Fiscal expenditures and the GDP – interdependences in transition

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The fall of the so-called socialist economies, as well as their transition to market economies, had one of the most interesting and long lasted economic events of the 20th century. Recently, time series became long enough to be analysed by modern econometric methods. With a simple, two-equation, linear model we can analyse and compare the fiscal policy of seventeen Eastern European countries. The empirical testing of the two versions of the model has been resulted a variegated picture about the relation of the GDP and the government expenditures. The Eastern European transition countries are possessing very different features. The economic processes are country specific and it is difficult to elaborate even a simple economic model to apply for this group of countries.

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Model building.
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The collapse of socialist economies in Eastern Europe and the former Soviet Union, as well as their subsequent transition towards market economies, was arguably one of the most considerable economic events of the 20th century. Recently, time series are long enough to analyse them with the latest econometric methods. The theoretical background of this paper is based on a paper by *Mellár* [2001] who constructed a simple, but easily verifiable economic model to investigate the Hungarian economy. The model can be transformed to a two-equation vector-autoregressive model which should be estimated on the basis of GDP and general government expenditure data. This idea opens the possibility to analyse and compare the fiscal policies of seventeen Eastern European countries. Four questions could be answered, namely whether

1. the aggregated demand or aggregated supply adjusts faster;
2. the Keynesian multiplicator effect is working;
3. Wagner's law is true; and
4. the government expenditures are limited.

In the first part of the paper, we offer a critical summary of the original Mellár's model. In the second part, we sketch the database used in the empirical estimations and tests. Then the pervious four questions are answered and we turn our attention to the stability question of this model. Originated on this phenomenon of the original model, we estimate an extended model that allows analysing a more shaded equilibrium situation. Following the economic side of the model, through the tests of integration and co-integration, we analyse the statistical characteristics of the applied time series. Finally, further research possibilities are explored.

1. The model

In this chapter, we provide a critical presentation of Mellár's model (*Mellár* [2001]). By this simple model, we can analyse the two-way relation between the GDP and the general government expenditures allowing to follow spillover effects. Because of its simplicity, the model cannot faithfully describe either the effect of different budget expenditures or the evolution of macro-processes. (For the detailed analysis of the effects of different budgetary actions in Eastern Europe, see *Purfield* [2003] and *Kotosz* [2006].) The dynamics of the GDP is based on three equations:

$$YD_t = c\left(Y_t - \tau G_t\right) + A_t + G_t \qquad 0 < c < 1, \qquad \tau > 0, \qquad /1/$$

$$YS_t = Y_t + \gamma G_t - \delta\left(\tau G_t\right) \quad \gamma, \delta > 0, \qquad /2/$$

$$\Delta Y_t = Y_{t+1} - Y_t = \alpha\left(YD_t - YS_t\right), \qquad |\alpha| < 1, \qquad /3/$$

where Y means the GDP, c is the marginal rate of consumption, G means the budget expenditures, A represents autonomous expenditures, and t is for time.

The dynamics of the budget expenditures is as follows:

$$\Delta G_t = \beta\left(Y_t^T - Y_t\right) + \omega\left(\bar{G}_t - G_t\right) \qquad \beta, \omega > 0, \qquad /4a/$$

where Y^T is the expected GDP, $\bar{G}$ is the practical upper limit of budget expenditures.

Additionally:

$$A_t = aY_{t-1} \qquad Y_t^T = hY_{t-1} \qquad \bar{G}_t = kY_{t-1} \qquad a, h, k > 0. \qquad /5a/$$

Equation /1/ is a simple Keynesian demand function, and it suggests that budget expenditures are covered only by income taxes, financing can be partial ($\tau<1$) or full ($\tau \geq 1$). Equation /2/ is a mixed supply function; the first and the third elements are Lucas-type, while the second element is a Keynesian one. Equation /3/ is not so trivial. As the sign of the α parameter is not fixed, the active role of the aggregated demand is not presupposed. Therefore in small, open economies (like some Eastern European countries) the increase of demand through the expansion of the imports and through the devaluation of the national currency can generate the decline of production. Equation /4a/ offers that the larger is the lag between expected and actual GDP the larger is the growth of budget expenditures, though this increment is reined by the upper limit. The dynamic kind of the model requires flexibility of the autonomous terms; the benchmark can be the lagged GDP (see equation /5a/).

At this point, Mellár makes three simplifications to gain a model easy to deal with. By his idea, we can replace the lagged GDP by current GDP in equation /5a/. By this manipulation, the matrix form of the model is:

$$\begin{bmatrix} Y_{t+1} \\ G_{t+1} \end{bmatrix} = \mathbf{A} \begin{bmatrix} Y_t \\ G_t \end{bmatrix} \qquad \mathbf{A} = \begin{bmatrix} 1 + \alpha\left(c + a - 1\right) & \alpha\left[\left(1-\gamma\right) + \tau\left(\delta - c\right)\right] \\ \beta\left(h-1\right) + \omega k & 1 - \omega \end{bmatrix}. \qquad /6/$$

Version /6/ of the model is very kind for statistical analysis, but doubtful from a theoretical point of view. Let us see what happened. *First*, the autonomous demand depends on current GDP, i.e. not autonomous. This inconsistency cannot be strained off at this level of simplicity of the model.[1] A new interpretation of equation /1/ is the following: a part of the demand is the function of the income but not of the dis-

[1] A clear solution would be the separate analysis of autonomous demand time series, but as they do not exist, the direct measuring is not possible. If we investigate relatively short time series, the autonomous demand (in real terms) can be considered as constant. In this case, equation /6/ is transformed as $a_{11} = 1 + \alpha\left(c - 1\right)$. The stability feature of the model does not change, but we have a constant in the first equation, without constant in the second one. This restriction makes trouble in econometric estimations.

posable income, so some demand is directly independent from taxes. *Second*, the expected GDP is the function of current GDP. The conflict is clear; there is no more expectation about a known measure. Furthermore, the next year budget expenditures grow accordingly as we have faulted the measurement of GDP (i.e. as the difference of current and expected GDP for year *t*). This conflict can be eliminated by a simple change in equation /4a/, instead of Y_t^T we use Y_{t+1}^T (equation /4b/). This form of the equation suggests that the budget expenditures are higher in year *t*+1, if the expectation of the government of GDP for year *t*+1 is higher than the current GDP in year *t*. This is a normal assumption, and it is sustainable even without any change in the expenditures/GDP ratio. *Third*, the practical upper limit of the budget expenditures is defined in the function of the current GDP. This change is not too rough, and it can be restored by the different use of equation /4a/, where instead of $\overline{G}_t$ we use $\overline{G}_{t+1}$ (equation /4b/). On account of the latter two variations, the model becomes more prospective, budget expenditures are planned on the basis of the future possibilities and not of the present bias. The new equations are:

$$\Delta G_t = \beta\left(Y_{t+1}^T - Y_t\right) + \omega\left(\overline{G}_{t+1} - G_t\right) \qquad \beta, \omega > 0\,, \qquad /4b/$$

$$A_t = aY_t \qquad Y_t^T = hY_{t-1} \qquad \overline{G}_t = kY_{t-1} \qquad a, h, k > 0\,. \qquad /5b/$$

The stability of the model depends on the absolute values of eigenvalues of the **A** matrix. As *Mellár* [2001] shows, calculated by economically rational parameter values, $tr\mathbf{A} \in [0, 2]$, thereby one of the necessary conditions is fulfilled ($|tr\mathbf{A}| < n$).[2] Mellár supposed that $|det\mathbf{A}| < 1$. We have doubts whether this condition is always fulfilled. If the economy is demand-directed ($\alpha > 0$), the condition on determinant normally is in order; but in a supply-oriented ($\alpha < 0$) economy, if the adjustment of government expenditures is slow (ω is low, the increase of government expenditures is based on supply expansion), the determinant may exceed 1. Based on these strongly Lucasian circumstances, the typically Keynesian model becomes unstable.

If the model is stable, and eigenvalues are real numbers (as they are by the empirical evidence), the equilibrium is stable node or saddle-point. When the eigenvalues are complex numbers, the equilibrium is stable spiral.

2. Data

To analyse the Eastern European economies, we need the description of the database taken in the following chapter. The surveyed period is 1990–2003. An earlier starting date would be pointless for the transition period; the closing date has a practical reason (comparable data has not been available for more recent years) and a

[2] On necessary and sufficient conditions of stability, see *Dameron* [2001].

theoretical one (in some countries the transition has been completed by that time). The relatively short period generates additional uncertainty to the results; thereby one should accept the economic results only with some provisions.

The unification of macroeconomic statistic measures is an old goal of different authorities and a dream of researchers, but recently, has never been reached. The 1993 SNA system and its European adaptation the ESA 95 have some measures of budget revenues and expenditures, and a relatively detailed system has been developed, created by the International Monetary Fund (IMF), the so-called Government Finance Statistics (GFS) system. Its first version was set in 1986; the new one was published in 2001.

By the GFS 1986, the fiscal operations were calculated on cash basis, while in SNA 1993 flows have been recorded on an accrual basis, so the data of the two systems were not comparable. By the new GFS, data are compiled on accrual basis, what makes SNA and GFS data comparable. It is a pity that the old and new data of GFS become incomparable because of the methodological changes; thereby longer time series could be analyzed after numerous adjustments. Otherwise, GFS is fully consolidated, but SNA is not, therefore the calculation of some relative measures (e.g. deficit/GDP) becomes inconsistent.

Even if there are certain standards, only a part of the countries uses them, and just a few in transition. It is clear now, that in the early transition period more important politico-economic tasks were emphasized than producing methodologically comparable government finance statistics, and for this period a set of data is no more reconstruable. In many cases, the analyst has to rely on estimations based on available data. These estimations can be better or worse, but the real numbers remain incognizable, therefore we call this phenomenon “fiscal data illusion”.

What type of data would be optimal for our analysis? The GFS (according to SNA) divide the total economy of a country into five sectors:

1. non-financial corporations sector,
2. financial corporations sector,
3. general government sector,
4. non-profit institutions serving households sector, and
5. households sector.

For analytical purposes, each of these sectors can be divided into subsectors. The general government sector is usually divided into central, state and local government sector, but in non-federal countries where regional governments do not exist or do not have enough power, the state government level is skippable. Social security system appears on the competent level, though this element is widely different in countries. As in Eastern Europe, the structure of the general government is diverse, the central government data represent less the role of the state, so general government consolidated data would be better to use. The new *Government Finance Statistics Manual* [2001] proposes the compilation of data for the whole public sector, which has an additional information function, but in our opinion it is less expressive for fiscal policy analysis.

A uniform database for general government fiscal operations does not exist. Even the IMF, publisher of GFS rules, does not have methodologically consistent data. The researcher must scout national sources (as Ministry of Finance, Statistical Office, National Bank), rarely prepared by the same principles, to convert and estimate comparable data. In some cases, even the national authorities have no acceptable data. Further problem is the confliction of sources. The necessary exploratory work was the subject of another paper (*Kotosz* [2004]).

In this one however, a database (as far as it was possible according to GFS standards) compiled and estimated by the author from different sources will be used. For general macroeconomic data, we looked for the World Economic Outlook Database of the IMF, published in April 2004, and Financial Statistics Yearbook series of the IMF. GDP data are on 1995 prices in local currencies, while general government expenditures are estimated indirectly from the current expenditure/GDP rate.

3. Empirical evidence

The econometric estimation and testing of model /6/ are simple. We have to estimate a simple VAR (Vector autoregressive) model which can be figured out most economic software. For this paper, we used EViews.[3] The model parameters' summary and the eigenvalues can be found in Table 1. The main characteristics are the following.

Element a_{11} of the matrix of each country indicates whether aggregated demand (if $a_{11}<1$) or aggregated supply (if $a_{11}>1$) is determinant in growth. As in this case the zero point is 1, in significance tests we have to check if we can reject the null hypothesis of $a_{11}=1$. For all other parameters, the crucial value is 0. Condition $a_{12}>0$ is fulfilled if the government expenditures have adequate transmission mechanism for that Keynesian multiplicator effect could proceed. By the two parameters together, the Keynesian kind of the economy can be tested. We suppose that in an economy where the aggregated demand is dominant, some demand-based economic policy can be successful (if $a_{11}<1$ then $a_{12}>0$). Parameter a_{11} is spread in the [0.53; 1.84] interval. (The value is smallest in Estonia, the largest in Belarus.) The growth is demand-based in eight countries (but significant at 5 percent only in two cases: Estonia and Latvia, at 10 percent in Lithuania, as the Baltic states are the examples of this type of economy). The economy seems to be supply-based in nine countries (in the case of Slovenia the a_{11} parameter is 1.0075, barely different from 1), and this behaviour is significant in Belarus, Bosnia and Herzegovina, Bulgaria, Hungary and Ukraine.

The Keynesian multiplicator effect ($a_{12}>0$) can be found in nine countries (in the case of Slovenia evidently neglectable – $a_{12}=0.0674$), but it is significant only in Es-

[3] As the estimation of VAR models is based on iterative methods, some smaller differences among different methods may emerge.

tonia and Latvia. In eight countries, the increase of the government expenditures refrains the economy; this effect is significant in five countries (Belarus, Bosnia and Herzegovina, Bulgaria, Hungary and Ukraine).

Table 1

*VAR parameter summary**

Country	Dependent variables	Independent variables		Eigenvalues
		Y_t	G_t	
Albania	Y_{t+1}	0.9887 (0.1944)	0.2447 (0.6025)	1.0585
	G_{t+1}	0.0880 (0.0839)	0.7501 (0.2601)**	0.6803
Belarus	Y_{t+1}	1.8402 (0.2751)**	–1.7243 (0.5848)**	1.0289
	G_{t+1}	0.7803 (0.1206)**	–0.6296 (0.2564)**	0.1818
Bosnia and Herzegovina	Y_{t+1}	1.3204 (0.1075)**	–0.4638 (0.1963)**	1.0754
	G_{t+1}	0.4867 (0.2373)**	0.1540 (0.4331)	0.3990
Bulgaria	Y_{t+1}	1.2409 (0.0596)**	–0.5693 (0.1248)**	1.0072
	G_{t+1}	0.3604 (0.0511)**	0.1292 (0.1070)	0.3828
Croatia	Y_{t+1}	1.2689 (0.1878)	–0.4428 (0.3669)	1.0398
	G_{t+1}	0.4219 (0.1165)**	0.2245 (0.2277)	0.4536
Czech Republic	Y_{t+1}	0.5983 (0.3239)	1.0308 (0.7894)	1.0254
	G_{t+1}	0.5363 (0.4285)	–0.2689 (1.0444)	–0.6960
Estonia	Y_{t+1}	0.5332 (0.1408)**	1.3159 (0.3588)**	1.0561
	G_{t+1}	0.1127 (0.0705)	0.7727 (0.1795)**	0.2497
Hungary	Y_{t+1}	1.1695 (0.0517)**	–0.2697 (0.1015)	1.0400
	G_{t+1}	0.1925 (0.0883)**	0.6391 (0.1733)**	0.7686
Latvia	Y_{t+1}	0.7019 (0.1052)**	0.8993 (0.2698)**	1.0650
	G_{t+1}	0.0779 (0.0680)	0.8722 (0.1744)**	0.5090
Lithuania	Y_{t+1}	0.6225 (0.2455)	1.2392 (0.7541)	1.0301
	G_{t+1}	0.0307 (0.1370)	0.9368 (0.4207)**	0.5292
Macedonia	Y_{t+1}	0.9606 (0.2539)	0.1357 (0.6991)	1.0124
	G_{t+1}	0.1470 (0.1400)	0.6273 (0.3855)	0.5755
Moldova	Y_{t+1}	0.7731 (0.2537)	0.5134 (0.7277)	*0.9622*
	G_{t+1}	0.0857 (0.0558)	0.7293 (0.1601)**	*0.5403*
Poland	Y_{t+1}	0.9381 (0.1337)	0.2292 (0.3085)	1.0389
	G_{t+1}	0.1502 (0.1070)	0.6975 (0.2470)**	0.5967
Romania	Y_{t+1}	1.0806 (0.2187)	–0.1703 (0.6295)	1.0231
	G_{t+1}	0.3278 (0.0717)**	0.0529 (0.2065)	0.1105
Slovakia	Y_{t+1}	1.1905 (0.2025)	–0.3662 (0.4845)	1.0346
	G_{t+1}	0.2094 (0.0894)**	0.5426 (0.2139)**	0.6984
Slovenia	Y_{t+1}	1.0075 (0.0678)	0.0674 (0.1462)	1.0292
	G_{t+1}	0.0235 (0.1209)	0.9565 (0.2609)**	0.9347
Ukraine	Y_{t+1}	1.5435 (0.0872)**	–1.3843 (0.2173)**	1.0449
	G_{t+1}	0.3758 (0.0667)**	0.0017 (0.1660)	0.5003

* Standard errors in parentheses.
** Significant at 5 percent (one-side tests, for null hypotheses, see in the table).
Note. Italic numbers for both eigenvalues less than 1.
Source: Here and in the following tables the author's own calculation.

By the empirical evidence, the significant demand-based features and the successful Keynesian macroeconomic policy are attached. It is not a surprise, as the Keynesian policy must raise the demand. Tough the question of Keynesian transmission mechanism is not whether it exists or not, but where and when it is true. Furthermore, what kind of macroeconomic/institutional/political environment makes the economy of a country Keynesian type? This question goes over the goals and frames of this paper.

The parameter a_{21} suggests the test of Wagner's law. In this form (the higher the GDP is, the higher the budget expenditures are in the next year) the law is always true (a_{21}>0). The more absorbing version (if the reallocation rate is growing in the function of the GDP) is the matter of an extended model. We have to mention here that a_{21} is significantly greater than zero only in Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Hungary, Romania, Slovakia, and Ukraine. This set of countries has special equilibrium characteristics (see Figure 4).

Finally, the a_{22}<0 is the sign of the weak control of budget expenditures (e.g. the expected upper limit can be overpassed). This is the case in Belarus and in the Czech Republic, significant only in Belarus where the transition towards market economy is at less developed state (*Kotosz* [2005]).

The general view about equilibrium of the model is almost flat: one eigenvalue of matrix **A** is out of unit circle (except for Moldova); thereby equilibria are saddle-points (in Moldova stable node). We must remark that the stable node equilibrium attracts the country to the origin, where the economy is totally collapsed (with no GDP and no budget). It is very important to see *that the stability of the mathematical model is not equivalent to the stability of the economy*, moreover any economic growth is possible only at the unstable saddle path (balanced growth is not stationary). We know that saddle-point stability with the equilibrium of (Y=0, G=0) means that only a certain budget expenditures/GDP rate ensures the stability of the model. Let us see the phase diagrams! It is clear by economic rationality (and partly based on a previous test on Keynesian kind) that the ΔY_t=0 and ΔG_t=0 lines have positive gradient (less than 1). The ΔY_t=0 curve is $G_t = \frac{1-a_{11}}{a_{12}} Y_t$ and the ΔG_t=0 curve is

$G_t = \frac{a_{21}}{1-a_{22}} Y_t$ (see on Figure 1).

The stability feature of the model in the relevant (+,+) quadrant depends on the relative position of the two curves. If the gradient of ΔG_t=0 is larger, then phase diagram can be seen on Figure 2. In this case, the phase diagram suggests an optimal long-term growth path. The (otherwise instable) saddle path results a constant expenditure/GDP ratio while the economy is continuously growing. In the positive quadrant, the dynamics is getting closer and closer to this optimal path. If the expenditure/GDP ratio is too high, the growing GDP decreases it; if the ratio is too low, the government expenditures increase faster than the GDP.

If the gradient of ΔY_t=0 is larger than the gradient of ΔG_t=0, the phase diagram looks a bit different (see Figure 3). This situation is less favourable than that on Figure 2. In these countries the too high expenditure/GDP rate can decrease only via the shut of the GDP, in extreme situation, the huge rate can result the collapse of the economy. Generally, these countries have to pay a large price for their budget consolidation by necessary depression.

Figure 1. ΔY_t=0 and ΔG_t=0 curves

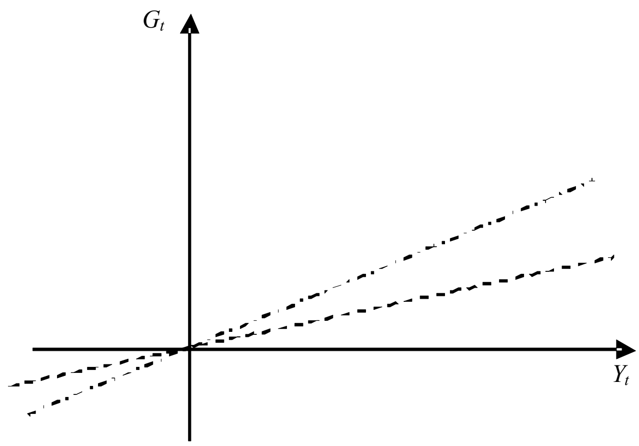


Figure 2. Phase diagrams for Albania, the Czech Republic, Estonia, Latvia, Lithuania, Macedonia, Poland and Slovenia

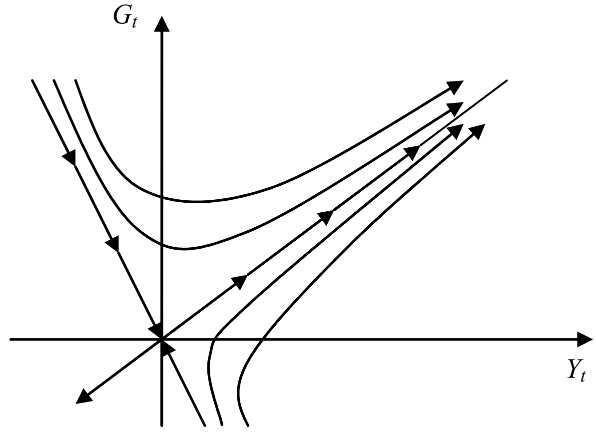
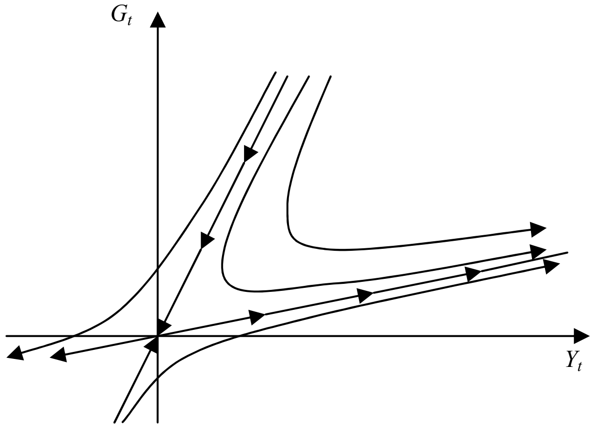


Figure 3. Phase diagrams for Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Hungary, Romania, Slovakia and Ukraine

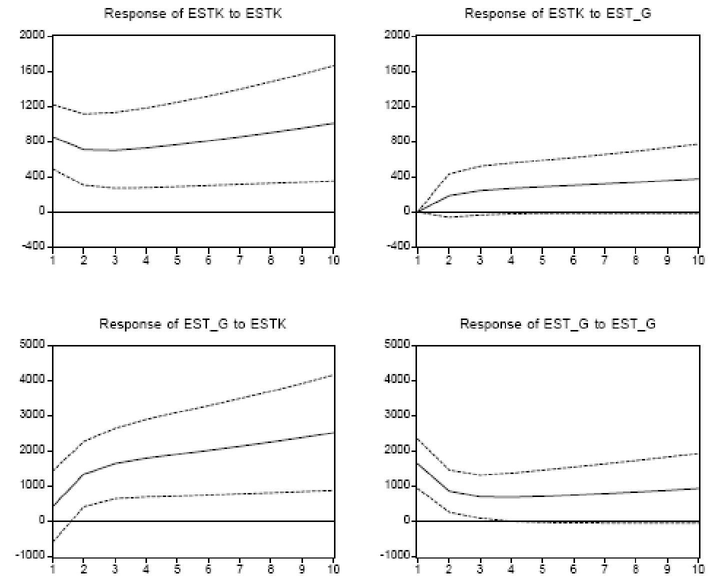


Finally, the mid-, and long-term behaviour of the economies can be described by the impulse response functions. This figure is very spectacular about the effect of different shocks (one standard deviation shock in government expenditures or of GDP). By the empirical evidence, there are two main types of the impulse response functions.

In one of these types all positive shocks have positive effects (a positive shock of the government expenditures makes the future GDP and the future government expenditures higher for all the next ten years, and a positive shock of the GDP makes the future GDP and the future government expenditures higher), but the size of the effect is different from country to country. Albania, Croatia, the Czech Republic, Estonia, Latvia, Lithuania, Moldova, Poland, Romania, Slovakia, and Slovenia are classed of this type. We turn a special attention to the Czech Republic. Because of the negative eigenvalue of the **A** matrix, all effects are sinusoidal decaying. In Lithuania, the effects of GDP shocks are positive, but insignificant all the time. In Poland, the prompt effect of the government expenditures shock is negative, but the second year positive impact balances it, then the response is continuously positive. In Slovakia, the shock of the government expenditures is non-effective for the GDP, and the effect on the government expenditures breaks down very quickly. In Slovenia, the budget expenditures are totally insensitive to GDP shocks.

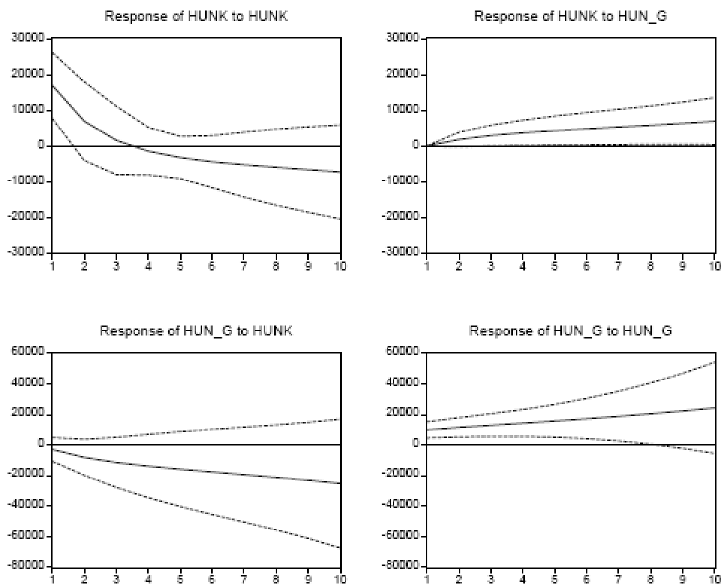
In the second type (Belarus, Bosnia and Herzegovina, Bulgaria, Hungary, Macedonia, and Ukraine), the response of the GDP and of the government expenditures are positive to GDP shocks, just like in the first type. Though in long-term, their response to government expenditures shocks are negative. The effect on budget expenditures breaks down, in the third or fourth year, it turns to be negative, and the cumulative effect in ten years time is negative. The most rigid budget is the Hungarian one (see Figure 5).

Figure 4. Response to Cholesky One Standard Deviation Innovations ± 2 Standard Errors (Estonia)



Note. ESTK for Estonian government expenditures and EST_G for Estonian GDP.

Figure 5. Response to Cholesky One Standard Deviation Innovations ± 2 Standard Errors (Hungary)



Note. HUNK for Hungarian government expenditures and HUN_G for Hungarian GDP.

4. Extension of the model

In the first part of the paper, we had a question about the possible extension of the modified model. The autonomous demand in the previously analysed model was not really autonomous. We can solve this inconsistency by assuming a constant autonomous demand (A_t=a). To be able to estimate the parameters of the new model, we need a theoretical constant in the second equation, as well. The easiest way is to hypothesize a constant (g) in equation /4b/ transformed it to equation /4c/.

$$\Delta G_t = g + \beta\left(Y_{t+1}^T - Y_t\right) + \omega\left(\overline{G}_{t+1} - G_t\right) \qquad \beta, \omega > 0 . \qquad /4c/$$

This constant means that we suppose that there is a permanent change in the government expenditures. For simplicity and coherence with the original model, we do not make any restriction about this constant. If g=0, then equation /4b/ is equal to equation/4c/.

The new VAR model is as follows:

$$\begin{bmatrix} Y_{t+1} \\ G_{t+1} \end{bmatrix} = \mathbf{A}\begin{bmatrix} Y_t \\ G_t \end{bmatrix} + \begin{bmatrix} \alpha a \\ g \end{bmatrix} \qquad \mathbf{A} = \begin{bmatrix} 1+\alpha\left(c-1\right) & \alpha\left[\left(1-\gamma\right)+\tau\left(\delta-c\right)\right] \\ \beta\left(h-1\right)+\omega k & 1-\omega \end{bmatrix}. \qquad /7/$$

The estimated parameters of the new model are shown in Table 2. If we compare the parameters of equation /6/ and /7/, a much diversified picture is shown. While in some countries beside the insignificant constants the parameters are practically unchanged, in others the main characteristics are totally different.

Table 2

VAR with constant – parameter summary

Country	Dependent variables	Independent variables		
		C	Y_t	G_t
Albania	Y_{t+1}	–773.9288	0.984933	0.287218
	G_{t+1}	6995.751	0.122285	0.365904
Belarus	Y_{t+1}	–1016.703	1.896046*	–1.704487*
	G_{t+1}	–1051.449	0.838088*	–0.609042*
Bosnia and Herzegovina	Y_{t+1}	636.1174*	0.890003*	–0.194015*
	G_{t+1}	179.0803	0.365533	0.229932
Bulgaria	Y_{t+1}	7.652851	1.191257	–0.533431*
	G_{t+1}	–35.31150	0.589437*	–0.036224
Croatia	Y_{t+1}	4431.195	0.924837	–0.080842
	G_{t+1}	3532.612*	0.147639	0.513008*

(Continued on the next page.)

(Continuation.)

Country	Dependent variables	Independent variables		
		C	Y_t	G_t
Czech Republic	Y_{t+1}	14238.32	0.538097	0.926526
	G_{t+1}	–10935.25	0.582486	–0.188781
Estonia	Y_{t+1}	–4296.226	0.630700*	1.271165*
	G_{t+1}	103.2788	0.110329	0.773782*
Hungary	Y_{t+1}	2660.415	1.169197*	–0.277739
	G_{t+1}	64432.32	0.185934*	0.443906
Latvia	Y_{t+1}	–38.53512	0.740275	0.860893*
	G_{t+1}	16.24386	0.061698	0.888346*
Lithuania	Y_{t+1}	187.4230	0.603447	1.249804
	G_{t+1}	615.5001	–0.031935	0.971601*
Macedonia	Y_{t+1}	45936.36	0.520185	–0.037213
	G_{t+1}	–32503.13*	0.458687*	0.749593*
Moldova	Y_{t+1}	1192.582*	0.720731	–1.177609
	G_{t+1}	102.2250	0.081263	0.584390*
Poland	Y_{t+1}	301.8661	1.038816	–0.171459
	G_{t+1}	185.6762	0.212109*	0.451035
Romania	Y_{t+1}	5976161	0.932018	–0.749964
	G_{t+1}	3529799*	0.240032*	–0.289446
Slovakia	Y_{t+1}	77060.37	0.765635	0.501389
	G_{t+1}	–18181.30	0.309665*	0.337868
Slovenia	Y_{t+1}	17662.04*	1.030718	–0.304118
	G_{t+1}	23963.88	0.054997	0.452326
Ukraine	Y_{t+1}	130.5329	1.465027*	–1.330780*
	G_{t+1}	–27.83720	0.392520*	–0.009256

* Significant at 5 percent (one-sided tests, for null hypotheses, see previously).

Let us see which countries are sensitive to the constant. Bosnia and Herzegovina seemed to be significantly supply-based economy in the original model, but it is weakly demand-based in the new one. The Keynesian multiplicator effect was significantly out of work, the significance is extincted, just as the antecedently significant Wagner's law is no more significant. In Croatia, the trend of the changes is the same. Lithuania is the first and last example of the (insignificant) falsification of Wagner's law. Macedonia follows the tendency of drastical changes of the other two ex-Yugoslavian state, as all the four parameters are greatly different in the models. With Romania, these four countries break the rule of demand-side manipulation feature, as in this model they are demand-based, but not Keynesian economies. The contrary is Slovakia, where in the model without constants the economy is supply-based and not Keynesian, in the extended version, we find a demand-based and Keynesian economy. In the case of Slovenia, the insignificantly Keynesian economy turns to be significantly non-Keynesian in the extended model. Finally, in the original version, the budget expenditures have no limit only in Belarus and in the Czech Republic (see Table 2). Bulgaria, Romania and Ukraine join to this group of weak control.

Table 3

VAR with constant – stability feature

Country	Dependent variables	Equilibrium*	Tangent of the Δ=0 line	Eigenvalues	Stability feature
Albania	*Y*	–59391.781	0.052	1.037249	saddlepoint
	G	–421.02919	0.193	0.313587	
Belarus	*Y*	–11779.637	0.526	1.018144	saddlepoint
	G	–6789.0217	0.521	0.268860	
Bosnia and Herzegovina	*Y*	2924.4154	–0.567	*0.754914*	stable node
	G	1620.7019	0.475	*0.365021*	
Bulgaria	*Y*	230.26992	0.359	*0.827022*	stable node
	G	96.907727	0.569	*0.328011*	
Croatia	*Y*	38574.444	–0.930	*0.893465*	stable node
	G	18948.369	0.303	*0.544380*	
Czech Republic	*Y*	721809.02	0.499	*0.994277*	stable node
	G	344477.58	0.490	*–0.644961*	
Estonia	*Y*	14824.323	0.291	1.083507	saddlepoint
	G	7686.5305	0.488	0.320975	
Hungary	*Y*	386727.43	0.609	1.089166	saddlepoint
	G	245170.96	0.334	0.523937	
Latvia	*Y*	–401.45997	0.302	1.056378	saddlepoint
	G	–76.355679	0.553	0.572243	
Lithuania	*Y*	15136.087	0.317	*0.787524±*	stable spiral (clockwise)
	G	4652.5996	–1.125	*±0.077641i*	
Macedonia	*Y*	92643.172	–12.894	*0.634889±*	stable spiral (counter-clockwise)
	G	39899.399	1.832	*±0.062546i*	
Moldova	*Y*	1772.1126	–0.237	*0.652560±*	stable spiral (counter-clockwise)
	G	592.45972	0.196	*±0.301744i*	
Poland	*Y*	8890.0169	0.226	*0.968541*	stable node
	G	3773.1527	0.386	*0.521311*	
Romania	*Y*	18898756	–0.091	*0.760578*	stable node
	G	6255481.3	0.186	*–0.118006*	
Slovakia	*Y*	–510711633	0.467	1.000091	saddlepoint
	G	–238876386	0.468	0.103412	
Slovenia	*Y*	–24370462	0.101	1.000190	saddlepoint
	G	–2403507.2	0.100	0.482855	
Ukraine	*Y*	3183.0571	0.349	*0.869725*	stable node
	G	1210.3732	0.389	*0.586046*	

* Equilibrium coordinates are not comparable among countries because of the use of local currency units.
Note. Italic numbers for eigenvalues of equilibrium different from saddlepoint.

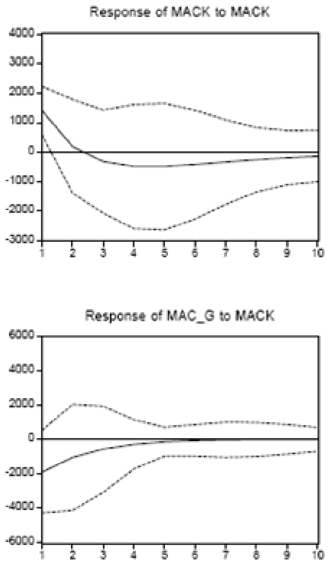
The stability feature of the extended model is different theoretically. Even the presence of the constants does not influence our statements about the relationship of matrix **A** and the stability conditions. If we ignore the constraint (e.g. the equilibrium point can be different from the origin), we have more theoretical possibilities. Beside the saddlepoint, other stability features can be rational in economic sense. For an economy with equilibrium in the positive quadrant, in mid-term the stable node or stable spiral stability can be fruitful if the equilibrium GDP is larger than the actual one. The equilibria in the negative quadrant all have saddlepoint stability.

In the countries, where the equilibria are in the positive quadrant, the equilibrium expenditure/GDP rates are computable. This rate is 55.4 percent in Bosnia and Herzegovina, 42.1 percent in Bulgaria, 49.1 percent in Croatia, 47.7 percent in the Czech Republic, 51.2 percent in Estonia, 63.4 percent in Hungary, 30.7 percent in Lithuania, 43.1 percent in Macedonia, 33.4 percent in Moldova, 42.4 percent in Poland, 33.1 percent in Romania, and 38.0 percent in Ukraine. Where the economy has a stable node or stable spiral stability feature, these expenditure/GDP rates can be declared as target of the countries. In the case of Estonia and Hungary, the particular situation of the saddle-paths is determinant, so further explorative work is necessary. Having regard to the tangent of the ΔY=0 and the ΔG=0 curves, the equilibria are the same as in the equation /6/, for Estonia (see on Figure 2) and for Hungary (see on Figure 3). It means that GDP and budget expenditures of both countries are over the equilibrium values, the dynamics assures the continual increasing of the GDP and the government expenditures. We will focus to the stability question of the expenditures/GDP rate in the next chapter of the paper.

The impulse responses are generally smaller, the effects become faster insignificant in the model with constants. For a series of the countries (Albania, Belarus, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Romania, and Ukraine) the impulse response functions are very similar in the two models.

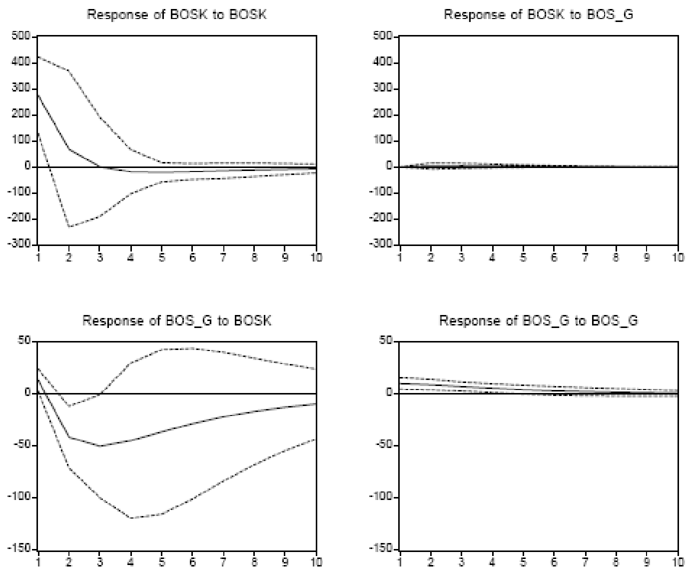
In countries, where the presence of the constants establishes stable equilibrium (instead of saddlepoint), the response functions are declining (converging to zero) after three or four years. The most conspicuous example is Macedonia (see Figure 6). Turn our attention to the special cases. In Bosnia and Herzegovina, the response to the shocks of the GDP is negligible, the self-effect of government expenditures is strongly declining, while the GDP responds to budget shocks with an enormous shut from the second year (see Figure 7). Moldova and Poland have the same characteristics as Hungary in both models (see Figure 5), even in the original model they formed part of the "every effect is positive" group. Slovakia is the counter-example of Poland, the declining hardly significant effects of the original model are replaced by the "every effect is significantly positive" case. Slovenia is another special case. Except for the autoresponse of the GDP (that is significantly positive in long term), all other responses are the same as in Bosnia and Herzegovina.

Figure 6. Response to Cholesky One Standard Deviation Innovations ± 2 Standard Errors (Model with constants – Macedonia)



Note. MACK for Macedonian government expenditures and MAC_G for Macedonian GDP.

Figure 7. Response to Cholesky One Standard Deviation Innovations ± 2 Standard Errors (Model with constants – Bosnia)



Note. BOSK for Bosnian government expenditures and BOS_G for Bosnian GDP.

5. Integration, cointegration, causality

In this analysis, we favoured the economic model and used the econometric methods ancillary. At this point, one has to check the general characteristics of the analysed time series to be sensible for the further possibilities of analysis. This section contains the tests about our time series. The results of some tests are conditions of the application of modeling techniques, while others go forward. We decided to hold together statistical tests, because we would like to separate the economic and statistical analysis of the model.

First it is important to investigate the integration of the time series. In *Mellár* [2001], the author experienced that the longer Hungarian time series both were $I(2)$ processes. Mellár comments that usually these type of time series are $I(1)$ processes. The unit root tests of these time series are problematic, because critical values are available for sample size at least 20, while our series are no longer than 14 years. It is predictable that the absolute value of small sample critical values are higher and it implicates that p values are higher than estimated for sample size of 20 (in some cases the test – adjusted to sample size of 20 – indicates the rejection of null hypothesis, but it should not be rejected, as the time series has a unit root).

Table 4

ADF test statistics

Country	Dependent variables	$I(0)$	$I(1)$	$I(2)$	Other
Albania	*Y*	0.204	–4.639**		
	G	–0.605	–3.447**		
Belarus	*Y*	–1.084	–1.254	–2.432	trend stationary
	G	–0.990	–6.604**		
Bosnia and Herzegovina	*Y*	–14.03**			
	G	–6.477**			
Bulgaria	*Y*	–1.126	–1.590	–3.477**	
	G	–5.790**			
Croatia	*Y*	–0.810	–5.035**		
	G	–4.339**			
Czech Republic	*Y*	–0.482	–4.510**		
	G	0.342	–2.096	–3.493**	
Estonia	*Y*	1.662	–3.385**		
	G	–0.802	–4.326**		
Hungary	*Y*	0.744	–7.479**		
	G	–0.829	–2.788*	–4.212**	
Latvia	*Y*	1.683	–2.690	–2.222	trend stationary
	G	–0.031	–2.825*	–5.278**	
Lithuania	*Y*	0.267	–3.774**		
	G	–0.407	–3.933**		

(Continued on the next page.)

(Continuation.)

Country	Dependent variables	*I*(0)	*I*(1)	*I*(2)	Other
Macedonia	*Y*	–2.004	–3.142*	–3.738**	
	G	0.956	–2.683	N/A	first difference trend stationary
Moldova	*Y*	0.194	–4.823**		
	G	–1.017	–3.373**		
Poland	*Y*	–2.202	–5.221**		
	G	1.054	–3.145*	–11.80**	
Romania	*Y*	–2.887*	–3.453**		
	G	0.366	–6.242**		
Slovakia	*Y*	–0.098	–4.146**		
	G	0.116	–2.934*	–4.743**	
Slovenia	*Y*	0.107	–2.224	–4.413**	
	G	–3.366**			
Ukraine	*Y*	–0.525	–1.317	–4.632**	
	G	–4.029**			

* Null hypothesis of the unit root is rejected at 10 percent.
** Null hypothesis of the unit root is rejected at 5 percent.

We have chosen the ADF (Augmented Dickey–Fuller) test for testing the unit root. The test statistics are in Table 4. In the cases when the original time series has not a unit root, *I*(1) and *I*(2) were not tested, and when the first difference of the time series has not a unit root, *I*(2) was not tested. The results differ from country to country. The most expected version that both GDP and government expenditures are integrated in first order (*I*(1)), cannot be rejected in eight countries (Albania, Estonia, Hungary, Lithuania, Moldova, Poland, Romania, Slovakia). In the case of Hungary, Poland and Slovakia at 5 percent the budget expenditures are *I*(2) time series. Bulgaria, Slovenia and Ukraine forms another group with *I*(2) GDP and stationary (*I*(0)) budget expenditures. Bosnia and Herzegovina has special feature with its stationary time series (due to data only after the war). In Belarus and Latvia, the GDP series are trend stationary (deterministic trend). Our results are far from Mellár's results, as for Hungary the second order integrated time series of the GDP are not proved, thereby his longer series are maybe *I*(2) processes because of a structural break around 1990.

Engle and *Granger* [1987] pointed out that a linear combination of two or more non-stationary series can be stationary. If such a stationary linear combination exists, the non-stationary time series are said to be cointegrated. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship among the variables (here between the GDP and the budget expenditures).

Owing to the results of the unit root tests, we can seek for cointegration equation only in eight countries. In this paper, we used the Johansen cointegration test (*Johansen* [1991], [1995]), the results can be found in Table 5.

Table 5

P-values of the cointegration tests and G/Y rates of cointegration equations*
(percent)

Country	Trace test without constant	Maximum eigenvalue test without constant	G/Y rate in CE equation	Trace test with constant	Maximum eigenvalue test with constant
Albania	4.57	9.35	-	0.01	0.00
Estonia	0.92	9.29	0.53	0.94	3.85
Hungary	0.43	8.71	2.00	1.92	10.15
Lithuania	0.47	1.58	0.34	4.79	4.78
Moldova	37.72	58.98	-	0.00	0.00
Poland	1.37	10.98	0.46	7.15	25.57
Romania	48.44	46.93	-	0.01	0.00
Slovakia	5.44	3.84	0.45	4.79	10.47

* The null hypothesis is the lack of cointegrating vector.

The results of the cointegration tests are antinomic. At 5 percent significance, only the Lithuanian GDP and budget expenditures are cointegrated without constant[4] (i.e. a fix expenditures/GDP rate can be supposed). By the trace test, we have found the two time series cointegrated without constant in Estonia, Hungary, Lithuania and Poland. In Albania, Moldova, and Romania cointegration with constant have been found. In the case of Estonia and Slovakia, a cointegration equation with and without constant can be presumed. In Table 5 the long-term relation of the two variables are expressed by *G/Y* rate, as it appears in the cointegration equation without constant. These rates generally are close to the observed rates, except for Hungary, where a theoretically (economically) impossible value has been calculated. Even the tests indicate cointegration equation also without constant, the version including the constant would be economically rational.

Table 6 contains the cointegration equations with constant, in the form of $G=\alpha Y+c$ (for the inverse form a simple re-arrangement is necessary). This form expresses a long-term – linear – relation between the budget expenditures and the GDP, the α parameter reads as the marginal reallocation rate; from 1 additional unit of national income, the government spends α unit more. Theoretically, the $\alpha=0$, $c>0$ situation means that the government spends without any regard to the GDP, while the $\alpha>0$, $c=0$ is the case of pure proportional spending, when a fix rate of the GDP is reallocated every year. As the base of the budget expenditures are the budget revenues, the two extremities imply the lump-sum and the proportional taxing system. By the empirical evidence, Albania and Romania is near to the lump-sum attitude, and the European Union members have very similar characteristics to each other.

[4] Note that including the constant in the cointegration equation is insignificant.

Table 6

*Parameters of cointegration equations with constant**

Country	α	*c*
Albania	0.181 (0.007)	8 979.4 (542.0)
Estonia	0.313 (0.028)	4 322.4 (1 345.5)
Hungary	0.277 (0.082)	168 350 (44 626)
Moldova	0.577 (0.047)	1 580.7 (82.54)
Romania	0.147 (0.011)	3 406 948 (189 531)
Slovakia	0.299 (0.078)	336 249 (99 762)

* Standard errors in brackets.

Table 7

*P-values of Granger causality tests**

Country	Dependent variables	Lags		
		1	2	3
Albania	ΔY	0.532	0.870	0.672
	ΔG	0.640	0.822	0.770
Bosnia and Herzegovina	Y	**0.005**	0.252	N/A
	G	0.538	0.988	N/A
Estonia	ΔY	0.923	0.830	0.888
	ΔG	0.770	0.384	**0.023**
Hungary	ΔY	0.733	0.916	0.743
	ΔG	0.521	0.597	0.224
Lithuania	ΔY	0.906	0.505	0.657
	ΔG	0.734	0.644	0.525
Moldova	ΔY	0.390	0.365	0.840
	ΔG	0.476	0.935	0.485
Poland	ΔY	0.640	0.692	0.978
	ΔG	0.723	0.778	**0.009**
Romania	ΔY	0.777	0.224	0.316
	ΔG	0.538	0.251	0.305
Slovakia	ΔY	0.245	0.727	0.881
	ΔG	0.752	0.974	0.308

* Null hypothesis: the independent variables do not Granger cause the dependent variables.
Note. Bold numbers for *p*-values less than 0.05.

Finally, in the countries, where the GDP and the government expenditures have the same $I(d)$ processes, the causality of the variables or their differences can be tested. The necessary condition for Granger causality test is the stationarity of the time series, thereby the Bosnian time series can be directly tested, and for the other eight countries, where both the GDP and the government expenditures can be $I(1)$ processes, the test can be executed on the first differences (i.e. the annual change of the GDP and the annual change of the budget expenditures). The main results are summarized in Table 7. Generally, the GDP cannot be declared to either cause the government expenditures, or vice versa, with any rational lags. There are three exceptions. In Bosnia and Herzegovina, the government expenditures are Granger cause of the GDP. As data are available for the after-war period, the reconstruction of the country has been based on international aids, arriving through governmental channels. In Estonia and Poland, with three lags in the test equation, the GDP change can be the cause of the government expenditures change. It is difficult to find the economic background of the three years lagged effect of the GDP changes. Otherwise, the significant VAR parameters and the lack of Granger causality suggest that the relation cannot be described in Grangerian term.

6. Conclusions

The empirical testing of the two versions of the simple dynamic model has been a result of a variegated picture about the relation of the GDP and the government expenditures. The Eastern European countries – each of them in transition from planned to market economy – have very different characteristics.

In the simplest model, clear country groups can be formed. While in some demand-based economies the Keynesian multiplicator is working, and the dynamics assure the continual growth, in others only supply-based economic policy can be efficient, and if once the government expenditures/GDP rate becomes too high, the reduction is possible only by general depression. The question is not more about the existence of Keynesian multiplicator, but about the institutional and political background of the nature of the economy. The extended model covers the equilibrium and attracts attention to the sensitivity of the equilibrium feature of certain countries. The discrepancies of the results of the two model versions turn our attention to the question if the different paths are in great part caused by different initial conditions.

The econometric analysis of the time series explores that for sophisticated analysis of this country group we need different tools. The varied order of integration opens the possibility of further analysis in certain countries, while restricts in others. In the countries of I (1) GDP and expenditure series, these two variables are cointegrated, but generally, a cause-consequence relation cannot be explored.

Finally, we have to mention that the main results of the original and the extended model for Hungary are analogous to the main findings of Mellár for a longer and mainly not transitional period. This fact strengthens our hypothesis that the deep economic processes are country specific and it is difficult to elaborate even a simple economic model applicable for this group of countries. For further analysis, it would be interesting to check if other – country-by-country – empirical works accept or deny the found fiscal rule. From modelling point of view, the application of a more detailed and/or non-linear model would be able to fortify (or refute) our hypotheses.

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