"Assessment of the external debt impact on a country's economic development indicators: Evidence from Ukraine"

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ASSESSMENT OF THE EXTERNAL DEBT IMPACT ON A COUNTRY'S ECONOMIC DEVELOPMENT INDICATORS: EVIDENCE FROM UKRAINE

Abstract

External public debt is not only a means of raising funds to finance public needs, but also an effective tool for stabilizing a country`s economic development, the assessment and analysis of which allows making effective management decisions at the state level and developing effective measures to improve the economic and debt situation. The paper aims to assess the impact of external public debt on Ukraine's economic development indicators (GDP, foreign direct investment, foreign exchange reserves). In order to achieve the stated goal distributed lag models are used, which allow modeling a country's economic development (according to key indicators) within certain forecast scenarios. The study covers the period from 2009 to 2021. An analysis of the dynamics of external public debt in Ukraine led to the conclusion about the unstable debt situation in Ukraine and a significant increase in external debt in recent years. Econometric models with a distributed lag of three years are built and the results of the influence of external public debt in different time periods are analyzed. The average lag in the built models is about one and a half years (for GDP) and two and a half years (for foreign direct investment). This value indicates that the average change (increase/decrease) in external public debt will change economic development over time. A positive conclusion is made on the possibility of not only assessing the time lag between the indicators, but also on the prospects for forecasting both the public debt and key indicators of Ukraine`s economic development.

INTRODUCTION

External public debt as a consequence of government borrowing does not exist on its own, it is part of the entire economic (financial) system of a country. It interacts with the economic system at different levels and in different directions. External government borrowing is one of the most important conditions for the formation and development of modern economic (financial) system, since debt policy is part of fiscal policy and plays no less important role in creating a competitive economy than tax, monetary and foreign exchange policy.

In many countries, external public debt is constantly growing, which poses a threat to their macroeconomic stability. In countries where the growth of external debt turns into a debt crisis, there is a risk of major disruptions and economic problems. However, paradoxically, it is precisely because of a number of advantages that arise from external borrowing that many countries are unwilling to give them up.

Growing debt burden in Ukraine to alarming parameters, excessive fundraising on rather unfavorable terms and their inefficient use, the

need for additional funds to address the negative consequences of the global COVID-19 pandemic – all this contributes to economic vulnerability and significantly slows down the development of the state. As of the end of 2021, Ukraine's external public debt amounted to UAH 1,560.23 billion (58.46% of the total public debt). Such figures eloquently testify to the significant dependence of Ukraine on external borrowing. With the threshold limit of the share of external debt at 40.0% of the total debt, during the analyzed period, from 2009 to 2021, its excess is observed by an average of 21.24%. With a total external debt of USD 57.20 billion, Ukraine's international reserves amount to only USD 30.94 billion, that is, all international reserves will be enough to repay only half of the total external debt, which indicates the riskiness of the current solvency situation.

Given the existing areas of vulnerability to the impact generated by debt processes, the issue of optimizing the management, assessment and forecasting of external public debt is quite relevant for Ukraine. Managing the country's external public debt and economic development is impossible without assessing and analyzing the impact of external government borrowing on key economic development indicators, which will ensure objectivity of information and positively affect the quality of management decisions.

1. LITERATURE REVIEW

A significant increase in public debt in many countries has raised the question of conducting economic work to optimize the assessment of the impact of public debt on economic development and maintain a safe level of public debt, including its external component, on the basis of calculations.

The development of economic thought has shown that the problem of public debt is not whether a country should resort to borrowing, it is to find an answer to the main question: For what purpose and to what extent the state can borrow and, most importantly, what are the consequences for the country`s economy?

There is a hypothesis in the economic literature that the relationship between debt and economic growth actually goes in the opposite direction. For example, Clements (2003) argues that when a country is heavily indebted, there is no incentive for the government to pursue macroeconomic reforms because the revenues from these macroeconomic policies will only be used to repay the debt.

In general, numerous scientific studies of Ukrainian and foreign economists are devoted to the problems of the impact of public debt on a country's economic development. Thus, the studies by Koziuk (2002), Baranovskyi (2016), Yefimenko et al. (2014), Bohdan (2012),

Novosiolova (2014), Slav'yuk (2010), Lisovenko (2014), Kuznichenko et al. (2018), Bilozubenko et al. (2020) and others are of great theoretical and practical interest.

The most relevant studies are empirical. Some of them are based on causal tests, although without a clear conclusion about cause and effect.

It should also be noted that the vast majority of researchers use the ratio of public debt and external public debt to a country's macroeconomic indicators as output data. Thus, among a number of studies examining the relationship between public debt and economic growth through the prism of the public debt-to-GDP ratio, one of the most famous is the work of Reinhart and Rogoff (2010). Their 2010 Growth in a Time of Debt study looks at data from 44 countries over nearly 200 years. The authors found little correlation between total public debt and real GDP growth for the debt-to-GDP ratio below 90%. Their main findings are that although the public debt-to-GDP ratio is less than 90%, GDP growth is not declining. One of the findings of this paper is that the growth of debt in developing countries can also result in higher inflation in the country.

Presbitero (1992) examined total public debt in 92 low- and middle-income countries for 1990–2007 and revealed the negative impact of growth from all levels of debt to about 90% of GDP. Above this level, significant negative impacts on growth due to poor economic governance and poor institu-

tions seemed to dampen any further significant identified debt effects. On the positive side, however, is another finding from these studies that low and moderate debt levels do not harm growth in countries with healthy macroeconomic and political environments. On the contrary, it has a very negative impact on growth from very high levels of debt, even in developed economies that are managed differently, such as Japan, some European countries and the US. Thus, recent studies have identified specific debt levels for different groups of countries, after which the impact on growth has been negative. These levels ranged from 60 to 90 percent of GDP.

Dabrowski (2016) in his study of fiscal stability shows that the level of "safe" debt for countries has decreased significantly since the global financial and economic crisis. One of the features of this work is exploring the maximum level of debt for developing countries, including the CIS countries (Kazakhstan, Belarus). Dabrowski notes that the growth of public spending (including public debt) in post-crisis countries will soon affect the economy as a whole.

Several recent studies have examined the relationship between external public debt and economic growth from different perspectives, using different data sets. Taken together, they provide valuable information and a compelling picture of the dangers of excessive public debt.

The relationship between external public debt and a country's socio-economic development indicators is usually assessed by scientists taking into account the correlation, using univariate and/or multivariate regression models, from which future data values are extrapolated.

For example, Yashchenko (2014) identifies the projected values of external and internal debt on the basis of incomes and expenses of Ukraine's state budget, using a four-equation system, determining, in turn, the correlation between variables.

Fahri Seker et al. (2015), using time series data, in particular the ARDL test, examined the impact of Nigeria's external debt growth on interest rates, savings, exchange rates and the country's budget deficit. These factors were found to be statistical-

ly significant in the long run, and the adjustment mechanism for the short run was very weak.

Zhuravka et al. (2021) assessed the persistence level and made some forecasts of state debt future values using Autoregressive Integrated Moving Average (ARIMA) model.

However, an important step is the choice of model variables that most closely correspond to the realities of a country's development.

Bohdan (2012), based on the approach laid down in the Stockholm Principles, points out the importance of studying indicators that illustrate the impact of certain macroeconomic and financial risks in the Ukrainian economy on the level of debt security.

Using the simulation methodology for four scenarios (basic, high deficit, crisis deepening, and contingent debt transformation), Karapetian and Rybak (2011) assess the impact of economic development indicators on public debt. Key factor variables that affect the relative indicators of public debt include the public budget deficit, the level of interest rates on loans, the accumulated amount of public debt, the level of financial markets and access to credit, inflation and exchange rate dynamics, real GDP growth rates.

However, many issues in this area remain unresolved and, above all, this is a search for new ways to build an effective system for managing external public debt and turning external public borrowing into an instrument of economic growth. Modern statistical theory has many different methods and models for determining the relationship between indicators. Despite the developed mathematical tools, the choice of an appropriate method that gives adequate results in assessing the interaction between indicators is one of the main tasks that arise when managing external public debt and promoting economic development. After all, the significant drawbacks of the standard assessment procedure are the difficulties in considering the time factor (lag of interdependence in time) and the feedback between indicators.

To assess the impact of government borrowing on a country`s economy, scientists, govern-

ment authorities, and international organizations (including the International Monetary Fund (IMF), World Bank (WB), International Bank for Reconstruction and Development (IBRD)) calculate and publish a number of debt security indicators. External debt security is assessed by indicators of the amount of debt and its service, which are compared with the magnitude of the capacity and ability of the state to fulfill its debt obligations. The key indicators used to assess the impact of external debt on a country's economy are:

- the ratio of public debt to GDP. Its ever-increasing value indicates a country's insolvency, threatens to reduce confidence in it in international financial markets, depreciate the national currency;

- the ratio of external debt to FX reserves;

- the ratio of external debt to foreign direct investment;

- the ratio of total external debt (which, in addition to public debt, also includes debts of banks and enterprises) to exports of goods and services, which indicates the ability to service external debts of all sectors of the economy at the expense of revenues from exports of goods and services. The more developed the export sector of the national economy, the more opportunities its subjects have to fulfill their debt obligations, etc.

However, these indicators do not give a sufficient idea of the level and direction of the impact of external debt on key macroeconomic indicators within the short-, medium- and long-term planning and forecasting horizons. As a result, they do not provide an opportunity to develop effective measures to balance current financing needs and a country's ability to service the accumulated debt, both now and in the future.

Thus, the study aims to assess the impact of external public debt on Ukraine`s economic development based on a system of regression equations with a distributed lag (Shirley Almon's method), which will allow identifying key relationships in the economy that explicitly or indirectly involve a country's external public debt, as well as forecast-

ing the level and direction of the impact of external debt on key macroeconomic indicators within the short- and medium-term forecast horizon.

2. DATA AND METHODOLOGY

To achieve the purpose of the study, the following scientific methods were used: analysis and generalization – to study the current state of Ukraine's debt security and key economic development indicators; regression analysis (Shirley Almon's method) – to assess the impact of external public debt on Ukraine's economic development (GDP, foreign exchange reserves, foreign direct investment). The distributed lag model algorithm in a generalized form consists of several steps. A distributed lag econometric model for $p = 3$ will look like this:

$$y_t = a + b_0 \cdot x_t + b_1 \cdot x_{t-1} + b_2 \cdot x_{t-2} + b_3 \cdot x_{t-3}. \quad (1)$$

Let's describe in more detail each step of the algorithm for constructing the above econometric model:

1. To estimate the unknown coefficients of the model, Shirley Almon's method is used, which assumes that the lag structure is described by a polynomial to some extent. In the model, the coefficients are represented as a polynomial of the second degree of the lag value j (formulas 2 and 3):

$$y_t = c_0 + c_1 \cdot j_1 + c_2 \cdot j^2, j = 0:3, \quad (2)$$

where

$$
\begin{aligned}
b_0 &= c_0, \\
b_1 &= c_0 + c_1 + c_2, \\
b_2 &= c_0 + 2c_1 + 4c_2, \\
b_3 &= c_0 + 3c_1 + 9c_2.
\end{aligned}
\quad (3)
$$

2. To calculate this model, you need to convert the original data into new variables according to the system of formulas 4:

$$z_0 = x_t + x_{t-1} + x_{t-2} + x_{t-3},$$

$$z_1 = x_{t-1} + 2x_{t-2} + 3x_{t-3},$$

$$z_2 = x_{t-1} + 4x_{t-2} + 9x_{t-3}. \tag{4}$$

Then the original equation will be rewritten as follows (formula 5):

$$y_t = a + c_0 \cdot z_0 + c_1 \cdot z_1 + c_2 \cdot z_2 + \varepsilon_t. \tag{5}$$

3. Further, using the Excel package, the parameters of the multiple regression equation are calculated. On the basis of the results obtained, it is necessary to assess what proportion of variation of the studied performance indicator is due to the influence of factors included in the multiple regression equation (based on the coefficient of multiple determination R^2) and check the constructed regression model for adequacy using Student's t-statistics.

4. Based on the found regression coefficients and relationships (formula 3), the regression coefficients of the original model are calculated and a model with a distributed lag is built (formula 1).

The paper analyzes annual data from 2009 to 2021 on the volume of external public debt (as a factor indicator) and key indicators of Ukraine's economic development (GDP, foreign exchange reserves, foreign direct investment).

Statistics for building models were selected in US dollars, and not in hryvnia equivalent, since analyzing the amount of Ukraine's ex-ternal public debt (Figure 1), one can see that since 2014 there has been a sharp deterioration in Ukraine's external debt stability. The period from January 2014 to early 2015 can be called a phase of extensive growth.

However, the growth of external public debt in hryvnia equivalent is not always accompanied by additional borrowing. It is important to note that in January 2015, public debt indicators were provided in accordance with the exchange rate of UAH 7,993 / one US dollar. However, already in February, the public debt reached a sharp increase due to a sharp devaluation (on February 26, the lowest official rate of UAH 30 per 1US dollar was recorded).

It should also be noted that the growth phase of 2009–2021 is not homogeneous, since at the very beginning and in 2021 these are completely different processes in terms of their quantitative assessment.

Therefore, to level the impact of the exchange rate and to adequately evaluate the data, data in US dollars were taken as data for calculation (Table 1).

The information base of the study is the legislative and regulatory legal acts of Ukraine, statistical materials of the State Statistics Service of Ukraine, data of the Ministry of Finance of Ukraine, articles by Ukrainian and foreign scientists.

Source: Built by the authors based on data from the Ministry of Finance of Ukraine.
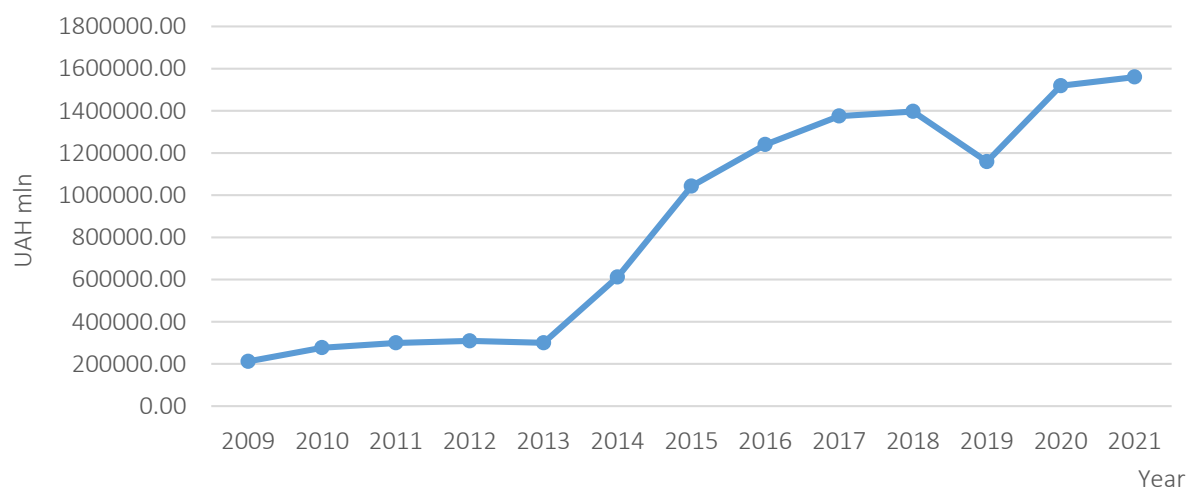

Figure 1. Time series chart of Ukraine's external public debt for 2009–2021, UAH million

Table 1. Initial data for calculation for 2009–2021, USD mln

Period	External public debt	GDP	Foreign direct investment	FX reserves
December 31, 2009	26518,70	117228,00	4654,00	26505,00
December 31, 2010	34759,60	136419,00	5759,00	34576,00
December 31, 2011	37474,50	163160,00	7015,00	31794,61
December 31, 2012	38658,80	175781,00	7195,00	24546,19
December 31, 2013	37536,00	183310,00	4079,00	20415,71
December 31, 2014	38792,20	131805,00	299,00	7533,33
December 31, 2015	43445,40	90615,00	-407,00	13299,99
December 31, 2016	45604,60	93270,00	3794,00	15539,33
December 31, 2017	48989,40	112154,00	3684,00	18808,45
December 31, 2018	50462,50	130832,00	4460,00	20820,43
December 31, 2019	48940,80	153781,00	5212,00	25302,16
December 31, 2020	53720,80	155582,00	-950,00	29132,63
December 31, 2021	57197,00	–	5218,00	30 940,95

3. RESULTS AND DISCUSSION

Let's analyze the impact of external debt on Ukraine's GDP. Let us construct an econometric model with a distributed lag for three years, $p = 3$.

To calculate this model, the initial data are converted into new variables according to the system of formulas 4. Further, using the Excel package, the parameters of the multiple regression equation will be calculated. The calculation of the parameters led to the following regression equation (formula 6):

$$y_t = -139070,05 - 9,97 \cdot z_0 + \\ +22,73 \cdot z_1 - 6,87 \cdot z_2, \qquad (6)$$

where

$$c_0 = -9.97,$$

$$c_1 = 22.73,$$

$$c_2 = -6.87.$$

Multiple determination coefficient $R^2 = 0.6196$, i.e. 62% of the variation in the performance attribute is explained by the factors included in the model. Let us now test the constructed regression model for adequacy using Fisher's criterion. From the regression analysis, $F = 27,14$. This value is greater than the tabular one, and the significance of $F = 0,0015 < 0,05$; this indicates the percentage of error from which the regression equation is calculated and the adequacy of the constructed model.

Let us check the significance of regression coefficients using Student's t-statistics. Regression analysis showed the following results (Table 2).

Table 2. Indicators of regression analysis of GDP/PD

Y crosscut	Coefficients	P-value
c_0	−9.97	0.0150
c_1	22.73	0.0137
c_2	−6.87	0.0140

Since the P-value for all regression coefficients is less than 0.05, one can conclude that they are significant. Based on the found regression coefficients and relations (7), the regression coefficients of the original model are calculated:

$$b_0 = -9.97,$$

$$b_1 = -9.97 + 22.73 - 6.87 = 5.89,$$

$$b_2 = -9.97 + 2 \cdot 22,73 - 4 \cdot 6.87 = 8,$$

$$b_3 = -9.97 + 3 \cdot 22.73 - 9 \cdot 6.87 = -3.84, \quad (7)$$

So, the model with distributed lag has the following form:

$$y_t = -139070,05 - 9.97 \cdot x_t + \\ +5.89 \cdot x_{t-1} + 8 \cdot x_{t-2} - 3.84 \cdot x_{t-3}, \qquad (8)$$

The structure of the lag in the model can be represented as shown in Figure 1.

An analysis of the model shows that an increase in external public debt by USD 1 million in the current period will lead to GDP growth over 3 years

by an average of USD 0.29 million. However, assessing the impact of debt on GDP by period, it should be noted that the short-term multiplier equals -9.97, that is, an increase in external debt by USD 1 million on average leads to a decrease in y_t (GDP) by USD 9.97 million in the same period. In a year, GDP will decrease by an average of -4.08; in two years GDP growth of USD 3.9 million can be forecasted.

The average lag in this model is 1.58. This value suggests that on average, an increase in Ukraine's GDP will change the size of public debt in 1.58 years.

Another factor that could cause large amounts of public debt to harm economic growth is the potential negative impact of the debt burden on foreign direct investment. When debt reaches a certain limit, foreign investors and creditors are wary of investing in an economy, which is detrimental to economic growth.

According to the basics of economic theory, external debt should affect the economy through investment and productivity. Since the main reason for attracting external loans is the lack of own funds to finance investment projects, the growth of total external debt should stimulate investment growth and capital growth, which leads to an increase in potential GDP. However, most often external loans can be used not for the implementation of investment projects, but for solving short-term problems to cover emerging deficits in the economy. Excessively high amounts of debt can also threaten to create a debt overhang, accompanied by an outflow of investment due to the fact that the income from potential investments does not go to investors, but is used to service previously taken loans.

The calculation of the parameters has led to the following regression equation:

$$y_t = -4261,42 - 0.05 \cdot z_0 - 1.06 \cdot z_1 + 0,43 \cdot z_2.$$ (9)

The adequacy of the constructed model is indicated by the multiple determination coefficient $R^2 = 0.7265$ and the value of $F = 0.0039 < 0.05$, indicating the percentage of error from which the regression equation is calculated.

Regression analysis showed the following results (Table 3).

Table 3. Debt/FDI regression indicators

Y crosscut	Coefficients	P-value
c_0	−0.05	0.008
c_1	−1.06	0.028
c_2	0.43	0.033

Since the P-value for all regression coefficients is less than 0.05, it can be concluded that they are significant. Using the found regression coefficients and ratios, a model with a distributed lag was obtained:

$$y_t = -4261,42 - 0.05 \cdot x_t + 0.68 \cdot x_{t-1} - 0.45 \cdot x_{t-2} + 0.64 \cdot x_{t-3}.$$ (10)

Analysis of the model shows that an increase in external public debt by USD 1 million will reduce foreign direct investment by an average of USD 0.53 million in three years.

The average lag in this model is 2.44, i.e., on average, attracting additional external debt to the Ukrainian economy will lead to a reduction in foreign direct investment in 2.44 years.

After analyzing the relationship between the indicators of external public debt (x_t) and FX reserves (y_t), the following regression values were obtained (Table 4).

Table 4. The obtained values for calculating the model with a distributed lag for external public debt and FX reserves for the period 2009–2021

Indicator	The value obtained	Characteristic
R-squared	0.600	Dependence is quite significant
F	3.008	The value is less than the tabular one indicates the inadequacy of the constructed model
F significance	0.116	> 0.05 Significant error rate
P-value z_0	0.887	The obtained regression coefficients are not significant
P-value z_1	0.378	
P-value z_2	0.264	

Unsatisfactory results obtained in calculating the relationship between the indices indicate the impossibility of using a distributed lag model to iden-

tify the relationship between external public debt (x_t) and FX reserves y_t.

The constructed models reflect the relationship between key indicators of Ukraine's economic development and the country's external public debt. This allows modeling the development of the economy and determining the dynamics of macroeconomic indicators and external debt within a certain forecast horizon, which reflects different behaviors of the model variables.

CONCLUSION

The most painful issue of Ukraine's financial system in recent years is the critical state of public debt, which was formed haphazardly, under the influence of the need for operational financing of current budget expenditures, which is reflected in its structure and dynamics. Ensuring the stability of the economic system and keeping the external debt burden within safe limits, or at least ensuring its permanence, are the primary tasks of Ukraine's debt policy.

To assess the impact of Ukraine`s external public debt on the country`s economic development indicators, a distributed lag model was chosen. The results show the interdependence and causality of factors that are affected by external public debt. Based on the constructed econometric model with distributed lag to analyze the relationship between GDP and external public debt, it was found that the indicators are closely related to each other. The resulting general correlation coefficient allows us to state that the change in GDP by 62% depends on the change in external public debt. At the same time, an increase in external public debt by USD 1 million in the current period will lead to GDP growth in three years by an average of USD 0.29 million. The average lag in this model is 1.58. This value suggests that, on average, an increase in Ukraine's GDP will change the amount of public debt in 1.58 years.

An analysis of the external public debt and foreign direct investment indicators suggests a significant interdependence between the indicators (72.65%). It was found that an increase in external public debt by USD 1 million will lead to a reduction in foreign direct investment by an average of USD 0.53 million in three years. The average lag in this model is 2.44, i.e., on average, attracting additional external debt to the Ukrainian economy will lead to a reduction in foreign direct investment in 2.44 years.

At the same time, one of the key stages of econometric modeling and building a comprehensive study on the state of external public debt and its interdependence with a country's economic development is the selection and formation of data for further work. In particular, the analysis of the relationship between foreign exchange reserves and external debt has shown the inadmissibility of building models with a distributed lag.

Thus, the obtained equations of models with distributed lag will allow modeling the economic development of a country (by key indicators) and the external dynamics of debt within certain forecasts.

AUTHOR CONTRIBUTIONS

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