The impact of inflation on economic growth: The case of Eurozone

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Abstract

The main purpose of this study is to investigate inflation rate and its impact on the growth rate or to GDP growth for Eurozone countries, using panel data for the period 1997-2017, on an annual basis with a total of 257 observations. For conducting the study, and achieving results, a multiple linear regression model with the least squares regression is used. Moreover, multiple linear regression analysis has been applied in order to investigate whether Inflation rate_{it} as an independent variable_{it} has any significant impact on economic growth. Consequently, in order to test the data used in the model we have applied diagnostic tests, such as Durbin-Watson test to analyze the correlation of serial correlation, as well as the Breusch-Pagan test for heteroskedasticity. The tests' results give us strong indications that the model has no relation between of serial correlation and there is no heteroskedasticity either. The study conducted shows results generated from the model, and according to the econometric results indicate that Inflation rate has positive impact on the economic growth rate for euro area.

Keywords: Inflation Rate, GDP Growth Rate, Deficit to GDP, Government Bond Yield, Regression

JEL classification: E31, O42, H62, E43, C33

Introduction

The paper attempts to analyse inflation rate, its impact on the growth rate or the GDP (Gross Domestic Product). Today most of countries in order to achieve sustainable economic growth are required to have price stability. Price stability still remains one of main objective extracted from macroeconomic policies of these countries. The growth rate and the global economic rate of inflation are always on the move, and to achieve a stable economic growth, the relationship between inflation and economic growth continues to be one of the issues considered problematic in the macroeconomic domain (Kasidi and Kenani, 2012). When it comes to the relationship between the inflation rate and the economic growth rate, the professional literature is revived, it noticed that in the previous economic theories came to the conclusions that there is no relationship between these variables. But today the opinion has changed and nowadays there is a consensus that economic growth and inflation variable are associated. Consequently, in periods with low inflation rate, it will certainly have economic growth, and when the inflation rate passes double-digits or in periods when there is a higher inflation rate, this would also hurt the economic growth trends. In this study, the panel data is used with data for seventeen (17) Eurozone countries covering a relatively long period of time and sufficient and accepted standards which attempt to produce professional and accepted results.

Our hypothesis is that Inflation rate has a positive impact on economic growth. In order to assess it for the purpose of this study for the purpose of the results to from the study to be more real, along with inflation rate and economic growth there are other data (variables) used too, such as budget deficit rate, government bond yields and unemployment rate. The structure of the paper includes literature review, methodology analyses, empirical data and analysis, conclusions and references.

Literature Review

When we review economic thoughts during the last century on the relationship between inflation rate and economic growth, especially periods before the 1970s, we noticed that there were continued debates over the relationship between these variables, and in this regard, at that time it was an accepted common opinion among researchers and macro policy makers that there is no positive correlation between the economic growth and the inflation rate. This widely acknowledged opinion at that time emerged from the context of economic development in Latin American countries during those periods (Behera, 2014), now this opinion has begun to change over the coming years. Nowadays, the results coming from the majority of studies, the results show that there is a correlation between inflation rate and economic growth. However, if we analyze the literature in details there are two issues worth pointing out:

- Firstly, it is widely accepted that there is a threshold of a certain inflation rate, whereby economic growth from the positive one begins to take negative direction, and
- Secondly, there is *no accepted opinion* on what is the optimal level or, putting it differently, what is the rate of inflation when economic growth begins to take negative paths.

Fischer (1993) used inter-sectorial and panel data for developed and emerging economies, where he also made a significant contribution to the literature which explored the relationship between inflation and economic growth in the long term, and according to his study findings, there is a significant negative correlation between inflation and economic growth. Barro (1995) assessed the effects of inflation on economic performance using data from 100 different countries covering the period 1960-1990, and in this study, he concluded that: if a number of variables are kept constant, according to the results of the regression that he used for the study, he concluded that an increase in average inflation of 10 per cent per year reduces the real GDP growth rate from 0.2 to 0.3 per cent per annum and simultaneously reduces the ratio of investments to GDP from 0.4 to 0.6 per cent.

Ghosh and Phillips (1998) claim that there is no doubt that high inflation is detrimental to economic growth, while this inflicting effect is less pronounced when it comes to moderate inflation rate. They have used a regression panel data and have found a significant opposite relationship between inflation and economic

growth, which exist excessively in all inflation rates, except for very low ones. Similarly, based on studies of Hasanov (2010), who used the annual data on the real GDP growth rate, the Consumer Price Index and the Gross Fixed Capital Formation growth rate in order to assess whether there is any threshold impact of the inflation rate in economic growth over the period 2001-2009. The results from the model showed that there is no linear relationship between inflation and economic growth in the economy of Azerbaijan. For example, while the level of the inflation rate is 13 per cent, the impact on GDP growth reflected in positive economic growth, while in the period when the inflation rate in the economy exceeded 13 per cent, economic growth expected to decrease by about 3 per cent. Nell (2000), using Vector autoregressions (VAR) technique, tested whether the issue of inflation was detrimental to economic growth or not. He used data for the period 1960-1999 and that his empirical results suggested that inflation within the one-digit could be beneficial to economic growth, while inflation over double-digits tends to limit economic growth. Sergii (2009), concluded that the relationship between economic growth and inflation has strictly a concave form with a so-called inflation threshold level. The main finding from this study was that the 8 per cent inflation rate tends to slow economic growth, while it under 8 per cent stimulates economic growth. When it came to the literature review, we note that, regardless of previous economic theories where there is no relationship between inflation and economic growth, today there is consensus in the opinion that economic growth and inflation are associated. Consequently, in periods with low inflation, it will certainly have economic growth, and when the inflation rate passes double-digits or in periods when there is a higher inflation rate, this would also hurt the economic growth trends of a particular country.

Methodology of analysis

The data used in the framework of this analysis are indicators or macroeconomic financial indicators, published by the Statistical Office of the European Union or Eurostat. Based on the professional literature there are three types of quantitative data suitable for analyzing financial phenomena, namely: time series, panel data, and cross-data.

In our paper, we have used panel data for seventeen (17) countries from the Eurozone, which cover a relatively long period, are also sufficient, accepted with standards, and enable us to produce useful results. The study has captured data for seventeen 17 Eurozone countries such as GDP Growth Rate, GDP deficit, Inflation Rate, Government Bonds Yields and Unemployment Rate. The data collected and then processed for the needs of the study presented on an annual basis for the period 1997 to 2017 with a total of 20-year periods with 357 observations. Data are tested on a yearly basis for a period between 1997 and 2017, so this is the reason that three different historical periods of these countries are included:

- There is a period when the Eurozone countries attempt to fulfill the Economic Criteria's derived by the Maastricht Treaty, also known as the Convergence Criteria (1995-1999),
- The period of the Euro introduction as the single national currency (1999-2002), and
- The period of Global Financial Crisis, respectively the so-called European sovereign debt crisis (2008-2015).

Empirical data and analysis

In this paper time series data is used and due to the advantages, this technique helps analyze the behavior of each determinant over time (Baltagi, 2005), (Gurajati, 2003). The linear regression model is used to determine the relative importance of each independent explanatory variable in impacting dependent variable. The general linear regression model is:

$$y = \beta_0 + \beta_1 x + \varepsilon$$

Starting from the general model and taking into account the selected variables, the empirical model used is:

$$\text{GDP growth}_t = C + \beta_1 \text{Inflation rate}_t + \beta_2 \text{Deficit to GDP}_t + \beta_3 \text{Government bond yields}_t + \beta_4 \text{Unemployment rate}_t + \varepsilon$$

The empirical approach to carrying out the study will result in descriptive data analysis is selected to assess the variations in different periods. Within the descriptive statistics, we have analyzed the movements for the dependent variable GDP growth rate and the independent or explanatory variables that are included in the regression model. Descriptive statistics are as follows: number of observations, minimum, maximum, average, standard deviation and variances that reflected in the table below.

Table 1: Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
GDP growth rate	357	-14.8000	26.3000	2.633898	3.9493942	15.598
Inflation	357	-4.5000	39.7000	3.058543	4.0031050	16.025
Deficit to GDP	357	-32.1000	6.9000	-2.822969	3.8733937	15.003
Govern. Bond yields	357	.4000	22.5000	4.838235	2.3341508	5.448
Unemployment rate	357	1.5000	25.4000	8.218207	4.1340093	17.090
Valid N (list wise)	357					

Source: Authors 'calculations

Based on the results generated by the model employed, the GDP growth rate has a mean value of 2.63 per cent with a standard deviation of 3.94 per cent. While, the minimum and maximum value is - 14.8 per cent, respectively 26.3 per cent with a variance of 15.59 per cent. While the explanatory variable, which is the essence of this study - Inflation Rate has an average value of 3.06 per cent and which has a standard deviation of 4.00 per cent. The minimum value achieved with the inflation rate is in the value of - 4.50 per cent that was achieved by Ireland in 2009, while the maximum value achieved was 39.70 per cent, achieved by Lithuania in 1995 with a variation of 16.02 per cent. The other explanatory variable deficit to GDP ratio based on the generated results has an average value of -2.82 per cent with a standard deviation of 3.87 per cent. The minimum value of the deficit to GDP ratio reached - 32.10 per cent in 2010 from Ireland, while the maximum value was 6.90 per cent in 2000 from Finland, with a coefficient of variation of 15.00 per cent.

Government Bonds Yields variable within our analysis reached the average value of 4.83 per cent with a standard deviation of 2.33 per cent. While the minimum value and the average reached, is 0.40 per cent, respectively 22.50 per cent with a variance coefficient of 5.44 per cent. The minimum value of the government bond yields ratio reached in 2009 from Luxemburg, respectively the maximum value reached in 2012 by Greece. While the latest variable applied in our econometric model is unemployment rate, which the average rate has reached 8.22 per cent in the euro area countries with a standard deviation of 4.13 per cent. The minimum unemployment rate in our analysis reached in 2001 to 1.50 per cent by the state of Luxemburg, the highest achieved unemployment rate was reached by Greece in 2013 in the value of 25.40 per cent.

Table 2: Correlation analysis

		GDP growth rate	Inflation	Deficit to GDP	Govern. Bond yields	Un- employm. rate
GDP growth rate	Pearson Correlation	1				
Inflation	Pearson Correlation	.185**	1			
Deficit to GDP	Pearson Correlation	.410**	.052	1		
Govern. Bond yields	Pearson Correlation	-.197**	.138**	-.290**	1	
Un-employment rate	Pearson Correlation	-.125*	.044	-.429**	.321**	1
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

Source: Authors 'calculations

Table 2 presents the correlation matrix that enables to summarize the correlations between all variables (Büyüksavarcı and Abdioğlu, 2011). Based on the results coming from the variables used in correlation matrix, there is a positive correlation between GDP growth rate in relation to the inflation rate and the deficit to GDP ratio with a confidence level of 99.9 per cent. The correlation between these two variables is 0.185 **, respectively 0.410 **. There is a negative correlation between the GDP growth rate with government bond yields at confidence level of 99.9 per cent and with a coefficient of - 0.197 ** and with the unemployment rate there is a negative correlation at confidence level of 95.0 per cent with a coefficient of -0.125 *. These negative correlations imply that the higher these ratios will affect the reduction of the GDP Growth Rate ratio within the group of 17 Eurozone countries. The inflation rate has a positive correlation with deficit to GDP, but this correlation is not significant. The significant positive correlation is between unemployment rate and government bond yields at 99.9 per cent confidence level with 0.138 ** coefficient, also a significant non-significant correlation with the unemployment rate at 0.044 coefficient. deficit to GDP ratio has a negative correlation with the confidence level of 99.9 per cent with two variables, with the government bond yields ratio with a coefficient of -0.290 ** and with the unemployment rate with a coefficient of -0.429 **. Based on a review of the literature and a common financial sense, any increase in these two ratios affects the reduction of the deficit to GDP Ratio, And finally, within our analysis, the ratio of government bond yields has resulted to have a positive correlation to 99.9 per cent confidence level, with a coefficient of 0.321 **.

Model Summary

The following table (number 3) presents the summary of the linear regression model with the following data: R, R² and R² adjusted, standard error evaluated and Durbin-Watson test. The results obtained from the model data show that the dependent variable has a strong correlation with the explanatory variables at the level of .463, respectively 46.3 per cent. While R² in our analysis is .214, which indicates that 21.4 per cent of the dependent variable explained by independent variables.

Table 3: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.463 ^a	.214	.205	3.5212930	1.567
<i>a. Predictors: (Constant), Unemployment rate, Inflation, Govern. Bond yields, Deficit to GDP</i>					
<i>b. Dependent Variable: GDP growth rate</i>					

Source: Authors 'calculations

The standard error estimated in the summary of the model has been 3.52 per cent. In our analysis for the verification of model stability, serial correlation, F-test and the Breusch-Pagan and Koenker test is used. The Durbin-Watson correlation value may range from zero (0) to four (4). If the Durbin-Watson value is approximately zero, then the serial correlation indicates that the data in the model have a high positive impact between the residual values. If the Durbin-Watson correlation offered, a value of four (4), it indicates that the data have a negative serial correlation. The model can be considered stable when the Durbin-Watson results are close to the value range of two (2). The Durbin-Watson test considered to have no serial correlation within the range of 1.5 to 2.5, indicating that the residual value has no serial correlation or there is no autocorrelation between the residual values. Therefore, based on this interval, the findings in our study show that Durbin-Watson is in the value of 1.567, which is within the interval value, and it can be considered that the model used is stable.

F-test equals .000 indicates that all coefficients together are statistically significant and different from zero. Also, correlation statistics show that the VIF factor with the highest value at the regression coefficients is 5.12, meaning that all independent variables are less than 10 ($VIF < 10$). Different empirical studies provide various arguments about multicollinearity. Thus, Mahorta (2007) emphasized that multicollinearity problems exist when the coefficient of correlation between variables is more than 0.75. (Cooper and Schindler, 2006) have suggested that the correlation below 0.80 between the additive and explanatory variables should have proper correlation and influence. Finally, Hair et al (2006) argue that the coefficient of correlation even below 0.90 cannot cause any serious multicollinearity problem. Multicollinearity results indicate that independent variables do not have any lasting relationship between them, and there is no need to change any of the variables in the applied regression model. Based on studies and rules on the Breusch-Pagan and Koenker tests, known as the White-White test, if the result of this test is lower than 0.05, then it is suggested that the withdrawal of the null hypothesis be made. In our analysis, the results of this test are as follows:

Table 4: Breusch-Pagan and Koenker test

	LM	Significance
Breusch-Pagan	30.177	0.051
Koenker	6.584	0.160

Source: Authors 'calculations

Null hypothesis: heteroscedasticity not present (homoscedasticity). Based on all these tests, we can conclude that the model applied in our case is quite stable.

Table 4: The results of coefficients.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	3.613	.518		6.977	.000
	Inflation	.224	.059	.185	3.812	.000
	Deficit to GDP	.404	.055	.396	7.357	.000
	Govern. Bond yields	-.244	.088	-.145	-2.786	.006
	Unemployment rate	.085	.052	.089	1.642	.101
a. Dependent Variable: GDP growth rate						

Source: Authors 'calculations

Findings

The generated econometric results show that Inflation Rate variable is statistically significant with a confidence level of 99.9 per cent with a positive impact ($P = .000$). This means that any increase in the Inflation Rate has a positive impact on economic growth rate. Based on our findings from the econometric model used, and comparing them with the empirical evidence derived by studies of various authors, also outlined in the literature review, we find that our conclusions are in accordance with those authors' research like Hasanov (2010), which has used the annual data of the real GDP Growth rate, where the results from the model showed that there was a non-linear relationship between Inflation and economic growth in Azerbaijan's economy and that while the level of inflation rate was 13 per cent impact on GDP growth reflected in positive economic growth. The deficit to GDP indicator is statistically significant with a confidence level of 99.9 per cent positive impact ($P = .000$). Based on the results generated for this indicator, it indicates that any increase in the deficit to GDP ratio has a positive effect on economic growth. Our findings are in line with the findings of similar models by a considerable number of authors such as Nayab (2015), where with co-integration techniques, the VAR Granger maturity test and the error correction model; found that the budget deficit has a significant positive impact on economic growth. According to the same study, results also support the Keynesian view on budget deficit. Adam and Bevan (2005) show results that the budget deficit of 1.5 per cent of GDP will have a positive impact on economic growth. Cinar at al. (2014) analyzed a group of five countries with a debt ratio for the lowest GDP and five other countries where the debt ratio was large in the euro area for the period 2000 - 2011, with the help of the ARDL panel model they found that deficit policy had a positive effect on economic growth in the short term. Loizides and Vamvoukas (2005), using the data set for Greece, the UK and Ireland, he concluded that in all countries that research has been conducted, the fiscal deficit affects economic growth.

The generated results show that the government bond yields variable is statistically significant with a confidence level of 99.9 per cent with a negative impact ($P = .006$). Based on the generated results, the effect of government bond yields has a negative impact; any increase in this indicator has a negative effect on the decline in economic growth. The results of our study are in line with the results of Hansen and Seshadri (2013) studying the long-term relationship between real interest rates and economic growth, while using US annual data on real interest rates, labor productivity, real growth revenues and real GDP growth for the period 1901-2011. Their findings from this study show that there is a "negative average" correlation between the ratio of interest rates and economic growth. Finally, the Unemployment Rate has not been statistically significant in economic growth, as the value of the P-value is ($P = 0.101$) and as such has no effect on economic growth.

Conclusions

If we refer to the results of our econometric analysis according to the panel data model, it is shown that the Inflation Rate variable is statistically significant with a confidence level of 99.9 per cent with a positive sign ($P = .000$). As a result, the inflation rate has positive impact on the growth rate. Moreover based on our findings from this and comparing with similar models of literature review - empirical evidence of different authors we noted that our findings are in line with number of studies from various authors such as Hasanov (2010), which used the annual data of the real GDP growth rate, where the results from the model showed that there was a non-linear relationship between inflation and economic growth and that while the level of inflation rate was 13 per cent the impact on GDP growth was reflected in positive economic growth. Moreover, Barro (1995) made an assessment of the effects of inflation on economic performance concluded that if a number of country characteristics are kept constant, then an increase in average inflation of 10 per cent per annum reduces the real GDP growth rate by 0.2 to 0.3 per cent per annum and at the same time so the ratio of investments to GDP grew from 0.4 to 0.6 per cent

Ghosh and Phillips, (1998) claim that when we have a moderate inflation rate, this is not detrimental to economic growth. Whereas, Sergii, (2009) concluded that the growth and inflation interaction was strictly concatenated with a so-called Inflation Rate, where the inflation rate of 8 per cent tends to slow economic growth while it is below 8 per cent encourages economic growth. In our case, analyzing the results from the econometric model with the data used for Eurozone area in, we conclude that the 1 per cent increase in Inflation Rate ratio contributes to growth of 22.4 per cent points in the Growth Rate if all other variable are kept constant. The results coming from the data used, also are as consequences that Eurozone countries have applied rules deriving from the Convergence Requirements - the Maastricht Criteria which has required that member states have a rate of moderate Inflation Rate in order to stimulate consumption and economic growth.

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