cy	reer_mt	reer_si	reer_sk	reer_emu
mean	97.1403	98.1338	99.6270	93.7065	95.5365
median	98.8450	98.5450	100.0500	94.5250	98.1200
max.	104.4100	105.9800	105.1400	134.6400	106.4700
min.	88.1200	90.2500	94.9900	63.8300	79.8700
st.dev.	4.7872	4.1853	2.6043	19.4983	7.9375

Descriptive statistics (neer)

	neer_cy	neer_mt	neer_si	neer_sk	neer_emu
mean	96.7298	98.5310	104.0288	98.4528	94.8593
median	99.0850	98.7300	101.4950	96.7000	98.0200
max.	105.6900	107.2300	122.9100	129.8500	109.7600
min.	86.3400	91.6300	99.2700	83.4100	77.3800
st.dev.	5.3184	4.3168	5.9428	13.1725	9.6266

Descriptive statistics (gdp)

	gdp_cy	gdp_mt	gdp_si	gdp_sk	gdp_emu
mean	97.1145	101.2988	98.5392	99.0513	99.2299
median	95.3600	98.0404	95.9289	94.4142	98.3287
max.	114.9185	112.5891	121.7960	135.1563	108.2159
min.	80.8304	92.6274	79.5352	78.9056	89.0915
st.dev.	10.0511	6.0501	12.4936	17.4531	5.4074

Source: Author's calculations.

Before estimating the model we test the time series for stationarity and cointegration. Correctly estimated SVAR model requires the time series for the endogenous variables are integrated of a same order (the endogenous variables of X_t are stationary) and are not cointegrated (endogenous variables follow different stochastic trend in the long run).

The augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were computed to test the endogenous variables for the existence of the unit roots. The results of the unit root tests are reported in the Table 2.

Table 2. Unit Root Test (Cyprus)

	reer_cy		neer_cy		gdp_cy_sa	
	ADF	PP	ADF	PP	ADF	PP
values	-0,77	-0,77	-0,12	-0,11	0,91	0,75
1.dif.	-7,80*	-7,80*	-7,12*	-7,07*	-4,74*	-4,77*

Unit Root Test (Malta)

	reer_mt		neer_mt		gdp_mt_sa	
	ADF	PP	ADF	PP	ADF	PP
values	0,34	-1,02	-0,25	-0,23	0,75	1,15
1.dif.	-9,90*	-8,82*	-6,11*	-6,11*	-6,59*	-6,59*

Unit Root Test (Slovenia)

	reer_si		neer_si		gdp_si_sa	
	ADF	PP	ADF	PP	ADF	PP
values	-0,94	-0,85	-4,79*	-3,76**	-1,03	-0,12

1.dif.	-8,63*	-8,42*	-4,40*	-7,1*	-4,64*	-3,17*

Unit Root Test (Slovak Republic)

	reer_sk		neer_sk		gdp_sk_sa	
	ADF	PP	ADF	PP	ADF	PP
values	0,94	3,13	-0,95	-0,59	-1,29	-1,73
1.dif.	-5,86*	-5,86*	-6,13*	-6,93*	-8,82*	-12,74

Unit Root Test (euro area)

	reer_emu		neer_emu		gdp_emu_sa	
	ADF	PP	ADF	PP	ADF	PP
values	-0,84	-1,00	-0,42	-0,53	-1,68	-1,69
1.dif.	-6,69*	-6,66*	-6,61*	-6,58*	-5,83*	-5,68*

Source: Author's calculations.

Note: Data represents the results of t-statistics. Null hypothesis can be rejected at 1% level of confidence (*), 5% level of confidence (**), 10% level of confidence (***).

Both ADF and PP test indicates the variables are nonstationary on the values (they have a unit root) so that the null hypothesis of a unit root cannot be rejected (with an exception for neer_si, where both test indicates the stationarity on the values) for any of the series and it is necessary for the variables to be first differenced to induce stationarity. Testing variables on the first differences indicates the time series are stationary so that we conclude that the variables are integrated of the order one (I(1)).

Because the endogenous variables have a unit root on the values it is necessary to the test the time series for cointegration using the Johansen cointegration test. The results of the cointegration tests are summarized in the Table 3. The test for the cointegration was computed using two lags as recommended by the AIC (Akaike Information Criterion) and SIC (Schwarz Information Criterion).

Table 3. Johansen cointegration test (Cyprus)

number of cointegrating equations	trace statistics	critical value (5%)	prob.	maximum eigenvalue statistics	critical value (5%)	prob.
r = 0	39.58	42.92	0.1037	24.13	25.82	0.0823
r = 1	15.45	25.87	0.5352	12.25	19.39	0.3927
r = 2	3.21	12.52	0.8511	3.21	12.52	0.8511

Johansen cointegration test (Malta)

number of cointegrating equations	trace statistics	critical value (5%)	prob.	maximum eigenvalue statistics	critical value (5%)	prob.
r = 0	45.49*	42.92	0.0270	19.25	25.82	0.0898
r = 1	22.31	25.87	0.0612	14.55	19.39	0.0887
r = 2	11.68	12.52	0.1330	11.68	12.52	0.1330

Johansen cointegration test (Slovenia)

number of cointegrating equations	trace statistics	critical value (5%)	prob.	maximum eigenvalue statistics	critical value (5%)	prob.
r = 0	47.40*	42.92	0.0015	31.37*	25.82	0.0103
r = 1	24.69	25.87	0.0527	16.64	19.39	0.0809
r = 2	12.24	12.52	0.1097	12.24	12.52	0.1097

Johansen cointegration test (Slovak Republic)

number of cointegrating equations	trace statistics	critical value (5%)	prob.	maximum eigenvalue statistics	critical value (5%)	prob.
r = 0	38.89	42.92	0.1193	24.05	25.82	0.0842
r = 1	14.84	25.87	0.5857	7.97	19.39	0.8238
r = 2	6.87	12.52	0.3582	6.87	12.52	0.3582

Johansen cointegration test (euro area)

number of cointegrating equations	trace statistics	critical value (5%)	prob.	maximum eigenvalue statistics	critical value (5%)	prob.
r = 0	21.42	42.92	0.1100	24.13	25.82	0.3643
r = 1	10.18	25.87	0.1112	12.25	19.39	0.1310
r = 2	1.41	12.52	0.2743	3.21	12.52	0.2743

Source: Author's calculations.
Note. * denotes rejection of the hypothesis at the 0.05 level.

The results of the Johansen cointegration tests partially reflect the results of the unit root tests. Both trace statistics and maximum eigenvalue statistics computed for Cyprus, the Slovak Republic and the euro area indicate (at 0.05 level) indicate no cointegration among the endogenous variables of the model. In Malta the maximum eigenvalue statistics denotes the rejection of the null hypothesis about no cointegration among variables (indicating the existence of one cointegrating relationship) while the trace statistics reports no cointegration among the variables. An increase in the length of the lag to three lags resulted in the loss of the cointegrating relation among variables indicating that any linear combination of two variables is nonstationary process. Finally, both test statistics reported one cointegrating relationship in Slovenia. This finding corresponds with the unit root test results. Here again an increase in the length of the lag to three lags resulted in the loss of the cointegrating relationship among variables.

As the results of the Johansen cointegration tests indicate the endogenous variables are not cointegrated (because they follow the different stochastic trend in the long run) it implies that there is no long-run equilibrium relationship among the variables of the model. Absence of cointegration among the endogenous variables also justifies the use of an unrestricted VAR model rather than VECM (vector error correction model).

Following the results of the stationarity and cointegration tests we estimate the model using the variables in the first differences so that we can calculate the variance decomposition (contributions of each structural shock to the real output conditional variance) and impulse-response functions (responses of the real output to one standard deviation structural shocks) of the real output for each new EMU member country and the euro area. In Figure 2 we summarize the relative importance of each of the structural shocks to changes in the real output. In Figures 3-5 we summarize the responses of the real output to the unexpected structural shocks.

Because the main objective of the paper is to analyze the impact of exogenous structural shocks on the real output development in Cyprus, Malta, the Slovak Republic and Slovenia we focus the interpretation of the results only to the analysis of sources of the real output variability in these countries. The results we then compare to the findings in the euro area real output determination by the nominal, demand and supply shocks.

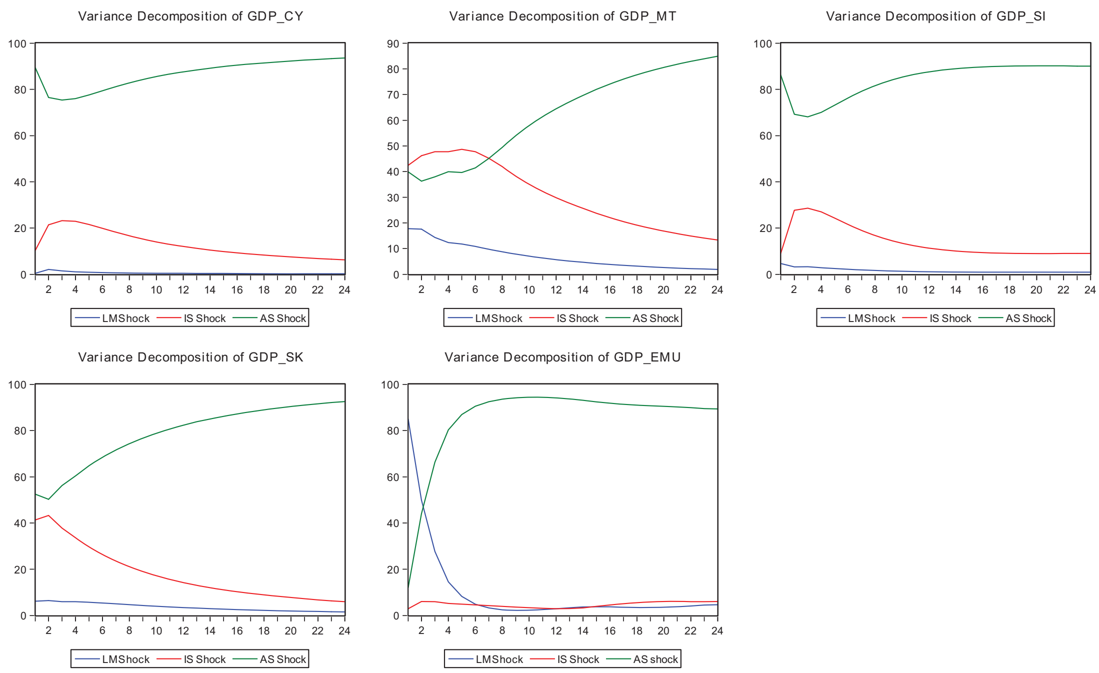

Figure 2. Variance decomposition (GDP)

Source: Author's calculations.

The Figure 2 reflects the variance decomposition of the real output in Cyprus, Malta, the Slovak Republic, Slovenia and the euro area that reports the contribution of each structural shock to the conditional variance of the real GDP at various forecast horizons (up to 24 quarters). The variance decomposition of the real output reflects a negligible role of the nominal (liquidity) shock on the variability in the real output in all new EMU member countries even though its initial impact is slightly higher in Malta than in other countries (moreover, the significance of nominal shock slightly decreases through the time). It seems the real output is not very responsive to the nominal shock in these countries. Higher exposure of the real output to the nominal shock would indicate its higher sensitivity to the unexpected effects of money demand disturbances, money supply disturbances or both. On the other hand, the weight of the nominal shock in explaining the variance in the real output seems to be much higher in the euro area especially in the first six quarters. Its strength similarly sharply decreases during this period. This results about the role of nominal shock in determining the real output variability in time correspond to our model assumptions about the long-term neutrality of the real output to this type of exogenous shock.

Despite the fact that we assumed long-term neutrality of the real output to the demand shock too, its impact on the real output variability in the selected group of the countries seems to be different in the short period in comparison with the nominal shock. The overall weight of the demand shock seems to be the highest within first four quarters and later its relevance decreases. While in Cyprus and the Slovak Republic the impact of the demand shock to the real output variability completely disappears in the long period, in Malta and Slovenia the share of the demand shock on the real output variability remains low but stable at 5.3 percent and 9.5 percent. By contrast the short-term impact of the demand shock to the real output variability in the euro area is almost irrelevant and it completely fades out in the long period.

The final outcome of the real output variance decomposition is the relative importance of the supply shocks. Even in the short period the supply shocks seem to be the most significant determinant of the real output variance in Cyprus and Slovenia. Initial weight of the supply shock in Malta and the Slovak Republic seems to be lower but still substantial. The situation is different when observing the weight of the supply shock in the euro area in the first few months. Finally, supply shocks accounted for an important fraction of the variance of the real output in all countries.

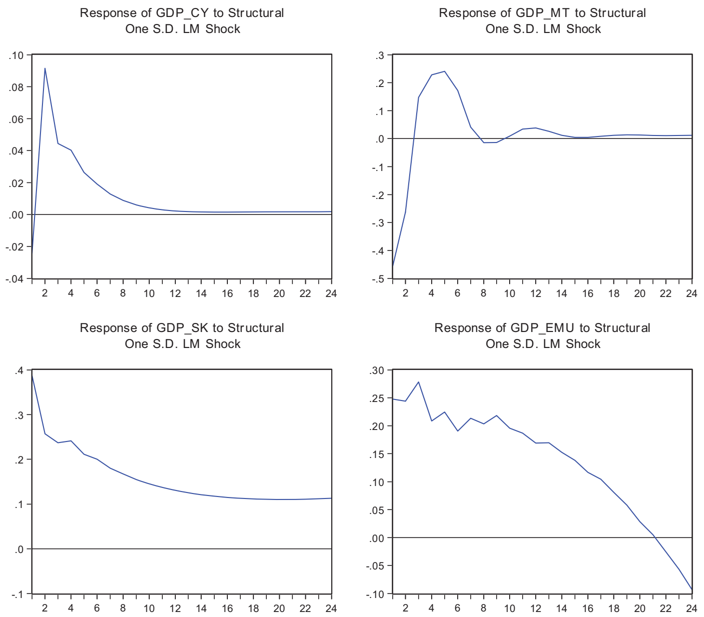

Figure 3. Response of real output to nominal shock

Source: Author's calculations.

The impulse-response functions that show the responses of the real output to the structural one standard deviation nominal shock are shown in the Figure 3. As we have expected, after the positive nominal shock the real output increased in all countries except Malta, where initial fall was followed by the short sharp upward trend in the real output development. There is also difference in the length of the period after which the positive impact of the nominal shock to the real output development fades out. While in all countries (the euro area included) the real output remained unchanged in the long-run, in the Slovak Republic the positive nominal shock caused the permanent increase in the real output at 0.11 percent.

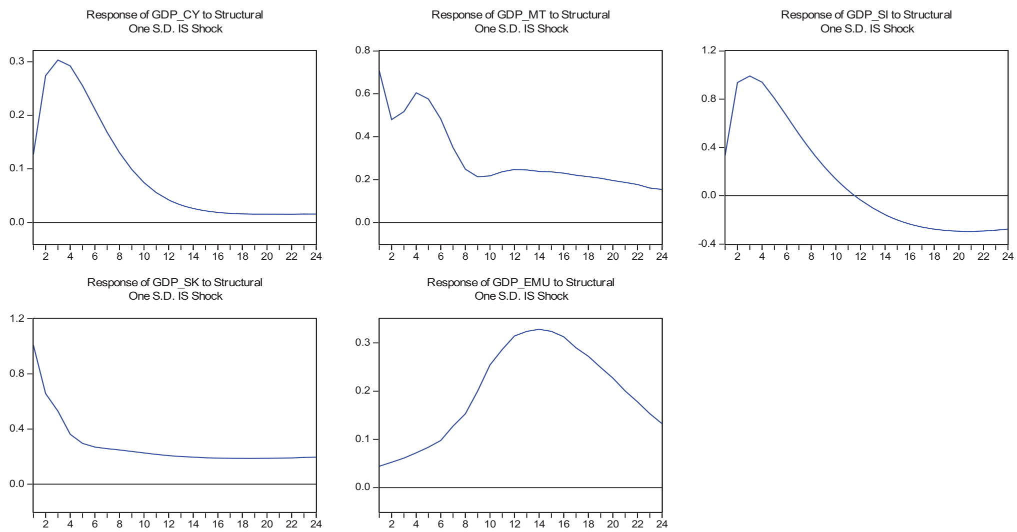

Figure 4. Response of real output to demand shock

Source: Author's calculations.

After one standard deviation positive demand shock the response of the real output provides very clear results that correspond to our initial assumptions. The response of the real output to the demand shock in all countries (except the euro area) seems to be rather intensive especially during one year after the shock, while subsequently the overall effect of the shock continuously weakens. In all new EMU member countries except the Slovak Republic (the real output remained higher at 0.2 percent) the assumption about the long-term neutrality of the demand shock in determining the real output variability was confirmed. Results for the euro area indicates the demand shock forced the real output growth with continuously increasing power, so that the overall positive effect reaches its peak three years after the positive demand shock.

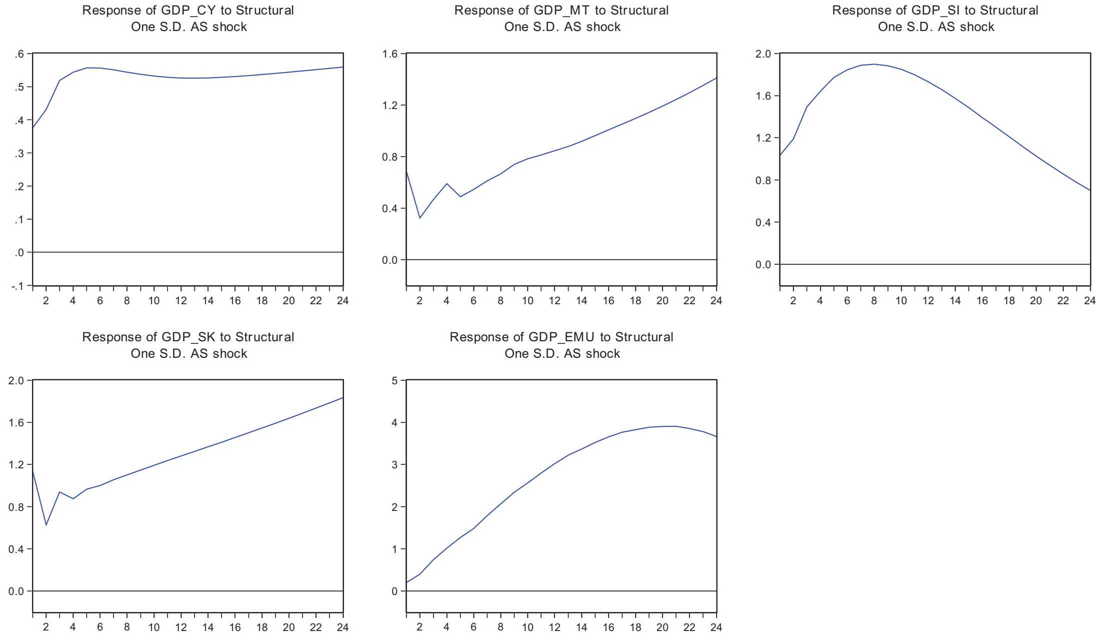

Figure 5. Response of real output to supply shock

Source: Author's calculations.

The response of the real output to the supply shocks in four new EMU member countries and the euro area is shown on the Figure 5. The supply shock seems to have rather strong positive impact on the real output development in all four economies. Of course, certain differences are present when comparing the intensity of the shock. While in Slovenia the supply shock doesn't seem to have permanent effect on the real output variability in the long run, in Cyprus, Malta and the Slovak Republic the results corresponds to our initial assumption, so that the real output remained permanently increased due to the supply shock in these countries. The real output in the euro area responded to the one standard deviation supply shock similarly as it was in case of the demand shock. Positive impact of the supply shock to the real output continuously increased and gained its peak after around five years.

4. Conclusion

In the paper we have estimated structural vector autoregression model for the four new EMU member countries (Cyprus, Malta, the Slovak Republic and Slovenia) with the objective to analyze the sources of the movements in the real output. The econometric model that we have used helped us to identify three types of exogenous structural shocks (nominal shock, demand shock and supply shock). Variance decomposition allowed us to estimate the contributions of each structural shock to the real output conditional variance. Impulse-response functions revealed the responses of the real output to one standard deviation structural shocks. Comparing the result for each new EMU member country and the euro area (consisting here of twelve old EU member countries) we may summarize our findings:

- The variability of the real output in the selected group of the countries is mainly determined by the supply shocks. The findings are similar to the results of the real output variance decomposition in the euro area countries.
- The role of demand shocks in determining the real output development in the new EMU member countries, especially in short period, seem to be much higher in comparison with the euro area.
- While the impact of the nominal shocks on the real output variability seems to be negligible in all four economies (perhaps except Malta in the short period), the real output of the euro area is significantly determined by this shock especially during first year after the shock.
- The real output in all four economies seems to respond roughly similar to all three exogenous structural shocks in comparison to the euro area when taking into account the direction of the real output response. Of much higher importance, in our opinion, is the durability and intensity of particular shocks.

5. References

[1] Bank for International Settlements: BIS Effective Exchange Rate Indices - http://www.bis.org/statistics/eer/index.htm

[2] Bayoumi, T., Eichengreen, B., (1992), *Shocking Aspects of European Monetary Unification*, NBER Working Paper, no. 3949, Cambridge, National Bureau of Economic Research.

[3] Borghijs, A., Kuijs, L., (2004), *Exchange rate in the Central Europe*, IMF Working Paper, no. 04/02, Washington, International Monetary Fund.

[4] Clarida, R., Gali, J., (1994), *Sources of Real Exchange Rate Fluctuations: How Important Are Nominal Shocks?,* Carnegie-Rochester Conference Series on Public Policy 41, 1994, pp. 1-56.

[5] Fidrmuc, J., Korhonen, I., (2001), *Similarity of supply and demand shocks between the Euro area and the CEECs*, BOFIT Discussion Papers 14/2001, Bank of Finland, Institute for Economies in Transition

[6] Gonda, V., (2006), *European Monetary Union in the Context of Global Processes in World Economy*, in: *Journal of Economics (Ekonomicky casopis)*, Vol. 54, no. 4 (2006), pp. 352-367.

[7] Isa, J., Okali, I., (2008), *European Monetary Union, Optimum Currency Area and Possible Effects of the Slovakia's Joining the Euro Area*, in: *Politicka ekonomie*, Vol. 56, no. 3, pp. 318-344.

[8] Lisý, J., Muchová, E., (2004), *Formation and Behaviour of Economic and Monetary Union as an Open Theoretical Issue*, in: *Journal of Economics (Ekonomicky casopis)*, Vol. 52, no. 4, pp. 429-448.

[9] Mirdala, R., (2008), *Exchange Rate and Output Vulnerability to Macroeconomic Shocks in Selected CEECs (SVAR approach)*, in: *Journal of Economics (Ekonomicky casopis)*, Vol. 56, no. 8, pp. 745-763.

[10] Mundell, R., (1961), *A Theory of Optimum Currency Area*, in: *Americam Economic Review*, Vol. 10, no. 2, pp. 657-665.

[11] OECD - Statistics v4.4 - Frequently Requested Statistics - http://www.oecd.org/document/15/0,3343,en_2649_201185_1873295_1_1_1_1,00.html

[12] Stavárek, D., (2008), *Exchange Market Pressures in the Central European Countries from the Eurozone Membership Perspective*, in: *South East European Journal of Economics and Business*, Vol. 2, no. 3, pp. 7-18.

[13] Stazka, A., (2006), *Sources of Real Exchange Rate Fluctuation in Central and Eastern Europe*, CESifo Working Paper, no. 1876, Munich, CESifo GmbH.

[14] Šikulová, I., (2009), *Experience of the Selected Eurozone Member Countries and Posture of the potential member countries to Euro Adoption*, Institute of the Economic Research, Slovak Academy of Sciences, Working Paper no. 15.

[15] Šindel, J., Saroch, S., (2008), *The Political Economy of Exchange Rate Policy in Central and Eastern European Countries - Sector Approach*, in: *Politická ekonomie*, Vol. 56, no. 1, pp. 17-39.

[16] Workie Tiruneh, M. *et al.* (2008), *Development and Perspectives of the World Economy: Turbulences on the Financial Markets and Economic Policy Dilemmas*, Institute of the Economic Research, Slovak Academy of Sciences, p. 301