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Economic Growth and Fiscal Expenditures in Hungary

Stylized Facts Based on VAR Modelling

The effects of fiscal policy on economic growth, and more generally the relationship between government expenditures and output is a central question in macroeconomics. In this paper we use a two-equation VAR model to estimate a mixed (Keynesian and Lucasian) theoretical model on Hungarian data between 1960 and 2011. We found that results differ in several aspects of both short and long term implications, as well as in terms of criteria for stability. Generally over this period our result does not prove the presence of Keynesian mechanisms, but Wagner's law proves strongly to be true. Our result show that stability is possible, but it requires sticking to a defined expenditure/GDP ratio, otherwise consolidations will unavoidably hurt growth. Based on our conclusions and a detailed analysis of our time series with regard to various economics features we also offer possible econometric alterations of methodology that might provide better estimations and more reliable answers to the proposed economic questions.

INTRODUCTION

The effects of fiscal policy on economic growth, and more generally the relationship between government expenditures and output has been a central question in macroeconomics since Keynes' General Theory. The appearance of theories with contradictory implications and the generally observable phenomenon of growing government/GDP ratios have made the issue, if possible, even more relevant.

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The theoretical background of this paper is based on an article by Mellár (2001)[3] 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 is to be estimated on the basis of GDP and general government expenditure data. With help of this framework four main questions could be answered, namely whether:

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

Thus the model provides the possibility to describe and understand the complicated relationship between the GDP and spending in the last 50 years, which is a necessarily prerequisite for future policy decisions, especially at times when an economic growth stimulus is needed.

We begin our paper with a brief review of the relevant literature followed by a summary of the original model. In addition, we offer an extended model that allows for a deeper analysis of the equilibrium, but barely affects the econometric diagnostics and the estimation process. In the second half, we describe the database used for the empirical estimations and tests.

Firstly, through the tests of integration and cointegration we analyse the statistical characteristics of the time series. After we have answered the previously posed four questions we turn our attention to the stability issue and also analyse causality. Finally, further research possibilities are explored and the paper is concluded by a brief summary of our results and their implications.

SUMMARY OF RELEVANT EMPIRICAL RESULTS

The relationship between government expenditure and economic growth is an issue that has been addressed several times by scholars, each time using a slightly different approach and running tests on data from different countries over different periods. Thus the results and conclusions differ in each case. In this chapter we would like to provide a quick overview of the most relevant literature with the aim of placing our case study among the existing papers and to show the readers how it differs from them.

Initially the driving force behind the detailed study of this issue was mostly the growing size of the government that has been a generally observable phenomenon over the past 50 years. Researchers naturally posed the question: what are

[3] Mellár, T. (2001): *Kedvezményezett vagy áldozat: A GDP és a költségvetési kiadások kapcsolata.* Statisztikai Szemle. Vol. 79. No. 7. 573–586.

the implications of growth? As economic theory gives contradictory predictions in general, it follows that a time and country specific econometric approach is very much required in order to get applicable answers.

Research done on this issue can be categorized into two major groups in terms of its methodology. The first group of papers applies simple regression techniques on the time series that are usually based on a production function. They might study one single country or a region with panel methods. A positive effect of government spending on growth is implied among others by Alleyne et al. (2004)[4] studying Caribbean countries between 1975 and 2002 or Alexiou (2009)[5] based on an inquiry into seven countries in the SEE region spanning from 1995 to 2005. Negative effects with this approach are presented for example by Ghura (1995)[6] after analysing Sub-Saharan countries between 1970 and 1990 and by Knoop (1999)[7] based on his research on the US economy spanning from 1975 to 1995.

The second group with regard to methodology includes papers using VAR (Vector AutoRegressive) models. This type of approach usually takes advantage of the properties of VAR models to be able to study causal relationship without any theoretical assumptions in the background. It is also common to add a third variable to the equations, to decrease biases by leaving out variables. Most of the papers find a bicausal relationship between our two variables and indicate a positive relationship between government spending and growth. One example is Cheng and Lai (1997)[8], who found a positive, bidirectional relationship when adding money supply in the case of South Korea on data running from 1954 to 1994. An interesting paper from Varadi and Vanlalramsanga (2012)[9] finds similar results conditional on low debt/GDP rations using Indian data between 1987 and 2010. Loizides and Vamvoukas (2005)[10] add unemployment and inflation (separately) as third variables between 1950 and 1990 and find positive, unidirectional relationships in the cases of the UK and Ireland, running from expenditures to growth, whereas in Greece evidence supports only growth causing

[4] Alleyne, K. – Lewis-Bynoe, D. – Moore, W. (2004): *An Assessment of the Growth-enhancing size of Government in the Caribbean*. Applied Econometrics and International Development, Vol. 4. No. 3. 77–94.

[5] Alexiou, C. (2009): *Government Spending and Economic Growth: Econometric Evidence from the South Eastern Europe (SEE)*. Journal of Economic and Social Research. Vol. 11 No. 1. 1–16.

[6] Alexiou, C. (2009).

[7] Knoop, T. A. (1999): *Growth, Welfare, and the Size of Government*. Journal of Economic Inquiry. Vol. 37. No. 1. 103–119.

[8] Cheng, B. S. – Lai, T. W. (1997): *Government Expenditures and Economic Growth in South Korea: A VAR Approach*. Journal of Economic Development, Vol. 22. No. 1. 11–24.

[9] Varadi, V. – Vanlalramsanga, C. (2012): *Assessment of the Impact of Fiscal Policy on Economic Growth: An Empirical Analysis*. EERI Research Paper Series No 06/2012. Economics and Econometrics Research Institute, Brussels.

[10] Loizides, J. – Vamvoukas, G. (2005): *Government expenditure and economic Growth: Evidence from trivariate Causality Testing*. Journal of Applied Economics. Vol. 8. No. 1. 125–152.

increasing government size. Oriakhi and Arodoye (2013)[11] also find a unidirectional, positive relationship on Nigerian data between 1970 and 2010 connecting spending to growth. Some of the observed negative relationships from spending to growth include a study from Ramayandi (2003)[12] on Indonesia during the period from 1965 to 1999.

Our case study joins the second group of papers in terms of using a VAR approach. The big difference though is that behind our VAR model there is a macroeconomic model developed by Mellár (2001)[13]. Thus in our case there is no arbitrarily chosen third variable, but because of the economic modelling in the background we are able to draw further conclusions with regard to stability for example. One other difference in our analysis is that we investigate a longer period than any of the studies mentioned above. In terms of how our results differ see the chapters on empirical evidence.

THE THEORETICAL MODEL

In this chapter, we would like to provide a critical presentation of Mellár's model[14]. Through this simple model, we can analyse the two-way relation between the GDP and the general government expenditures allowing it to follow spill over effects. Due to 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)[15] and Kotosz (2006/a)[16].
The dynamics of the GDP is based on three equations:

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

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

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

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. [17]

[11] Oriakhi, D. E. – Arodoye, L. N. (2013): *The Government Size - Economic Growth Relationship: Nigerian Econometric Evidence Using a Vector Autoregression Model*. International Journal of Business and Management. Vol. 8. No. 10. 126–133.

[12] Ramayandi, A. (2003): *Government Size in Indonesia: Some lessons for the local Authorities.* Working Paper in Economics and Development Studies. No 200302. 1–13.

[13] Mellár (2001): op. cit.

[14] ib.

[15] Purfield, C. (2003): *Fiscal adjustments in transition countries: Evidence from the 1990s.* IMF Working Paper 03/36, International Monetary Fund, Washington D.C.

[16] Kotosz, B. (2006/a): *Megszorítások és lazítások – A rendszerváltás fiskális politikájának szerkezetéről*. Közgazdasági Szemle. Vol. 53. No. 2. 158–174

[17] $\tau, \gamma, \delta, \alpha, \beta, \omega, a, k, k$ are parameters indirectly estimated with restrictions clarified after equations /1-5/. Generally they have a technical role unless stated otherwise in the text.

The dynamics of the budget expenditures is as follows:

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

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

Additionally:

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

Equation /1/ is a simple Keynesian demand function, and it suggests that budget expenditures are covered only by income taxes; financing can be partial (τ<1) or full (τ≥1). Equation /2/ is a mixed supply function; the first and the third elements are Lucas-type, while the second element is Keynesian. 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 import and through the devaluation of the national currency can generate the cease in production. Equation /4a/ suggests that the larger the lag between expected and actual GDP, the larger 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 which is easy to deal with. With his idea, we can replace the lagged GDP by current GDP in equation /5a/. By this manipulation, the matrix form of the model is:

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

The /6/ version of the model is very favourable for statistical analysis, but doubtful from a theoretical point of view. Let us see what happened. First, the autonomous demand depends on the current GDP, i.e. not autonomous. This inconsistency cannot be filtered out at this level of simplicity of the model.[18] A new interpretation of equation /1/ is the following: a part of the demand is the

[18] 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, $a_{11} = 1 + \alpha(c - 1)$. The stability feature of the model does not change, but we have a constant in the first equation, without a constant in the second one. This restriction causes problems in econometric estimations and we have to estimate an SVAR model.

function of the income but not of the disposable income, so some demand is directly independent from taxes. Second, the expected GDP is the function of the current GDP. The conflict is clear; there is no more expectation about a known measure. Furthermore, the coming year's budget expenditures grow accordingly as we have faulted the measurement of the 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 for GDP for year *t+1* is higher than the current GDP in year t. This is a usual assumption, and it is sustainable without 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 extreme, and it can be restored by the different use of equation /4a/, where instead of $\bar{G}_t$ we use $\bar{G}_{t+1}$ (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 on the present bias. The new equations are:

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

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

The stability of the model depends on the absolute values of eigenvalues of the A matrix. As Mellár shows [19], calculated by economically rational parameter values, $tr\mathbf{A} \in [0,2]$, thereby one of the necessary conditions is fulfilled ($|tr\mathbf{A}| < n$)[20]. Mellár supposed that $|det\mathbf{A}| < 1$ We still have doubts whether this condition is always fulfilled as in Kotosz (2009)[21]. If the economy is demand-directed ($\alpha > 0$), the condition on determinant is normally 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 typical 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.

[19] Mellár (2001): op.cit.

[20] On necessary and sufficient conditions of stability, see Dameron, P. (2001): *Mathématiques des modèles économiques*. Economica, Paris.

[21] Kotosz, B. (2009): Fiscal Expenditures and the GDP – Baltic Transformation Compared. In: Glavanovics, A. – Szele, B. (eds): *Közép-Európa: Transzfer és dialógus*. Kodolányi János Főiskola, Székesfehérvár. 203–222.

The previous criticism of the original model can easily be dealt with as we can see in Kotosz (2006/b)[22]. First, the autonomous demand in the previously analysed model was not really autonomous. We can unravel this inconsistency by assuming a constant autonomous demand (*At=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 to equation /4c/.

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

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 place any restrictions on this constant. If *g=0*, then equation /4b/ is equal to equation /4c/.

The new VAR model is as follows in equation /7/:

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

DATA AND METHODOLOGY

The dataset of the model to be estimated needs only two time series, the real GDP and the real government expenditures. Our dataset has three sources; first we used the dataset of the original Mellár-model[23] that has the series for 1960-1999. This dataset overpasses all feasible methodological changes, and has been developed by a team of specialists from the Central Statistical Office (KSH). From the on-line dataset of KSH we have these series on nominal values for the period 1995-2011, accompanied by the GDP-deflator series. The government expenditure price index was obtained from Eurostat. Having a common period for the two series (1995-1999), we could adjust data to assure continuity and to avoid structural breaks created by the dataset.

To test stationarity we used three unit-root tests, the Augmented Dickey-Fuller test (Said-Dickey, 1984)[24] and the Phillips-Perron test (Phillips-Perron, 1988)[25],

[22] Kotosz, B. (2006/b): *Fiscal expenditures and the GDP – Interdependencies in transition.* Statisztikai Szemle. Vol. 84. No. 10. 18–40.

[23] Mellár (2001): op. cit.

[24] Said, E. – Dickey, D. A. (1984): *Testing for Unit Roots in Autoregressive Moving Average Models of Unknown Order.* Biometrika. Vol. 71. No. 3. 599–607.

[25] Phillips, P. C. B. – Perron, P. (1988): *Testing for a Unit Root in Time Series Regression*. Biometrika. Vol. 75. No. 2. 335–346.

and also the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test[26]. To estimate the theoretical model, we applied the vector autoregressive (VAR) approach (Sims, 1982)[27] and Kirchgassner et al, 2012[28]) considering warnings and approaches by Toda-Phillips (1993)[29] and Toda-Yamamoto (1995)[30]. Granger causality was tested by the original Granger test (Granger, 1969)[31], also counterweighed by the modifications of Dolado-Lütkepohl (1996)[32].

EMPIRICAL EVIDENCE – THE ORIGINAL MODEL

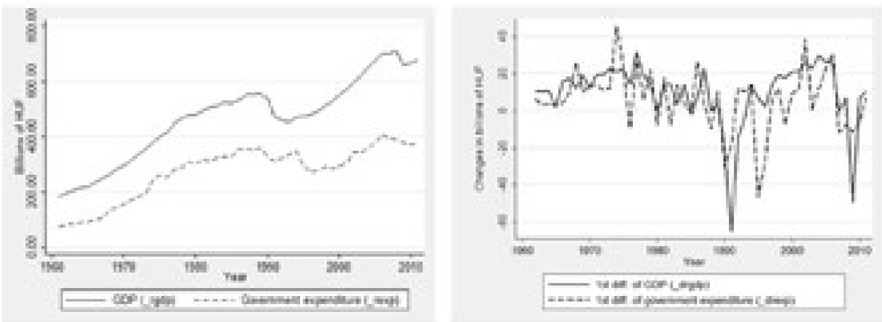
In this chapter we present our empirical results based on the estimation of the theoretical model described earlier. We begin by examining the stationarity of the dataset, using several different unit root test. After estimating the VAR model, we proceed with interpreting the elements of the resulting matrix and connect them with the theory that best explains the relationship of the fiscal policy and growth in Hungary in the past 50 years. Afterwards we address the question of stability by deriving the necessarily conditions for a stable path from theory. Finally, we conclude by analyzing the long term relationship of our variables with the help of the impulse response functions and we also explore the possibility of a causal relationship based on the Granger test.

Before starting the econometric estimation of the model, we are beginning our inquiry with analysing the general characteristics of the dataset. After plotting the data to get a preliminary idea of their nature, we examine the integration of our time series. As shown in Figure 1 both GDP and government expenditures have an upward trend mostly throughout the entire time frame as expected (graph on the left). Yet, even though, by and large, the two variables move together, the differences prove that the relationship is more complex (graph on the right). Furthermore, we also see that the expenditure/GDP ratio increases slightly toward the end of the time period. Several questions arise following these observations. Our objective is to study these phenomena with precise econometric tools and by the end we hope to be able to answer some of the questions with our results.

[26] Kwiatkowski, D. - Phillips, P. C. B. - Schmidt, P. – Shin, Y. (1992): *Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root.* Journal of Econometrics. Vol. 54. No. 1–3. 159–178.
[27] Sims, C. A. (1982): *Policy analysis with econometric models*. Brookings Paper on Economic Activity. 107–164.
[28] Kirchgassner, G. – Wolters, J. – Hassler, U. (2012): *Introduction to Time Modern Series Analysis.* Springer-Verlag, Berlin.
[29] Toda, H. Y. – Phillips, P. C. B. (1993): *The spurious effect of unit roots on vector autoregressions.* An analytical study. Journal of Econometrics. Vol. 59. No. 3. 229–255.
[30] Toda, H. – Yamamoto, T. (1995): *Statistical inference in vector autoregressions with possibly integrated processes.* Journal of Econometrics. Vol. 66. No. 1–2. 225–250.
[31] Granger, C. W. J. (1969): *Investigating causal relations by econometric models and cross-spectral methods*. Econometrica. Vol. 37. No. 3. 424–438.
[32] Dolado, J. – Lütkepohl, H. (1996): *Making Wald tests work for cointegrated VAR systems. Econometric Reviews*. Vol. 15. No. 4. 369–386.

As a next step we perform several different tests in order to provide a detailed picture and more robust conclusions about stationarity. Luckily our long term series enables us to run unit root test reliably as opposed to several other studies that mostly lack this advantage because of their insufficient number of observations.[33] The trade-off here might be that given the drastic changes in the political regime of Hungary, longer term series might contain structural breaks. Keeping this in mind, firstly we run Augmented Dickey-Fuller tests for up to 6 lags then proceed with the Phillips-Perron test for the suggested 3 lags and finally perform KPSS tests for a default maximum of 3 lags on our dataset. The null hypothesis in the first two types of tests has a unit root whereas in the case of the KPSS test it is exactly the opposite. So it follows that in the case of stationarity we expect the ADF and PP tests to be significant and the KPSS test to be insignificant. The results are shown in Table 1 and Table 2 for output and government expenditure, respectively.

Figure 1: **Line plots of GDP and government expenditures (graph on the left) and of their differences (graph on the right)**[34]



[33] Kotosz (2006/b): op. cit.
[34] Source: The authors' calculation.

Table 1: **Test statistics of various unit root test for output**[35]

	Y	1st diff. of Y	2nd diff. of Y
ADF (no lag)	-1.280	-4.154 **	-9.827 ***
ADF (1 lag)	-2.003	-3.055	-5.368 ***
ADF (2 lags)	-2.356	-3.052	-4.657 ***
ADF (3 lags)	-2.189	-2.888	-5.016 ***
ADF (4 lags)	-2.314	-2.142	-4.034 ***
ADF (5 lags)	-2.756	-2.070	-2.927
ADF (6 lags)	2.754	-2.430	-3.098
KPSS (no lag)	0.620 ***	0.174 **	0.019
KPSS (1 lag)	0.320 ***	0.120 **	0.030
KPSS (2 lags)	0.221 ***	0.097 ***	0.034
KPSS (3 lags)	0.173 **	0.086 ***	0.041
PP (3 lags)	-1.711	-4.204 ***	-10.384 ***
stationarity	non-stationary	non-stationary	stationary

Table 2: **Test statistics of various unit root test for expenditure**[36]

	G	1st diff. of G	2nd diff. of G
ADF (no lag)	-1.318	-5.898 ***	-10.321 ***
ADF (1 lag)	-1.554	-4.564 ***	-7.528 ***
ADF (2 lags)	-1.619	-3.775 **	-7.092 ***
ADF (3 lags)	-1.711	-2.782	-5.781 ***
ADF (4 lags)	-2.088	-2.352	-4.423 ***
ADF (5 lags)	-2.434	-2.261	-3.399 *
ADF (6 lags)	-2.541	-2.272	-3.326 *
KPSS (no lag)	0.940 ***	0.106	0.012
KPSS (1 lag)	0.489 ***	0.093	0.021
KPSS (2 lags)	0.338 ***	0.091	0.031
KPSS (3 lags)	0.263 ***	0.090	0.049
PP (3 lags)	-1.429	-5.868 ***	-13.617 ***
stationarity	non-stationary	non-stationary	stationary

As we see all three tests suggest second order integrity in case of the output variable, as opposed to the expected I(1). With regard to the budget expenditure, the majority of the tests points in the same direction, implying that this variable

[35] *** Significant at 1 percent ** Significant at 5 percent * Source: The authors' calculation.
[36] *** Significant at 1 percent ** Significant at 5 percent * Source: The authors' calculation.

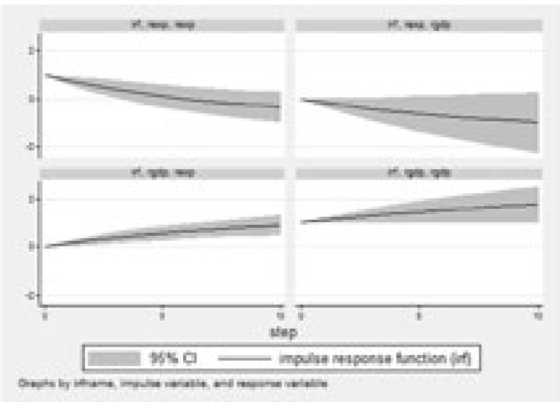
is also I (2). One reason for these results, as suggested by Mellár[37], might be a structural break in 1990, caused by the change of regime. This hypothesis calls for further studying of the time series and possible alterations of the modelling with regard to structural breaks which is beyond the scope of this current examination.[38] As both time series are integrated from the second order we also test for the existence of a cointegration vector. The Johansen test fails to prove the existence of a cointegration equiton with or without a constant.

After the detailed study into the nature of our variables, in this section we proceed with the econometric testing of the model that we introduced in the previous chapter. The model - as described in /6/ - can be translated into a VAR model, which might easily be estimated with the help of most statistical software, in our case with STATA[39]. Results are shown in Table 3.

Table 3: **Results of VAR estimation without constant**[40]

	Y	**G**
Y_{t-1}	1.107 **	0.142 ***
S.E. p-value	0.051 0.041[41]	0.046 0.002
G_{t-1}	-0.152 *	0.776 ***
S.E. p-value	0.086 0.077	0.078 0.000
Eigenvalues	1.0174	0.866

Figure 2: **Impulse response functions**



[37] Mellár (2001): op. cit.
[38] However, the test results are contradictious, and do not affirm a break in 1990.
[39] As the estimation of VAR models is based on iterative methods, some smaller differences among different platforms may occur.
[40] *** Significant at 1 percent ** Significant at 5 percent * Source: The authors' calculation.
[41] Null hypothesis is that the coefficient is not 1.

First of all, it is worth pointing out that three of the estimated parameters are significant on at least the level of 5%, and the a21 element is significant on the 10% level. So, based on our data, in the case of all 4 types of relations we will be able to draw conclusions.[42] Interpretations of the values follow from the model. The a11 element indicates whether aggregated demand (if $a_{11}<1$) or aggregated supply (if $a_{11}>1$) is determinant in growth. A negative a_{12} element means that there is no effective Keynesian multiplier present, namely increasing budget expenditures has a stronger effect on supply than it has on demand. In light of these significant results we conclude that the circumstances were so; that in Hungary during the examined period there were no observable Keynesian multiplier effects and growth was determined by supply, rather than by demand. The a_{21} parameter tells us whether or not Wagner's law [43] proves to be present in case of Hungary. A strongly significant positive value suggests that higher GDP is followed by higher budget expenditures in the following year. A more in-depth study of causal relationships will be continued by running Granger-causality tests later on. Finally, the value of a_{22} conveys information about the strength of control over the budget. A positive parameter means that the control is weak, so there is no effective upper limit that would prevent the expenditures from growing.

With help of the estimated values we calculate the eigenvalues, also presented in Table 3. These values determine the stability of the model, and the nature of the equilibrium. In case either of the values is bigger than the other, the equilibrium is saddle point. Although it says that the model is mathematically unstable, it does not mean that it is unstable economically as well. On the contrary, economic growth is only possible in the case of an unstable saddle path. Stable node equilibrium would mean that the economy evidently returns back to its origin point, which is the state of no GDP and budget. From an economical point of view that would be a collapse. According to the calculated eigenvalues the equilibrium in our system is saddle point.

In the case of a saddle-point equilibrium in order for there to be stability there has to be a constant expenditure/GDP rate. Examining the gradients of $\Delta Y_t=0$ and $\Delta G_t=0$ the phase diagrams tell us important implications about the way the economy can be brought back to the constant rate. As the gradient of $\Delta Y_t=0$ is larger than the gradient of $\Delta G_t=0$ so it follows that once expenditures have become too high, consolidation is only possible by sacrificing growth, thus depression is unavoidable in this case.

Finally, we study the impulse response functions, which not only describe the long term behaviour of our economy, but also provide visual interpretations of our previous findings. The functions are plotted in Figure 2. The starting

[42] As values of the VAR estimation correspond to the elements of the A matrix in /6/, the matrix notation will be used for future reference.
[43] Wagner, A. (1883): *Finanzwissenschaft*. Winter, Leipzig.

points of the functions correspond to the estimated matrix-values. An increase in expenditures is expected to have a positive and significant effect on itself for approximately 4 years. This might be interpreted as the rigidity of the budget. Furthermore, expenditures' negative effect on output seems to be long-term, but since it is not significant, further conclusions will not be drawn from this fact. Wagner's-law on the other hand seem to have a long-term significant effect, the positive relationship is still present after 10 years.

Our analysis is finished by addressing the issue of causality in Grangerian terms. As we indicated previously, almost all the reviewed literature study the causal aspect of the relationship and they also apply methodology introduced by Granger[44]. Since our time series are non-stationary, running the Granger-test on the previously estimated VAR model would be likely to distort the result. To circumvent this problem, we use the idea developed by Todo and Yamamoto (1995)[45] and add to the equations two further lags of both variables, as they are both integrated of the second order. When testing the significance of first lags, the null hypothesis is that there is no Granger-causality, so small p-values indicate causality. As for GDP causing expenditure the p-value is 0.677, whereas when the opposite is assumed, directionality it is 0.166. Based on these results we conclude that the relationship between the GDP and the government expenditures has not been a causal period in Grangerian terms during the examined period. However, it must be emphasized that in order to make econometric testing technically possible, we had to deviate from the original model that includes one lag.

EMPIRICAL EVIDENCE – THE EXTENDED MODEL

As explained earlier, changes are motivated by economic considerations and on the level of modelling they manifest as adding a constant. (see /7/) Otherwise we follow the same steps as we did with the original model and we present and contrast these results with the previous ones.

The newly estimated matrix-elements and eigenvalues are reported in Table 4. The matrix elements do not change enough to alter our general findings from the previous section. One big difference is though, that once we assume constant autonomous demand, significance of the estimated parameters decreases. As a result our previous conclusions about growth being driven by supply and no observable Keynesian multipliers lose ground. Results about the Wagner-law and the weak control over budget remain the same and significant.

[44] Granger (1969): op. cit.
[45] Todo-Yamamoto (1995): op. cit.

Table 4: **Results of VAR estimation with constant**[46]

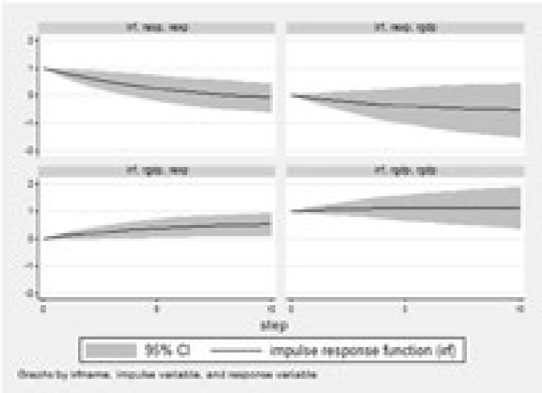
	Y	**G**
Y_{t-1}	1.041	0.104 *
S.E. p-value	0.057 0.481[47]	0.053 0.051
G_{t-1}	-0.102	0.806 ***
S.E. p-value	8.124 0.023	0.079 0.000
constant	18.499 **	0.866
S.E. p-value	8.124 0.023	7.602 0.155
eigenvalue	0.981	0.866

The other important difference is that the equilibrium in the extended model is stable node as opposed to the previous saddle point. Adding the constant to the equations means that the equilibrium does not necessarily have to be the origin point anymore. Thus stable node equilibrium becomes economically plausible in this new model framework, assuming it is in the positive quadrant and the equilibrium GDP is larger than its current level. This assumption is met if the equilibrium real GDP is 42.3% higher than the 2011 value. The computed equilibrium expenditure/GDP rate for the examined economy is 59.2%.

As shown in Figure 3, impulse response functions remain the same in all important aspects, only the effects become insignificant slightly faster. Consequently, effects seem to last for a shorter period when adding a constant. Finally, based on the result of Granger tests we still cannot reject that there is no causal relationship in either direction. In case of government expenditure causing output the p-value is 0.191, in the opposite direction it is 0.855.

[46] *** Significant at 1 percent ** Significant at 5 percent * Source: The authors' calculation.
[47] Null hypothesis is that the coefficient is not 1.

Figure 3: **Impulse response functions**



ECONOMETRIC EXTENSIONS OF THE MODEL

From an econometric point of view we were looking for estimation possibilities for the theoretical model instead of a strict econometric solution. However, finding a consistent and reliable methodology that unites both econometric and economic considerations proved to be a difficult task. Given the integration and co integration properties of the dataset the best solution from a statistical point of view would have been to construct the VAR model with the second differences of variables that are stationary. This solution, however, makes economic interpretations practically impossible. So we opted to remain in the framework indicated by the economic model, but consequently it limits the reliability of our results due to statistical concerns. One way out of this trap might be running unit root tests that allow for structural breaks and then revisit the question of co integration in the light of the result. It very well might be the case that problems we face at the moment are the results of structural breaks and thus can be solved. However, these estimated structural breaks are widely scattered, without any uniform focus around 1990. It also suggests a continuity of the Hungarian economy; and strengthens the legitimacy of the analysis over the 50 year period.

CONCLUSIONS AND SUMMARY

During the course of this writing we first tested the original model that was based on Keynesian assumptions about our economy. Short-run results imply that the Hungarian economy has been driven by supply rather than by demand. Also, since there was no observable Keynesian multiplier effect, this model implies that a circumstances are so, that based on the experiences of the past 50 years, a Keynesian fiscal policy is not likely to stimulate growth. However, this result is not backed by estimations of the extended model. This approach finds no significant evidence for the lack of Keynesian mechanisms, though it also fails to prove they were indeed present. The original implications, however, also fall more in line with the results of the Granger causality test, which concluded that no causal relationship exists running from expenditures to output. Even if our readers might not be entirely convinced by the results of the immediate responses, both of the models clearly predict the lack of significant expenditure effects on both mid- and on long-term.

On analysing the opposite direction of the relationship it is much easier to take a stance. Both models support the fact that GDP has a positive effect on the government expenditures not just in the short run, but it is still observable in 10 years' time. A similar unanimity is found in case of government control, but unfortunately no modelling alterations hide the fact that government expenditures tended to rise above their limits. Present strict EU regulations on debt and deficit measures might finally be able to put an end to this trend; however it assumes that previous leniency will not be resumed once the crises passes.

In terms of stability both approaches offer the prospect of economic stability and potential growth on the condition of committing to a certain equilibrium expenditure/GDP ratio that defines the saddle path. As co integration tests in the case of both models failed to show the existence of this constant rate, it is thus concluded that the economy has not been on its equilibrium path during the examined period.

When combining our results some potential traps materialize as results of the characteristics of our economy. We have seen that all our estimations confirm the tendency to exceed budget limits. Unless we manage to change it permanently, combining this fact with the mind-term rigidity of the budget and the unavoidable sacrifice in growth in the case of consolidations (implied by the equilibrium saddle path in the original model) we will constantly limit our possibility to grow. There may be disagreement about whether a rigorously enforced EU budget limit is the best policy when trying to restore growth in a serious global crisis, but in case of the Hungarian economy under normal circumstances it is definitely a long-run necessity to strengthen budget control in order to be able to meet potential growth prospects in the future.

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HUNGARIAN SUMMARY

A makroökonómiában központi kérdés a fiskális politika gazdasági növekedésre gyakorolt hatása, illetve általánosabban a kormányzati kiadások és a kibocsátás közötti kapcsolat. A tanulmány 1960 és 2011 közötti magyar adatokon VAR modell segítségével becsül egy kevert, keynesi-lucasi jellegű elméleti modellt. A kapott eredmények eltérnek egymástól mind az időtáv, mind a stabilitási feltételek tekintetében. Az ezek alapján levont főbb következtetések értelmében rövidtávon nem bizonyítható a keynesi folyamatok jelenléte, a Wagner törvény érvényesülése azonban bármely vizsgált időtávon erősen kimutatható. Az eredmények továbbá azt mutatják, hogy a stabilitás megvalósítható, ha a gazdaság egy meghatározott kiadás/GDP pályán mozog. Amennyiben ez a feltétel nem teljesül, akkor folyamatos konszolidáció válik szükségessé, ami elkerülhetetlenül növekedési áldozatokkal jár. Végül a dolgozat az idősorok alapos vizsgálata és a kapott eredmények értelmezése alapján lehetséges módosításokat javasol az ökonometriai modellezésben, melyek pontosabb becsléseket és megbízhatóbb válaszokat eredményezhetnek.

Lajos György Mátrai: Károly Kisfaludy, poet, writer and painter