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DETERMINANTS OF PUBLIC DEBT - COMPARATIVE ANALYSIS OF EUROPEAN COUNTRIES

Abstract: The country's public debt is one of the main macroeconomic indicators of a country's stable economy. The authors in this study try to explain the diversity of the effects of many macroeconomic indicators on the public debt of developed and developing countries. The sample of the study includes 12 countries, of which the countries are divided into two groups. The first group includes developed countries while the second group includes developing countries. The study aims to analyze and compare the effects of macroeconomic factors on the public debt of countries. The authors use the statistical software E-views where at the beginning of the study they analyze the descriptive data of developed and developing countries. After that, a series of diagnostic tests are performed, such as unit root tests and the derivation of the correlation matrix to reject the hypotheses of non-stationarity and collinearity. At the end of the research, the authors use the POLS method and the Fixed effect model to interpret the effects of independent variables on the dependent variable of public debt. The study covers the period from 1998 to 2023 and includes projections for the year 2024. An additional goal of the study is to observe and analyze the movement of macroeconomic factors in crisis and recessionary periods of the world economy. These findings will be useful to regulators who are developing, amending, or implementing public debt laws, policies, and regulations.

Keywords: Public debt, Macro-economic factors

1. INTRODUCTION

Public debt is a crucial aspect of any country's economy. It refers to the amount of money that a government owes to its creditors, both domestic and foreign. In European countries, public debt has been a significant concern for policymakers, economists, and citizens. This study discusses the issue of public debt in European countries, the factors contributing to it, and its impacts on the European economies. High levels of public debt have significant impacts on European economies. One of the impacts is that it limits a government's ability to respond to future economic crises. High levels of debt make it difficult for governments to borrow more and increase their spending to support their economies during a crisis. Additionally, high levels of public debt can lead to higher interest rates, which can increase the cost of borrowing for individuals and businesses. This, in turn, can lead to reduced economic growth and higher unemployment rates. Several factors such as economic crisis periods, an aging population, and a decrease in economic growth have contributed to high levels of public debt. The impacts of public debt on European economies are significant, limiting governments' ability to respond to future economic crises and leading to higher interest rates and reduced economic growth. The key difficulties facing policymakers when faced with large public debt are choosing the best time, speed, and means to reduce it. Fiscal consolidation, rapid economic growth, high inflation, or low-interest rates are the components of a debt-reduction plan as determined by the debt dynamics equation. Fiscal consolidation, or austerity, may be counterproductive in the current climate of low domestic growth and the zero-interest rate band. Growth stimulation may enhance fiscal balance and debt dynamics, resulting in increased tax revenue for the

government (Cherif & Hasanov, 2018). In the context of rising life expectancy, stable governance, and institutional conditions, it is necessary to regularly examine the sustainability of public debt to discuss technical proposals to maintain it at an even rate. (Briceno & Perote, 2020).

2. LITERATURE REVIEW

There are numerous studies that have analyzed the effects of economic growth on the public debt of countries such as (Pegkas, Staikouras & Tsamadias, 2020; Lim, 2019; De Vita, Trachanas & Luo, 2018; Gomez & Rivero, 2017; Gomez & Rivero, 2015; Bell, Johnston & Jones, 2015; Iovin & Navarro, 2015; Law, Ng, Kutan & Law, 2021). All studies represent a negative bidirectional relationship between economic growth and public debt. A study conducted by Jacobs, Ogawa, Sterken & Tokutsu (2020) also analyzed the direction of the impact of economic growth and public debt. The results indicated the presence of a unidirectional negative impact of economic growth on the public debt of countries. A study such as Cecchetti, Mohanty & Zampolli (2011) indicated the significance of the effects of public debt on economic growth if the level of public debt is above 90% of the country's GDP.
Awoyemi (2020), who looked into capital expenditure, concluded that the Nigerian economy may lower public debt and the debt-to-GDP ratio by raising capital spending since doing so frequently has a major impact on output, and doing so could lower the debt-GDP ratio. A study conducted by Knapkov, Kiaba & Hudec (2020) indicated the statistical significance of the effect of GDP growth, the openness of the economy, the size of the public sector, the rate of return on government bonds, and the unemployment rate on Slovakia's public debt. According to one study, real interest rates, budget deficits, and trade openness, all raised public debt while inflation and investment decreased their value. The analysis also revealed that Tunisia's state debt is mostly determined by the budget deficit (Belguith & Omrane, 2019). A study by Ali & Yayja (2019), using governance indicators such as voice and accountability, political stability and the absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, and control of corruption, investigated their impact on public debt in Arab countries. The results of the study indicated a statistically significant effect of all indicators except for the control of corruption indicator. According to Mohanty and Panda (2019), research, public debt has a negative influence on economic growth but a beneficial impact on long-term interest rates. The findings also revealed conflicting responses regarding Indian investment and inflation. The abundance of oil, economic growth rate, the proportion of mineral rent in total revenue, interest rates paid on foreign borrowings, and being a developing country were all statistically significant influences on the rise in public debt, according to a study conducted by Sadiq & Ghato (2019).

3. METHODOLOGY AND DATA

In this part of the study, the authors define the methodology of the research itself. As mentioned earlier, the study covers the period from 1998 to 2023, as well as projections for 2024 (???). The research was conducted on the example of 12 countries, which were divided into two groups. The first group includes developed European countries, which include Belgium, France, Italy, Germany, Luxembourg, and Slovenia, while the second group represents developing countries, namely Bosnia and Herzegovina, Croatia, Montenegro, Macedonia, Russia, and Serbia. The subject of the study is a comparative analysis of the impact of macroeconomic factors such as GDP growth, Exports, Expenditures, Imports, Inflation, and Investments on the public debt of developed and developing countries. In this chapter, the authors define and state the hypotheses and main models that are the subject of testing, as well as the formulas of the diagnostic tests used. All the data used were downloaded from the website of the International Monetary Fund, and the authors define the dependent and independent variables used in this study in the table below.

Table 1: Dependant and independent variables

	Symbol	Variable	Proxy
Dependent variable	GD	Gross national debt	Gross debt as % of GDP
Independent variables	GDP	Gross domestic product	Annual growth %
	EXPE	Government expenditure	Expenditure as % of GDP
	EX	Exports	% Change in exports
	IM	Imports	% Change of Imports
	INF	Inflation	% Annual change
	INVE	Investment	Investments as % of GDP

Source: authors

3.1. Hypothesis and tests

Based on previous studies, the authors define the following hypotheses:

H0 - Macroeconomic factors have no influence on Public Debt
H1 - Macroeconomic factors have an impact on Public Debt

As mentioned, the authors divide the subject of the study into a group of developed countries and a group of developing countries, where the impact of various macroeconomic factors is analyzed. In addition to the main hypotheses, the authors define auxiliary hypotheses:

H2 - The change in GDP has an impact on the public debt of developed countries
H3 - The change in GDP has an impact on the public debt of developing countries
H4 – Government expenditure has an impact on the public debt of developed countries
H5 - Government expenditure has an impact on the public debt of developing countries
H6 - Exports have an impact on the public debt of developed countries
H7 - Exports have an impact on the public debt of developing countries
H8 - Imports have an impact on the public debt of developed countries
H9 - Imports have an impact on the public debt of developing countries
H10 - Inflation has an impact on the public debt of developed countries
H11 - Inflation has an impact on the public debt of developing countries
H12 - Investments have an impact on the public debt of developed countries
H13 - Investments have an impact on the public debt of developing countries

For econometric research, panel data are frequently employed since they make it possible to integrate the spatial and temporal dimensions. Namely, panel data are made up of numerous independent instances of the same observation unit. One of the requirements underlying the econometric analysis of time series is stationary data, which is the most crucial requirement for an econometric approach (Musdaq, 2011). It speaks about the time series' mean and variance as constant values. The Augmented Dickey-Fuller test is used in this research to assess whether the data are stationary. The data is not steady and has a unit root if the p-value is more than 0.05. Since using non-stationary data can lead to an unfavorable regression model, the unit root test is used to eliminate it (spurious regression). The following assumptions are part of this test:

H0 : Data is not stationary (has a unit root)
H1: Data is stationary

The multicollinearity test, which shows us whether there is a high level of correlation between the independent variables, is also one of the necessary tests to check the validity of the data. If the variance inflation factor exceeds the threshold value of 10, the data is multicollinear and must be omitted from the regression model. According to Lin, Foster, and Ungar (2011), the VIF test was utilized for the analysis, and the computed regression is as follows:

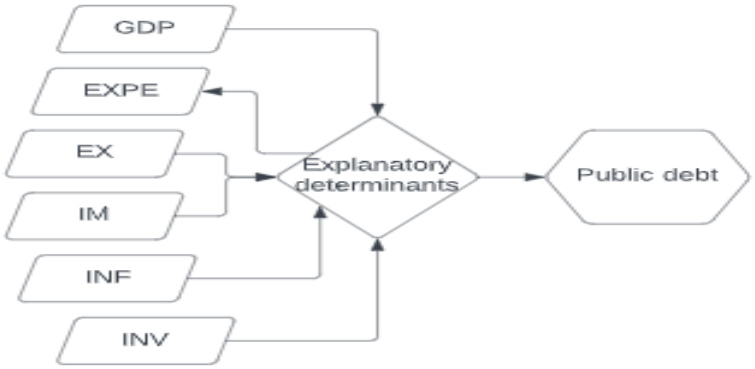
$$VIF = 1/(1 - R_j^2) \quad (1)$$

Where:

- VIF – Variance inflation factor
- R^2_j – R square of the regression model

This test includes the following hypotheses:

H0 : Multicollinearity exists
H1: There is no multicollinearity



Picture 1: Model construction
Source: authors

After establishing the main and auxiliary hypotheses, as well as reviewing the diagnostic tests, the authors derive the following regression models that represent the subject of this study:

$$Y_{dev} = \alpha + \beta_{1GDP_{it}} + \beta_{2EXPE_{it}} + \beta_{3EX_{it}} + \beta_{4IM_{it}} + \beta_{5INF_{it}} + \beta_{6INVE_{it}} + \epsilon \quad (2)$$

$$Y_{deve} = \alpha + \beta_{1GDP_{it}} + \beta_{2EXPE_{it}} + \beta_{3EX_{it}} + \beta_{4IM_{it}} + \beta_{5INF_{it}} + \beta_{6INVE_{it}} + \epsilon \quad (3)$$

Where:
- Y_{dev} stands for the dependent variable of the public debt of developed countries
- Y_{deve} stands for the dependent variable of the public debt of developing countries
- GDPit stands for the GDP growth of a country i at time t
- EXPEit stands for government expenditure of country i at time t
- EXit stands for exports of country i at time t
- IMit stands for imports of country i at time t
- INFit stands for inflation of country i at time t
- INVEit stands for investments of country i at time t

3.2 Developed Countries

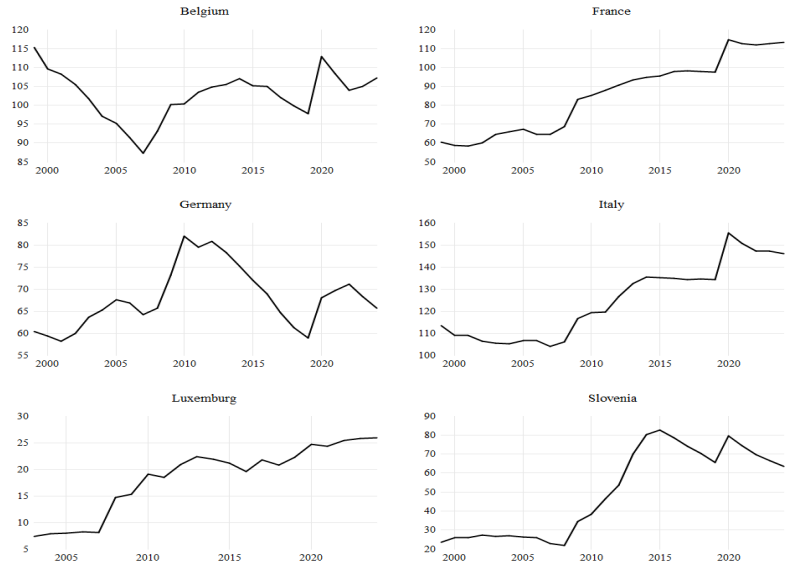
In this part of the study, the authors present a descriptive analysis of the variables used in the examples of developed and developing countries that are the subject of this study. In addition to the descriptive analysis, the authors graphically illustrate the movement of the public debt levels of the countries in the period from 1998 to 2023. The data was collected from the IMF website and the analysis also includes the expected amounts of the public debt of the observed countries for 2024. The table below shows a descriptive analysis of the variables in the example of developed countries, where it can be seen that the largest amount of standard deviation is present in the variable of public debt and is 37,094, which lets us know that with this variable there are the largest deviations from the minimum to the maximum value of the indicator. Further analysis shows that the highest amount of public debt was achieved by Italy in the amount of 155.313% of GDP in 2020, while the lowest amount of public debt was achieved by Luxembourg in 2003 in the amount of 7.439% of GDP. The highest percentage growth of GDP was achieved by Slovenia in 2021, by 8.211%, while the highest amount of inflation of 9.471% was achieved by Belgium in 2022. The highest amount of imports, measured as a percentage change, was achieved by Luxembourg in 2010, at 17.809%, as well as the highest amount of change in exports at 27.047% in the same year. Observing the investments, it is noticeable that the largest amount of investments as a percentage of GDP was achieved by Slovenia in 2007, in the amount of 33.047%, while the smallest amount was achieved by Luxembourg, 16.183%, in 2009. As for government spending, the highest level was achieved by France, in the amount of 61.421% in 2020, while the lowest amount was achieved by Luxembourg in 2007, at 37.391% of GDP.

Table 2: Descritptive statistics of developed countries

	Mean	Max	Min	Std. Dev.	Obs
GD	76,37173	155,313	7,439	37,09417	152
GDP	1,623171	8,211	-9,026	2,726665	152
EXPE	49,19832	61,421	37,391	5,041369	152
EX	3,570592	27,047	-19,53	6,714558	152
IM	3,484184	17,809	-20,673	6,315626	152
INF	2,358487	9,471	-0,521	2,008929	152
INVE	21,90224	33,047	16,183	2,961968	152

Source: authors

In addition to the descriptive analysis, the authors use the graphic illustration for further analysis of the trend of the level of public debt in the observed period. The period of analysis covers 25 years, and it contains a trend of movement through many crisis periods, the most recent of which is the appearance of war in the eastern part of Europe. It is noticeable that in all the countries that are the subject of the analysis, there are growing trends in the level of public debt in periods of crisis. From the emergence of the dotcom bubble in the 90s, the world crisis of the late 2000s, the Coronavirus pandemic until today's conflicts in the eastern part of Europe, there is a noticeable growing trend, followed by a period of a slight decline in the indebtedness of developed countries.



Picture 2: Developed countries
Source: authors

3.3 Emerging Countries

Analyzing developing countries in the table above, we notice that, similarly to developed countries, the highest amount of standard deviation is present in the public debt variable, which means that there is the largest spread between the maximum and minimum values. A high level of standard deviation is also present in the import and export variables, which is different concerning developing countries. Looking at the maximum and minimum amounts of public debt as a percentage of GDP, in the example of developing countries, the largest amount of public debt of 135.193% of GDP was achieved in 1998, by Russia. Also, the lowest amount of public debt for the observed period was achieved by Russia at 7.446% in 2008. Analyzing the percentage change in GDP, the authors note that the highest amount was achieved by Montenegro in 2021, of 13.043%, while the lowest amount was also achieved by Montenegro, a drop of 15.307% in 2020. Observing the inflation, the largest amount was achieved by Russia in 1999, as much as 85.746%, while the lowest amount was achieved by Bosnia and Herzegovina, namely a drop of 1.584% on an annual basis in 2016. In addition to the largest change in GDP, Montenegro also achieved the largest percentage changes in imports and exports. Imports in 2006 in the amount by 47.42%, while exports in 2021, even 81.86% growth. The highest amount of state investment as a percentage of GDP was achieved by Croatia in 2008, at 30.516%, while the highest amount of government spending was achieved by Bosnia and Herzegovina in 2000, at 56.306% of GDP.

Table 3: Descritptive statistics of developing countries

	Mean	Max	Min	Std. Dev.	Obs
GD	46,0576	135,193	7,446	24,07081	118
GDP	2,879381	13,043	-15,307	4,068129	118
EXPE	42,70537	56,306	29,04	5,818406	118
EX	5,810805	81,86	-48,302	12,76585	118
IM	5,271864	47,418	-39,016	12,94524	118
INF	5,776839	85,746	-1,584	9,045998	118
INVE	18,65192	30,516	-15,307	8,329447	118

Source: authors

In the graph below, a similar case is noticeable in developed countries. Observing trends in public debt, a slight rise in crisis periods is noticeable. The most interesting item is the example of Russia, where a significant decrease in public debt has been noticeable since the end of the 90s, and the beginning of the 2000s. In the continuation of the study, the authors present the findings and comment on the results.

Picture 3: Developing countries
Source: authors

4. FINDINGS

As one of the main conditions for performing a correct panel regression model is the absence of multicollinearity of the used variables. In this study, the authors use the correlation matrix as well as the variance inflation factor to prove the absence of multicollinearity. The table below shows the correlation matrix in which the relationship between the dependent and independent variables is observed. It is noticeable that the level of correlation between the used variables does not exceed the threshold level of 0.80.

Table 4: Correlation matrix

	GD	GDP	EXPE	EX	IM	INF	INVE
GD	**1,0000**	-0,2504	0,6333	-0,0613	-0,0552	-0,0524	-0,0583
GDP	-0,2504	**1,0000**	-0,3093	0,6652	0,6441	0,1827	0,1718
EXPE	0,6333	-0,3093	**1,0000**	-0,1209	-0,1944	-0,3820	0,1295
EX	-0,0613	0,6652	-0,1209	**1,0000**	0,6311	-0,0514	0,0992
IM	-0,0552	0,6441	-0,1944	0,6311	**1,0000**	0,0138	0,1004
INF	-0,0524	0,1827	-0,3820	-0,0514	0,0138	**1,0000**	-0,0513
INVE	-0,0583	0,1718	0,1295	0,0992	0,1004	-0,0513	**1,0000**

Source: authors

This fact was confirmed by using the Variance inflation factor, which is a frequently used collinearity test. Since the threshold value of VIF does not exceed the threshold value of 10, we can confirm the absence of multicollinearity. With the help of the results of the correlation matrix and the variance inflation factor, we can reject the null hypothesis of the existence of multicollinearity of variables.

Table 5: Variance inflation factor

Variables	Coeff.	Centered Vif
EXPE	0,07692	1,30692
EX	0,05102	2,15075
GDP	0,49035	2,47098
IM	0,04617	1,96987
INF	0,04738	1,23916
INV	0,06563	1,07419
Average VIF		**1,70198**

Source: authors

Another important diagnostic test used to derive a valid regression model is the unit root test. The unit root test serves to establish the stationarity of the data used. Stationarity is one of the main factors in the performance of a valid regression model. In the analysis, the authors use three unit root tests, often used in the analysis of panel data. The data in the table above show us that all data except the public debt data are stationary at level, because the probability does not exceed the 5% significance level, while the public debt data become stationary after performing the 1st difference. As mentioned earlier, the condition for rejecting the null hypothesis of data nonstationarity is a probability below the 5% significance level.

Table 6: Unit root test

	Level			1st difference		
Variables	Levin, Lin & Chu	ADF	PP	Levin, Lin & Chu	ADF	PP
GD	-1,24190 (0,1071)	34,2712 (0,0800)	33,1513 (0,1009)	**-4,11966 (0,0000)***	**95,0787 (0,0000)***	**165,748 (0,0000)***
GDP	**-8,66258 (0,0000)***	**111,669 (0,0000)***	**202,321 (0,0000)***	-16,8435 (0,0000)	228,111 (0,0000)	863,857 (0,0000)
EXPE	**-2,40915 (0,0080)***	**47,7883 (0,0027)***	**55,3983 (0,0003)***	-7,76883 (0,0000)	124,087 (0,0000)	232,503 (0,0000)
EX	**-10,2357 (0,0000)***	**125,576 (0,0000)***	**220,998 (0,0000)***	-11,5906 (0,0000)	212,938 (0,0000)	1170,09 (0,0000)
IM	**-9,14462 (0,0000)***	**129,367 (0,0000)***	**269,787 (0,0000)***	-10,2670 (0,0000)	207,923 (0,0000)	1168,57 (0,0000)
INF	**-15,0971 (0,0000)***	**101,409 (0,0000)***	**70,8365 (0,0000)***	-10,8480 (0,0000)	184,399 (0,0000)	320,456 (0,0000)
INVE	**-4,24529 (0,0000)***	**48,5273 (0,0009)***	**59,6682 (0,0000)***	-11,7821 (0,0000)	156,127 (0,0000)	470,192 (0,00000)

Source: authors

After diagnostic tests of multicollinearity and unit root, the authors in the table below use POLS and a fixed effects model to derive an adequate regression model. The table below shows both types of models for developed and developing countries. Based on the obtained results, we note that in the case of developed countries, the influence of independent variables such as consumption, exports, GDP growth, and inflation proved to be statistically significant. It is noticeable that the growth of consumption and exports by 1% causes the growth of public debt by 0.5617% and 0.217339% in the case of developed countries, while the growth of Gdp and Inflation by 1% causes the decrease of public debt by 1.22279% and 0,337600% respectively. The negative impact of GDP growth is supported by studies such (Alfonso & Jalles, 2013; Swamy, 2020). In the case of developing countries, it was discovered that only GDP growth and imports have a statistically significant impact on public debt. A 1% increase in GDP results in a 2.624085% decrease in public debt, while a 1% increase in imports leads to a 0.396608% increase in public debt, respectively. These results are expected and in accordance with the findings of (Afanaisev & Shash ,2016), since developing countries are much more dependent on the import of funds than on exports, GDP growth itself has a stronger impact on reducing public debt than the case in developed countries. Also in the table above, the R-squared indicator is noticeable, which in the case of both models indicates that the given variables describe more than 50% of the changes in the public debt variable.

Table 7: Panel regression model

Variables	Developed countries		In development countries	
	POLS	FIXED	POLS	FIXED
EXPE	0,111169 (0,0640)	**0,561709** **(0,0000)***	0,197876 (0,2091)	0,492031 (0,1007)
EX	0,257528 (0,0057)	**0,217339** **(0,0045)***	0,104885 (0,2158)	0,112980 (0,1881)
GDP	-1,224343 (0,0000)	**-1,22279** **(0,0000)***	**-2,624085** **(0,0000)***	-2,558257 (0,0000)
IM	-0,213676 (0,0380)	-0,136188 (0,1165)	**0,396608** **(0,0000)***	0,404182 (0,0000)
INF	-0,128235 (0,3788)	**-0,337600** **(0,0074)***	0,007989 (0,9406)	-0,005588 (0,9632)
INV	0,018677 (0,8616)	0,163513 (0,1427)	-0,030304 (0,7560)	0,001739 (0,9944)
C	-2,858328 (0,3240)	**-27,83156** **(0,0000)***	-3,613311 (0,6353)	-16,97106 (0,2019)
R - squared	0,558878	**0,720217**	**0,51178**	0,52232
Prob.	0,0000	0,0000	0,0000	0,0000

Source: authors

The main test used to identify the adequacy of POLS and Fixed effects models is the likelihood ratio. This indicator serves to show which of these two used models shows more adequate results. Based on the table above, it is noticeable that in the case of developed countries, the probability does not exceed the threshold value of 0.05, so the Fixed effects model proved to be more adequate, while in the case of developing countries, the POLS model proved to be more adequate. Observing the obtained results, the authors can reliably reject the main null hypothesis of the absence of macroeconomic effects on the public debt of European countries. Further analysis shows that in the case of developed countries, the authors can accept the additional hypotheses H2, H4, H6, and H10 set at the beginning of the study. In the case of developing countries, the authors can accept additional hypotheses H3 and H9.

Table 8: Likehood ration

	Developed Countries		In development count.	
Effects test	Statistic	Prob.	Statistic	Prob.
Cross-section F	16,14646	**0,0000***	0,590248	0,6704
Cross-section Chi-square	69,20684	**0,0000***	2,575399	0,6312

Source: authors

CONCLUSION

As mentioned earlier, the country's public debt represents one of the very important macroeconomic items that the country must keep under control. Indebtedness itself does not necessarily mean a negative item in a country's balance sheet if that money is used adequately. In addition to public debt, there are many other macroeconomic indicators of key importance for the economic success of a country. Precisely for this reason, a deeper and more precise understanding of the implications of certain indicators on public debt is needed to develop an adequate policy for the consumption of borrowed funds. In this study, the authors used 12 European countries as a sample, where one half included developed countries and the other half included developing countries, divided according to the criteria of the International Monetary Fund. The aim of the study was to analyze the impact of various macroeconomic indicators on the public debt of developed and developing countries, as well as their comparative analysis. In addition to analyzing the effects of macroeconomic indicators on public debt, the authors used the study to also analyze the effect of crisis periods in the previous twenty years on the movement of the public debt of the countries used in the study. The comparative analysis provides insight into the economic situation of developing countries and developed countries as well as certain

differences between these economies. The results indicated a statistically significant effect of consumption, exports, GDP growth, and inflation on the public debt of developed countries, while in developing countries the impact of GDP and exports proved to be statistically significant. These studies, as mentioned, give greater insight into the implications of various macroeconomic factors on the public debt of countries and provide support to policymakers for better maneuvering of borrowed funds. The limitations of the study are the use of only 12 countries, and the author's suggestion for further research is the use of a larger number of countries in future research on this topic.

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