

# **DOCTORAL (Ph.D) THESIS**

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## **EUROPEAN COMPARATIVE ANALYSIS OF PUBLIC FINANCES AND INFLATION (1997-2008)**

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## 1. Preliminaries and objectives of the study

The objective of the doctoral dissertation is to analyse the development level and budgetary situation of European states and to analyse and define the relationship between inflation rate and public balance. These two factors interact, thus, both directions of the relationship can be analysed, that is, *the influence of the change in inflation rate on public balance*, as well as, the impact of balance on inflation rate. Numerous theoretical approaches can be found in the literature considering mainly the second issue, while less can be read about the first issue. This was therefore the reason to address this problem in my dissertation, because new findings can be expected here. As the review of the literature had not revealed such study that analyses the whole issue, after having studied the theme in depth I set my objective to analyse the data of European countries between 1997 and 2008.

The addressed problem is not approached from the macro economic theory side, but from the side of *modelling and econometric analysis* with focus on the inflation rate, on the basis of the literature review. The basis for the *empirical analysis* is theoretical. I want to find out how strong relationship can be found between inflation rate and public balance, what is the direction of this relationship, what other factors influence the deficit *and to what extent* (public revenues, expenditure and interest expenses).

After the analysis of relationships in European countries, it will be possible to better understand the background processes and relationships; and possible directions of fiscal changes can also be revealed. As results of all the previous, the information to be achieved on the relations can help the countries to avoid unsustainable deficit and debt by considering the effects of inflation rate.

The findings of the research addressed the following questions:

1. How do the changes in inflation rate influence public balance; what mechanisms act and to what extent? Does the inflation rate change affect the public revenues and expenses?
2. What role do the state debt including paid interest macro economic situation and development state play in influencing the fiscal indicators?
3. What do the fiscal indicators and inflation look like in Hungary; where is the position of Hungary among the Visegrad Countries?

It is not easy though to answer the main question, since the involved countries experience different development, inflation, growth rate, seigniorage incomes and government debt, which basically influence the results of the analysis according to the previous. Every country is in different phase of its own development cycle; due to the convergence of real price levels, inflation rate is higher in a country with lower price level; therefore, in these countries higher government deficit is expected according to the theories. The question is whether the analysis to be done on the European countries will prove this statement.

## **2. Material and methods**

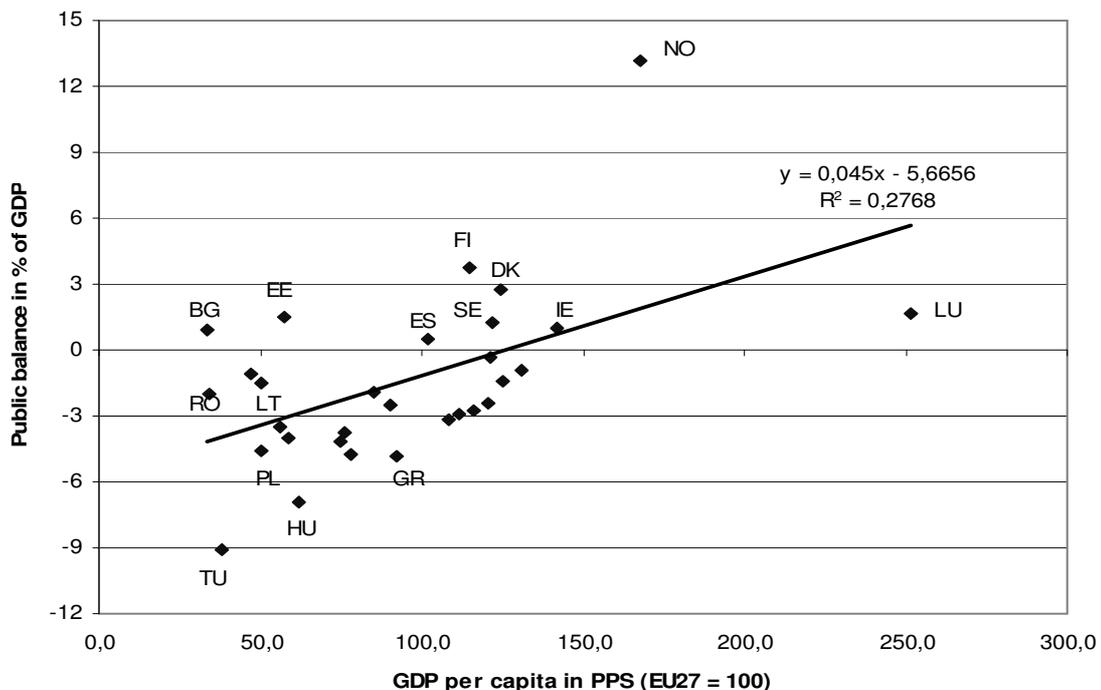
Eurostat data were used in all the analyses. The data cover the period between year 1997 and 2008; while earlier analyses of the author dealt with shorter periods, mainly between 1999 and 2007 and between 2001 and 2007. Besides the EU-27, Iceland and Norway were also investigated, and where data were available Turkey was included as well (as indicated later). Regression models were used to define the relationship between the variables; these were based on Microsoft Office Excel, SPSS and Gretl econometrical software. Multivariable statistical tools were widely used in the analyses: correlation and regression analysis, K-centred cluster analysis, principal component analysis and panel techniques (fix effect and random effect models) were used. The choice of variables involved in the analyses was made on the basis of available data, explanatory variables of similar studies and the questions to be answered.

### 3. Results

#### 3.1. Relationship between state of development and budgetary categories and inflation

Thus, the more developed a country is, the higher its revenue-to-GDP ratio is, therefore the better situation the government budget is in. Linear regression shows that public balance is determined by the development status of the country by 27.68 per cent; if the GDP per capita increases by 10 per cent of PPS, 0.45 percentage point better balance can be expected on average. Luxembourg, as the most developed country, is an outlier, while the similarly highly developed Norway poorly fits the regression model due to its outstanding government surplus. The budgetary situation of Bulgaria, Estonia and Finland is better than it could be expected on the basis of their development status; because they can be found much higher than the regression values. Compared to their development status, Turkey, **Hungary** and Greece have worse budgetary situation.

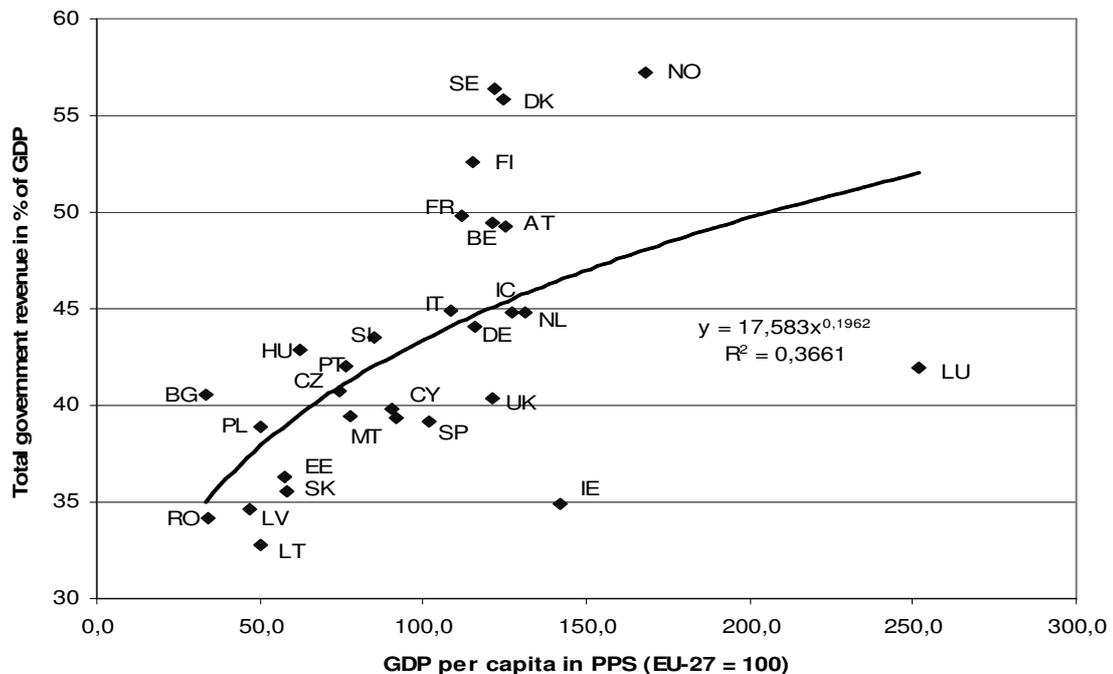
Figure 1: Public balance in the percentage of GDP depending on development status



Source: Own construction based on Eurostat data sets

According to the results, the more developed a country is, the higher is its revenue. On the basis of the regression model, if GDP per capita increases by 1 per cent, the revenue-to-GDP ratio will grow by 0.196 per cent in general. The Figure indicates that Scandinavian states (Finland, Sweden, Denmark, Norway) and France, Belgium and Austria have much higher revenues than that it could be expected according to their development level. According to the regression model a GDP-to-revenue ratio of approximately 45 per cent would be reasonable, considering the data of similarly developed countries (Cyprus, Italy, Germany, Iceland). Compared to its outstanding development, Luxembourg, as well as Ireland, has much lower government revenue than the regression value would indicate. The GDP-to-revenue ratio of the rest of the countries fits the regression model. It is important to note that the data of **Hungary** also fits the model, thus the government revenue of the country amounts to what can be expected on the basis of its development stage.

**Figure 2: Total government revenue in per cent of GDP depending on development status**

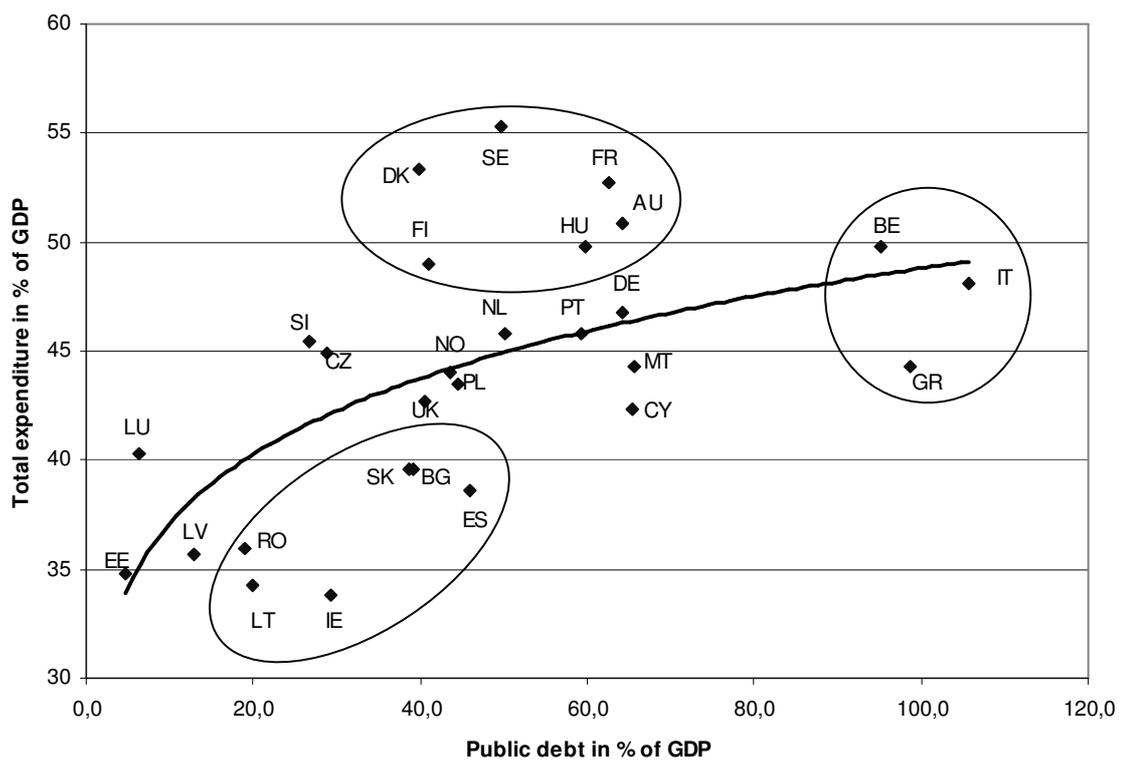


Source: Own construction based on Eurostat data sets

## Relationship between gross government debt and expenditure

In case of countries with low government debt (around 20 per cent ratio to GDP) the low expenditure is reasonable, however in some countries it is even too low (Romania, Ireland, Lithuania, Bulgaria, Slovakia, Spain). In case of a part of the countries with moderate debt (Denmark, Finland, Sweden, France, Austria and Hungary) expenditure does not correspond with the government debt; they have much higher expenditures. For the three countries with the highest debt (Belgium, Italy, Greece) the high expenditure is reasonable due to the presumably high interest to be paid.

**Figure 3: Total expenditure in per cent of GDP depending on the public debt**

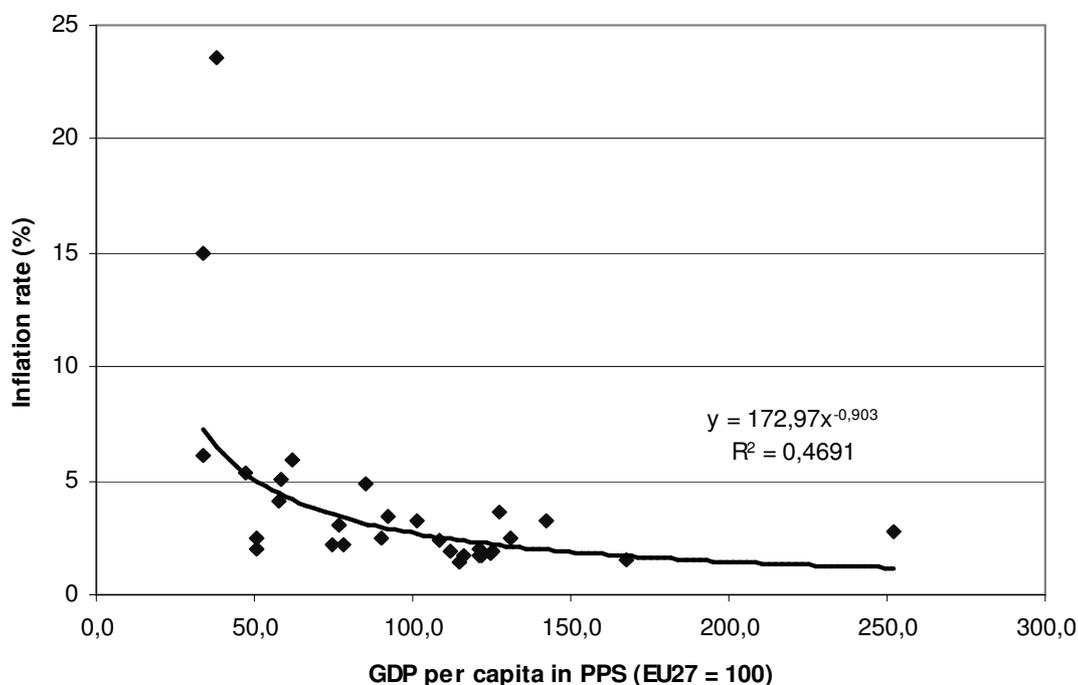


Source: Own construction based on Eurostat data sets

## Relationship between inflation rate and state of development

The analysis of the regression indicated that the best fitting regression model was the multiplicative regression model; the coefficient of determination was ( $R^2$ ) 46.91 per cent, that is the GDP per capita determines the inflation rate in 46.91 per cent. On the basis of the regression model, if GDP per capita increases by 1 per cent, the inflation rate decreases by 0.903 per cent per cent on average. Figure 4 shows the inflation rate in its relation with development level<sup>1</sup>.

**Figure 4: Inflation rate depending on development status**



Source: Own construction based on Eurostat data sets

### ***3.2. Development as a principal component***

Several variables are suitable for describing development, thus it is not easy to express its content with a single variable. The macro economic variables

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<sup>1</sup> The calculation was based on the average data of the EU27, Iceland, Turkey and Norway between 2001 and 2007.

of the countries to be analysed correlate with each other, therefore in order to avoid multicollinearity, these variables together cannot be involved in the analyses. Therefore, principal component analysis was chosen, which method groups more development related variables that bear similar content in one principal component; this principal component expresses the development with the use of complex information. Thus it becomes possible to differentiate the countries according to their development status on the basis of the created latent variable.

Based on the standardised<sup>2</sup> figures of gross domestic product per capita, relative price level, labour productivity, GDP real growth rate and unemployment rate the development variable was created with the use of the first three ones. The latter two variables weakened the results, therefore they were left out. The SPSS creates the development principal component as the linear combination of variables. The missing values were replaced by the means of the indicators.

$$Dev = 0,357 * z GDPcap + 0,36 * z labprod + 0,34 * z pricelev$$

On the basis of the above equation the annual development indicator of each country can be calculated. Due to the standardisation of the principal component, results above zero express a development status above the average, while those below zero mean development level below the average. The calculated figures varied between -1.95 and 2.5.

The principal component accounts for 89.42% of the total information (of the overall variation of the three variables). It determined 91.9% of the variance of GDP per capita, 93.3 % of that of labour productivity and 83.1% of that of relative price level. All of the three variables correlate closely (almost deterministic relationship) with development as a principal

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<sup>2</sup> This is implied by the letter „z” in the name of the variables.

component; which indicates that in case of developed regions the GDP per capita, labour productivity and relative price level are high.

According to the development indicator the analysed countries were grouped in four groups. The group “**low level of development**” consists of Bulgaria, the Czech Republic, Estonia, Lithuania, *Hungary*, Poland, Romania and Slovakia. Greece, Spain, Cyprus, Malta, Portugal and Slovenia belong to the group “**average level of development**”. The group of “**developed countries**” consists of Belgium, Denmark, Ireland, France, Italy, the Netherlands, Austria, Finland, Sweden, the United Kingdom and Iceland. Finally, Norway and Luxemburg belong to the group of “**most developed countries**”.

### ***3.3. The Effect of inflation on public balance***

Earlier analyses of the author showed no significant relationship of inflation rate with either the public revenues or expenses on the basis of data of the period from 1997 to 2008. In accord with the theory, the primary balance is not in relation with inflation either. Although, inflation influences interest expenses, its share within the total expenses is so low that its effect on the expenses-to-GDP ratio is insignificant. ***Significant correlation was found***, however, ***between inflation and public balance*** in the analyses.

$$publbal = 2,28 - 0,042 * infl + 2,59 * dev - 0,067 * debt$$

One percentage point increase in inflation, results in 0.042 percentage point decrease in the public balance, assuming that all influencing factors remain same. If a country’s development status improves by one unit<sup>3</sup>, 2.59 percentage point of improvement can be expected assuming constant inflation and debt rate. Finally, if debt-to-GDP ratio grows with 1

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<sup>3</sup> One unit equals to the difference in the development between Finland and Slovenia, the United Kingdom and Slovakia or Spain and Hungary in 2008.

percentage point, public balance is expected to decrease by 0.067 percentage point in average, assuming constant inflation rate and development.

When we leave development out of the model, the impact of inflation decreases and that of debt increases; with the following coefficients:

$$publbal = 2,24 - 0,031 * infl - 0,067 * debt$$

And if we want to get the pure effect of inflation on its own, the following equation is given:

$$publbal = - 0,983 - 0,0292 * infl$$

The effect of inflation has got even slighter, thus, if inflation rate increases by 1 percentage point, public balance decreases by 0.0292 percentage point on average.

### ***3.4. The Situation of Hungary and comparison with the Visegrad Countries***

Given its *development* status, Hungary is in a worse budgetary situation, while its public *revenues* harmonise with its development level. From the aspect of *debt rate* and *expenditure ratio*, Hungary seems to be similar to more developed countries (high government debt, high expenditure ratio), while from the aspect of *inflation rate* it is closer to less developed countries (high inflation rate). This results in the least favourable position. Hungary's budgetary situation and inflation rate are unfavourable not only from a European view, but it can also be stated that Hungary is in the worst position in comparison with the other Visegrad Countries.

According to the average figures of the period from 1997 to 2008, the upper quartile *inflation* group of the countries contains Estonia, Poland, Lithuania, Slovenia, Slovakia, Bulgaria, Hungary and Romania. It is almost the very same as the group of countries with "low level of development". According

to its *development* status, Hungary is mostly similar to Estonia and the other Visegrad Countries. However, the inflation rate is lower in these countries, especially that of the Czech Republic.

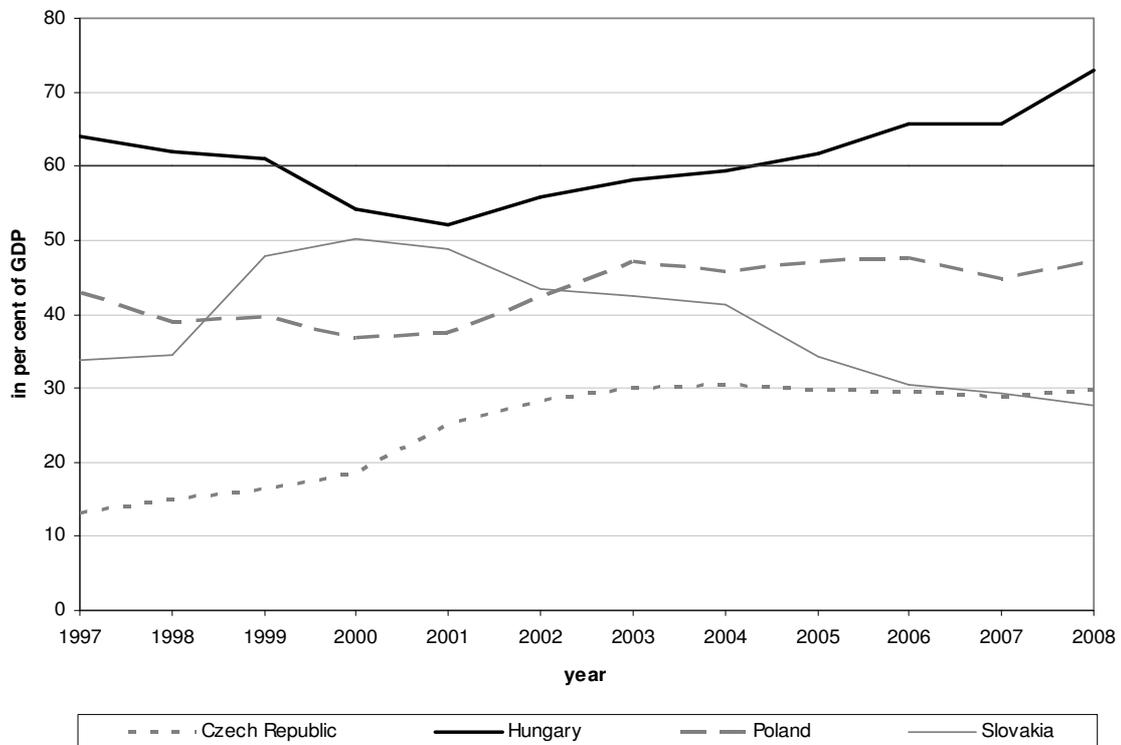
According to the grouping by *debt rates*, Hungary is in the group of Germany, France, the Netherlands, Austria, Portugal, Malta and Iceland, which have lower inflation rates. Those countries however, that have the similar development status to that of Hungary, have similar inflation rates but lower debt rates. On the basis of the *public balance*, Romania, Portugal, the Czech Republic, Poland, Greece, Slovakia and Malta and at the end Hungary belong to the lower quartile. This suggests that the Visegrad Group Countries have similar government deficits; therefore the comparison was made with the Czech Republic, Slovakia and Poland. In order to consider all of the fiscal factors, the countries were grouped with the use of k-centred cluster analysis on the basis of *government debt, public balance and the expenditure and revenue ratios*. It was found that higher deficit belongs to the group of countries with higher debt, naturally; and the expenditure and revenue ratios are higher, as well. Bulgaria, Hungary, Poland, Slovakia belong to this group, while the Czech Republic, Estonia, Latvia, Lithuania, Romania and Slovenia belonged to the other group with better figures. The results obtained here are similar to earlier findings of the author, to the effect that the Czech Republic is in a better fiscal situation than the rest of the Visegrad Countries.

The comparison of the Visegrad Countries showed that Hungary is in the worst position in all aspects of the analysis; however the differences became gradually smaller. This is naturally due to also the facts that these countries addressed the Maastricht convergence criteria, their economies have stabilised, the economic environment became more predictable and the

development of the countries has converged; all which have led to better and converging indicators.

The main problem in Hungary in my opinion is that debt rate has continuously increased since 2001 (exceeding the reference level of 60% in 2005), even despite that the implicit interest rates sharply decreased during the last 12 years; although, compared to the other three countries, Hungary still finances its debt from loans with too high interest rates. Although, there has been a significant improvement seen in the primary balance, thus in the government deficit from 2006; the real GDP growth rate is far behind both those of the previous years and the other Visegrad Countries; and in 2008 even the nominal growth rate was lower than that of them. In my opinion, there is a need for change in the fiscal policy, because in the past years Hungary experienced unsustainable fiscal results which can not be left out of consideration. Thus, adjustment is unavoidable.

**Figure 5:** Debt-to-GDP ratio of Visegrad Countries, between 1997 and 2008



Source: own construction based on Eurostat data

### ***3.5. Factors determining the public balance in the Visegrad Countries***

Although *significant correlation was not found between the public balance and inflation rate* based on the data between 1997 and 2008, however, three models could be created with the factors determining the public balance:

$$a., \text{publbal} = 2,78 - 0,075 * \text{debt} + 4,37 * \text{dev}$$

$$b., \text{publbal} = -0,98 - 0,05 * \text{debt} - 0,235 * \text{impl intrate}$$

$$c., \text{publbal} = -4,84 - 0,59 * \text{intexp/GDP} + 0,41 * \text{realgrowth}$$

Comparing the coefficients with those obtained in the European analysis, I found difference in the development: it was 2.59 in the previous analysis, while the rest of the variables seem to have almost the same effect on the public balance, generally, in the European countries. It can be stated, thus, that government debt rate, implicit interest rate, interest expenditure to GDP ratio and real growth result in almost same change in the public balance in the analysis of the 29 countries as in case of the analysis of the Visegrad Countries. Accordingly, these effects are the same within the group as well; however, the country level data are highly heterogeneous.

## 4. Conclusions and Recommendations

The objective of the doctoral dissertation was to analyse the development level and budgetary situation of European states and to analyse and define the relationship between inflation rate and public balance. Due to the interaction of these factors, both directions of the relationship can be analysed. I wanted to know what *the effect of the change in inflation rate on public balance* is. Numerous theoretical approaches can be found in the literature considering mainly the second issue, while less can be read about the first issue. The addressed problem was not approached from macro economic theory side, but from the side of *modelling and econometric analysis* with a focus on the inflation rate, on the basis of a literature review. The *empirical analysis* is based in theoretical background. After the analysis of relationships in European countries, it will be possible to better understand the background processes and relationships. Thus the information on the relations can help the fiscal policy to become sustainable by considering the effects of inflation rate.

I have found that the more developed a country is, the higher its revenue-to-GDP ratio is, therefore, the better situation the government is in and the lower the inflation rate is in the country.

It was also found that in the European countries (between 1997 and 2008) inflation rate has no relationship with revenues and expenditure, nor with the primary balance, but it does have impact on public balance. Based on several models it can be stated that if inflation rate increases by 1 percentage point, the public balance worsens by an average 0.03 percentage point, assuming that the other variables remain the same. Contrary to this, the analysis of the Visegrad Countries did not show the same results. Among the factors influencing the public balance, government debt, development

level, implicit interest rate, real growth rate and interest expenses to GDP ratio were listed; similarly to the European countries.

***Compared to similarly developed countries, inflation rate and government debt are higher in Hungary.*** Therefore, it is difficult to compare the public balance. According to its ***development*** status, Hungary is mostly similar to Estonia and the other Visegrad Countries. However, the inflation rate is lower in these countries, especially that of the Czech Republic. From the aspect of ***debt rates***, the comparison of budgetary situations of these countries is not possible on the basis of the average figures; because the debt rate is 61% in Hungary on average, while it is much lower in the other countries. The government deficit figures of the Visegrad Countries are similar; therefore Hungary was compared to the Czech Republic, Slovakia and Poland. The comparison has led to the result that Hungary is in the worst position from the aspects of its inflation rate and budgetary situation. The differences between the analysed countries became gradually smaller during the period analysed.

The main problem in Hungary is the rapid growth rate of the government debt, which is no longer sustainable.

Further questions must be answered in the future, beyond review of the current results, considering the variation due to cycles and political factors (effects of the years of election) as well; as well as the activity rate, the proportion of internal and external debts and long-term interest rates. That is, all those factors that were left out of the analyses of the dissertation. The analysis should not ignore the impact on the current account either. Including all these factors may result in a better picture about the relationship between public balance and inflation. As I emphasised earlier it is also necessary to include dynamics in the analyses in order to create a more exact description of the processes. My further aim is to set up a

dynamic model on the analysed factors, which better reveals the relationships of economic processes. This model will be suitable to define the interactive relationship of public balance and inflation rate.

The objective of the dissertation was neither to give recommendations widely applicable and acceptable for economic policy nor to give advice for decision makers. Because it is not proven that the results obtained apply to not every circumstance; hence at best only a period of 12 years was covered in the analyses, therefore the conclusions need to be treated conditionally and the results definitely need to be re-considered later on. The objective of the research was to reveal the relationship of the analysed factors, with the assumptions of the given conditions. The main question focused on the determining factors of the budget, placing inflation into the centre. In the calculation of the impact many variables were needed to be considered; thus the author faced many types of difficulty, because the involved countries experience different development, inflation, growth rate, seigniorage incomes and internal debt. Every country is in different phase of its own development cycle; due to the convergence of real price levels, inflation rate is higher in a country with lower price level; which is accompanied with higher government deficit, expectedly, according to the theories. This statement was proven in the analyses of the European countries, but it was not true for the Visegrad Countries. In case of Hungary (on the basis of data of only 12 years) even the opposite was seen to happen. As I have pointed out in the dissertation in depth, many authors had already explained the particular tasks to do, however these recommendations were not heard yet; my intention is to strengthen this impulse that there is no more time left to wait and the change is necessary; efforts need to be made to stabilise fiscal policy and to sustain it along with achieving and then maintaining monetary stability.

In subsequent work I will consider what phase of the conjuncture cycle the analysed countries are in; the impact of the years of parliamentary elections; the difference between the share of superannuation within the expenditure across countries; and the ratio of the elderly people within the population or the activity rate. As further factors, the impact of taxation can be also considered; this has an impact on the balance of payment on current account as well. Including all these factors in the analysis may result in a better picture about the relationship between public balance and inflation.

## 5. New scientific results

1. On the basis of average figures of the period between 2001 and 2007, I have found that the more developed a country is, the higher its *revenue-to-GDP* ratio is; therefore the better its *budgetary situation* is. If GDP per capita increases with 10 percentage points, public balance improves with 0.45 percentage point in average and if GDP per capita improves 1 percent, *revenue-to-GDP* ratio improves with 0.196 percentage, expectedly. In the European countries, if *GDP per capita* increases with 1 percentage point, *inflation rate* decreases with 0.903 percentage point in average; this coefficient was 0.86 in case of Hungary.
2. Based on standardised figures of gross domestic product per capita, relative price level and labour productivity, I have created the “development indicator” which was used to group the countries. According to the development indicator the analysed countries were grouped in four groups. The group “**low level of development**” consists of Bulgaria, the Czech Republic, Estonia, Lithuania, *Hungary*, Poland, Romania and Slovakia. Greece, Spain, Cyprus, Malta, Portugal and Slovenia belong to the group “**average level of development**”. The group of “**developed countries**” consists of Belgium, Denmark, Ireland, France, Italy, the Netherlands, Austria, Finland, Sweden, the United Kingdom and Iceland. Finally, Norway and Luxemburg belong to the group of “**most developed countries**”.
3. On the basis of 29 countries’ data between 1997 and 2008 I have found significant correlation between inflation rate and public balance. Based on several models it can be stated that if inflation rate increases with 1 percentage point, the public balance worsens by 0.03

percentage point in average, assuming that the other variables remain the same. Government debt as influencing factor of public balance was found an important element in the analysis (with a coefficient around 0.06). Significant relationship between public balance and inflation rate was not found, although, in the Visegrad Countries. However, among the factors influencing public balance government debt, development level, implicit interest rate, real growth rate and interest expenses to GDP ratio were listed; similarly to the European countries.

4. Given its *development* status, Hungary is in a worse budgetary situation, while its public *revenues* harmonise with its development level. From the aspect of *debt rate* and *expenditure ratio*, Hungary seems to be similar to more developed countries (high government debt, high expenditure ratio), while from the aspect of *inflation rate* it is closer to less developed countries (high inflation rate). This results in the least favourable position. Hungary's budgetary situation and inflation rate are unfavourable not only from a European view, but it can also be stated that Hungary is in the worst position in comparison with the other Visegrad Countries.

## 6. List of publications related to the Phd research

### *Refereed papers published in science journals:*

1. **Somogyi, Patrícia** (2006): Olaszország inflációjának regionális elemzése (2000-2004), Acta Scientiarum Socialium, Tomus XXI.-XXII./2006. Kaposvár, pp. 129-148.
2. **Miklós-Somogyi, Patrícia** (2007): A költségvetés egyenlege és az infláció kapcsolata, Acta Oeconomica Kaposváriensis, Vol 1., No. 1-2, Kaposvár, pp. 165-174.
3. **Miklós-Somogyi, Patrícia – Balogh, László Ph.D.** (2009): The relationship between public balance and inflation in Europe (1999-2007). Bamberg Economic Research Group on Government and Growth, Working Paper, Bamberg University, Bamberg, Germany. 2009. június
4. **Miklós-Somogyi, Patrícia – Balogh, László Ph.D.** (2009): Költségvetés és infláció európai összehasonlító elemzése (1999-2007). Közgazdaság, Budapesti Corvinus Egyetem, Budapest. Under issue.

### *Presentation:*

1. **Miklós-Somogyi, Patrícia** (2007): Infláció és adózás. Előadás a Kaposvári Egyetem 1. Gazdaságtudományi Konferenciáján. 9 november 2007