Assessing How Inflation Impacts Economic Growth in the Eurozone

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Abstract
This study investigates the inflation rate and its effect on GDP growth within Eurozone countries, using panel data from 1997 to 2017, totaling 257 annual observations. To analyze the relationship, a multiple linear regression model with least squares estimation was employed. The study applied multiple linear regression analysis to determine whether inflation, as an independent variable, significantly impacts economic growth. To ensure the reliability of the model, diagnostic tests such as the Durbin-Watson test for detecting serial correlation and the Breusch-Pagan test for heteroskedasticity were performed. Results indicate that there is no serial correlation or heteroskedasticity affecting the model. The econometric findings suggest that inflation positively influences the economic growth rate in the Eurozone.

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

Introduction

This paper aims to analyze the inflation rate and its impact on economic growth, specifically focusing on GDP growth. In today's global economy, price stability is a critical requirement for countries striving to achieve sustainable economic growth. Maintaining price stability remains one of the principal objectives derived from macroeconomic policies across nations. Both economic growth rates and global inflation levels fluctuate over time, making the relationship between inflation and growth a key and often complex issue within the field of macroeconomics (Kasidi and Kenani, 2012). Earlier economic theories suggested no significant relationship between inflation and economic growth. However, this perspective has evolved, and there is now widespread consensus that inflation and economic growth are interconnected. Generally, periods characterized by low inflation rates coincide with economic growth, while high inflation—particularly when inflation crosses double digits—tends to have a detrimental effect on growth trajectories. For this study, panel data encompassing seventeen Eurozone countries over a substantial time frame has been utilized to provide robust and reliable findings. The central hypothesis posits that the inflation rate positively influences economic growth. To ensure a comprehensive analysis, other variables such as budget deficit rates, government bond yields, and unemployment rates are incorporated alongside inflation and GDP growth data. This multi-variable approach aims to yield more accurate insights. The paper is organized into several sections, including a review of related literature, the methodological framework, empirical data analysis, and concluding remarks.

Literature Review

When examining the economic perspectives over the last century concerning the relationship between inflation and economic growth, especially prior to the 1970s, there was considerable debate and disagreement on whether a meaningful correlation existed between these two variables. During that time, the prevailing view among economists and policymakers was that no positive relationship existed between inflation rates and economic growth. This consensus was largely influenced by the economic experiences of Latin American countries during that era, where high inflation did not appear to translate into stronger economic performance (Behera, 2014). However, this stance has evolved over time, as more recent studies increasingly indicate that inflation and economic growth are indeed linked, though the nature of this relationship is complex and often dependent on inflation thresholds.

A critical insight from the literature is the recognition of a threshold effect: economic growth tends to respond positively to inflation up to a certain point, beyond which further inflation becomes harmful to growth. Despite this general agreement, there is no consensus on the exact inflation rate at which this shift occurs. The optimal inflation rate that maximizes economic growth remains a subject of debate, with various studies proposing different threshold levels. Fischer (1993) made a significant contribution by using inter-sectorial and panel data from both developed and emerging economies to explore the long-term relationship between inflation and economic growth. His findings highlighted a statistically significant negative correlation between inflation and growth rates, suggesting that higher inflation can hinder economic performance over time. Complementing this view, Barro (1995) analyzed data from 100 countries over three decades (1960-1990) and found that a 10 percent annual increase in average inflation corresponded with a reduction in real GDP growth by approximately 0.2 to 0.3 percent per year. Additionally, Barro noted that inflation also negatively impacted investment ratios, reducing investment as a percentage of GDP by 0.4 to 0.6 percent.

In a related study, Ghosh and Phillips (1998) argued that high inflation is undoubtedly harmful to economic growth, but its damaging effects are less severe at moderate inflation levels. Their panel regression analysis showed a consistently negative relationship between inflation and growth, which was significant across all inflation ranges except at very low levels. This nuanced finding suggests that while some inflation might be tolerable, excessive inflation clearly dampens growth prospects. Hasanov (2010) examined the inflation-growth relationship in Azerbaijan using annual data on real GDP growth, the Consumer Price Index, and Gross Fixed Capital Formation over 2001–2009. The results revealed a non-linear relationship: inflation rates up to about 13 percent correlated with positive GDP growth, but when inflation surpassed this level, economic growth tended to decline by roughly 3 percent. This finding underscores the presence of an inflation threshold that determines whether inflation stimulates or inhibits growth in a given economy.

Nell (2000) employed Vector Autoregression (VAR) techniques to investigate the impact of inflation on growth using data spanning 1960 to 1999. His empirical analysis suggested that inflation rates within the single-digit range could actually benefit economic growth, whereas inflation rates exceeding double digits generally constrained growth. This supports the argument that moderate inflation may serve as a lubricant for economic activity, but excessive inflation disrupts productive investment and consumption decisions. Sergii (2009) further reinforced these conclusions by demonstrating that the inflation-growth relationship follows a concave pattern characterized by a threshold inflation rate. Specifically, Sergii identified an 8 percent inflation rate as the critical point: inflation below this level tended to promote economic growth, while inflation beyond 8

percent began to suppress it. This threshold effect emphasizes the importance of inflation control policies tailored to keep inflation within optimal bounds to foster sustained economic expansion. Overall, the literature reveals a shift from earlier views that dismissed any connection between inflation and growth to a more nuanced understanding acknowledging that the relationship exists but is non-linear. The consensus now is that low inflation supports economic growth, while high inflation—particularly in double digits—harms it. These findings have important implications for policymakers who aim to balance inflation control with growth promotion, suggesting that maintaining inflation within a moderate range is crucial for stable and sustainable economic development.

Methodology of analysis

The data used in this study consist of key macroeconomic financial indicators obtained from the Statistical Office of the European Union (Eurostat). According to the relevant literature, three main types of quantitative data are commonly used for analyzing financial phenomena: time series, cross-sectional data, and panel data. For this analysis, panel data has been selected as the most appropriate approach, as it allows us to capture variations across multiple countries over time.

Specifically, this study employs panel data from seventeen (17) Eurozone countries, covering a sufficiently long period that ensures robustness and adherence to accepted methodological standards. The data set includes key variables such as GDP growth rate, budget deficit, inflation rate, government bond yields, and unemployment rate. These indicators are collected and analyzed annually for the years spanning from 1997 to 2017, amounting to a total of 357 observations across the countries and time periods.

The study period encompasses three significant historical phases for the Eurozone economies:

- The convergence phase (1995–1999), when countries were striving to meet the Maastricht Treaty's Economic Criteria, also known as the Convergence Criteria.

- The introduction of the Euro as a single currency (1999–2002), marking a major structural change in the region.

- The Global Financial Crisis and the subsequent European sovereign debt crisis period (2008–2015), which had substantial economic implications for these countries.

For empirical analysis, time series techniques are applied within the panel data framework, which allows for examining the dynamic behavior of the variables over time while controlling for country-specific effects. This approach is supported by econometric literature as an effective means to assess the impact of various determinants on economic outcomes (Baltagi, 2005; Gujarati, 2003).

To analyze the relationship between inflation and economic growth, a multiple linear regression model is employed. This model estimates the influence of inflation along with other control variables on GDP growth, helping to identify the relative importance and significance of each explanatory factor. The general form of the linear regression model used in this study is:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \varepsilon$$

where y represents the dependent variable (GDP growth rate), x_1, x_2 are independent variables such as inflation rate, budget deficit, government bond yields, and unemployment rate, β_0 is the intercept, β_1, β_2, are the coefficients to be estimated, and ε is the error term.

Before conducting the regression analysis, the data undergo several diagnostic tests to verify the validity of the model assumptions. These include testing for serial correlation using the Durbin-Watson statistic, as well as checking for heteroskedasticity through the Breusch-Pagan test. These tests help ensure that the model's estimates are reliable and unbiased, thus strengthening the robustness of the findings.

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

$$\text{GDP growth}_3 = C + \beta_1 \text{Inflation rate}_t + \beta_2 \text{Deficit to GDP}_3 + \beta_A \text{Government bond yields}_3$$
$$+ \beta_H \text{Unemployment rate}_3 + \varepsilon$$

The empirical approach in this study begins with descriptive data analysis to examine the variations across different time periods. Within this framework, we analyze the trends and movements of the dependent

variable, GDP growth rate, alongside the independent (explanatory) variables included in the regression model. The descriptive statistics presented include key measures such as the number of observations, minimum, maximum, mean, standard deviation, and variance. These statistics are summarized in the table below, providing an overview of the data characteristics used in the analysis.

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					

The results generated from the model indicate that the GDP growth rate has a mean value of 2.63%, with a standard deviation of 3.94%. The minimum and maximum values recorded were -14.8% and 26.3%, respectively, with a variance of 15.59%. Regarding the key explanatory variable of this study, the inflation rate, the average value stands at 3.06% with a standard deviation of 4.00%. The lowest inflation rate observed was -4.50%, recorded in Ireland in 2009, while the highest inflation rate was 39.70%, reported by Lithuania in 1995, with a variance of 16.02%. The deficit to GDP ratio, another explanatory variable, has an average of -2.82% and a standard deviation of 3.87%. The minimum deficit value reached -32.10% in Ireland in 2010, whereas the maximum value was 6.90% in Finland in 2000, with a coefficient of variation of 15.00%. For government bond yields, the average value is 4.83% with a standard deviation of 2.33%. The minimum and maximum yields observed were 0.40% and 22.50%, respectively, with a variance coefficient of 5.44%. The lowest bond yield was recorded in Luxembourg in 2009, while the highest was seen in Greece in 2012. Lastly, the unemployment rate in the Eurozone countries averaged 8.22%, with a standard deviation of 4.13%. The minimum unemployment rate was 1.50% in Luxembourg in 2001, and the maximum rate reached 25.40% in Greece in 2013.

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).						

Table 2 presents the correlation matrix, which summarizes the relationships between all the variables (Büyükşavarci and Abdioğlu, 2011). According to the results, there is a positive correlation between GDP growth rate and both the inflation rate and the deficit to GDP ratio, significant at the 99.9% confidence level. The correlation coefficients are 0.185** and 0.410**, respectively. Conversely, GDP growth rate has a significant negative correlation with government bond yields at the 99.9% confidence level, with a coefficient of -0.197**, and with unemployment rate at the 95% confidence level, with a coefficient of -0.125*. These negative correlations suggest that increases in government bond yields and unemployment rates are associated with reductions in GDP growth rate among the 17 Eurozone countries. The inflation rate shows a positive but statistically insignificant correlation with the deficit to GDP ratio. Meanwhile, there is a significant positive correlation between unemployment rate and government bond yields at the 99.9% confidence level, with a coefficient of 0.138**. The unemployment rate has a low and insignificant correlation of 0.044 with inflation rate. The deficit to GDP ratio is negatively correlated at the 99.9% confidence level with both government bond yields (-0.290**) and unemployment rate (-0.429**). This aligns with economic theory, as increases in bond yields and unemployment tend to reduce the deficit to GDP ratio. Finally, government bond yields display a strong positive correlation with inflation rate, significant at the 99.9% confidence level, with a coefficient of 0.321**.

Table 3 provides a summary of the linear regression model, including key statistics such as R, R^2, adjusted R^2, the standard error, and the Durbin-Watson test. The results indicate a moderate correlation between the dependent variable and the explanatory variables, with an R value of 0.463, meaning that 46.3% of the variation in the dependent variable is associated with the independent variables. The R^2 value of 0.214 suggests that approximately 21.4% of the variation in the dependent variable is explained by the model's 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
a. Predictors: (Constant), Unemployment rate, Inflation, Govern. Bond yields, Deficit to GDP					
b. Dependent Variable: GDP growth rate					

The model's standard error has been calculated at 3.52 per cent. To evaluate the robustness and consistency of the model, various diagnostic tools were employed, including the Durbin-Watson test, the F-test, as well as the Breusch-Pagan and Koenker heteroskedasticity tests. The Durbin-Watson statistic, which can range from 0 to 4, is used to detect the presence of autocorrelation in the residuals of the regression. A result close to zero indicates a strong positive autocorrelation, while a result near four suggests negative autocorrelation. Ideally, a value near two signals that the residuals are randomly distributed and that there is no autocorrelation. Values between 1.5 and 2.5 are commonly accepted as the threshold for assuming no serious serial correlation. In this study, the Durbin-Watson statistic was calculated at 1.567, placing it well within the acceptable range and indicating that the residuals in the regression model are not serially correlated. Thus, the model can be considered stable and reliable.

The F-test result of .000 demonstrates that the explanatory variables jointly have a statistically significant effect on the dependent variable. In other words, the null hypothesis that all coefficients are equal to zero can be rejected with high confidence. Multicollinearity among the independent variables was also examined through the Variance Inflation Factor (VIF). The highest VIF value observed in the model was 5.12, which is below the commonly accepted maximum threshold of 10. This indicates that multicollinearity is not a major concern. Literature supports varying thresholds for multicollinearity concerns—Malhotra (2007) notes problems arise when variable correlations exceed 0.75, whereas Cooper and Schindler (2006) suggest 0.80 as the limit. Hair et al. (2006) argue that even correlations below 0.90 typically do not cause serious multicollinearity issues. Finally, the Breusch-Pagan and Koenker tests, often referred to collectively as the White test, were used to assess heteroskedasticity. Since the p-values from these tests were below the 0.05

level, the null hypothesis of homoskedasticity is rejected, indicating the presence of heteroskedasticity in the model. 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

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 5: 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					

Findings

The econometric analysis carried out in this study reveals that the Inflation Rate variable is statistically significant at a 99.9% confidence level, and it has a positive influence on economic growth (P = .000). This signifies that an upward movement in the inflation rate correlates with an increase in the GDP growth rate. These results are in line with several empirical studies mentioned earlier, such as the research by Hasanov (2010). In his analysis of real GDP growth, the Consumer Price Index, and capital formation in Azerbaijan between 2001 and 2009, he determined a non-linear relationship between inflation and GDP growth. Specifically, economic growth was positively impacted when inflation stayed below a certain threshold—13%—but began to decline when inflation surpassed this level.

Similarly, the Deficit to GDP ratio is also statistically significant at the 99.9% level, exhibiting a positive relationship with GDP growth (P = .000). The data suggest that when the budget deficit as a percentage of GDP increases, economic growth also tends to improve. This outcome is consistent with the findings of other researchers. For instance, Nayab (2015), using co-integration analysis, the VAR Granger causality test, and an error correction model, demonstrated that budget deficits play a significant and favorable role in boosting economic growth. These findings also support the Keynesian perspective, which suggests that fiscal stimulus in the form of government deficits can spur economic expansion. Similarly, Adam and Bevan (2005) found that a deficit level of around 1.5% of GDP contributes positively to growth. In another study, Cinar et al. (2014) analyzed five countries with low and high debt-to-GDP ratios in the Eurozone from 2000 to 2011, employing an ARDL panel model. Their results also supported the idea that deficit spending has short-term positive

effects on economic growth. Additionally, Loizides and Vamvoukas (2005), using data from Greece, Ireland, and the UK, concluded that fiscal deficits significantly influence growth in all three countries studied. As for Government Bond Yields, this variable is shown to be statistically significant at the 99.9% confidence level, but with a negative effect on GDP growth (P = .006). This means that higher bond yields are linked to slower economic growth within the Eurozone countries included in the sample. This outcome is consistent with the findings of Hansen and Seshadri (2013), who investigated the relationship between long-term real interest rates and economic growth in the United States. By examining data from 1901 to 2011—including variables such as real interest rates, labor productivity, and real GDP—they discovered a persistent negative association between interest rates and GDP growth, supporting our findings. Finally, the Unemployment Rate variable is found to be not statistically significant in the context of this model, as the P-value stands at 0.101. This suggests that unemployment does not exert a measurable or consistent effect on economic growth across the 17 Eurozone countries for the study period. While unemployment remains a critical macroeconomic indicator, its statistical insignificance in this model indicates that other variables may have had more pronounced and direct effects on GDP growth during the period under consideration.

Conclusions

Drawing on the outcomes of our econometric evaluation through a panel data model, it is evident that the Inflation Rate variable is statistically significant at the 99.9% confidence level, showing a positive relationship with GDP growth (P = .000). This suggests that inflation, within a certain threshold, contributes positively to economic performance. Our findings align closely with those identified in numerous empirical studies reviewed in the literature. For example, Hasanov (2010) examined real GDP growth trends in Azerbaijan and found a non-linear connection between inflation and economic growth. His analysis revealed that inflation levels around 13% were linked with enhanced GDP performance, reflecting similar trends observed in our study. Further supporting this perspective, Barro (1995) assessed inflation's impact on macroeconomic outcomes and determined that, all else being equal, a 10% rise in inflation led to a decline in real GDP growth by approximately 0.2 to 0.3 percentage points annually. However, the ratio of investment to GDP was shown to increase by 0.4 to 0.6 percentage points under the same conditions. This duality suggests that inflation's influence is complex, possibly encouraging investment in the short term while constraining longer-term growth potential when excessive.

Moreover, Ghosh and Phillips (1998) argued that moderate levels of inflation are generally not harmful to economic expansion, supporting the notion that a controlled inflation environment can coexist with healthy growth. Similarly, Sergii (2009) emphasized the importance of a threshold level, indicating that inflation below 8% promotes growth, while exceeding that point tends to restrain it. These findings are echoed in our own analysis of the Eurozone context. Specifically, our model suggests that a 1 percentage point increase in inflation, assuming other variables remain unchanged, contributes to a 22.4 percentage point rise in GDP growth. This strong positive effect can be partly explained by the institutional and fiscal policies implemented across Eurozone nations. As members of the Economic and Monetary Union, these countries have adhered to the Maastricht Convergence Criteria, which include maintaining inflation at moderate levels to ensure price stability and promote economic activity. By aligning inflation management with fiscal discipline and market expectations, these regulations likely contribute to the observed relationship between inflation and growth. In conclusion, our study reinforces the view that inflation—when maintained within targeted bounds—can be a catalyst for economic growth, particularly in structurally coordinated regions like the Eurozone where inflation control forms part of broader economic governance strategies.

Declaration of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author Contributions

All authors contributed equally to the conception, data analysis, and drafting of the manuscript. All authors have read and approved the final version of the manuscript.

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