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ANALYSIS OF THE INFLUENCE OF MONETARY INSTRUMENTS ON THE SIZE OF THE DOMESTIC PUBLIC DEBT

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ABSTRACT

The article is devoted to highlighting the results of research aimed at improving existing approaches to conducting a comprehensive analysis of the nature of the relationships between the parameters of the state's monetary and debt policy. Among other things, such indicators as the size of the domestic public debt, the size of international reserves, the level of inflation, the exchange rate and the discount rate are taken into account.

The proposed approach to the analysis of the influence of managed monetary indicators on the size of the internal state debt proved that the use of the ARDL model gives slightly better results than the VECM in terms of the adequacy of the description and forecasting of the studied process. At the same time, both models proved their ability to describe the change in the size of the internal state debt, and have high values of coefficients of determination and low values of the indicator of the average absolute percentage error. In the future, it is recommended to use it for the analysis of the causality of the influence, discriminant analysis and the expediency of changing monetary instruments independently of other instruments.

On the basis of the developed models, the results were obtained, which allow us to draw conclusions that the system continues to remain stable after fluctuations of key factors capable of destabilizing it and will be able to return to its previous state after a shock for some time. This is confirmed by the fact that, on the basis of statistical tests, the existence of a long-term relationship between the investigated indicators and the impulse response function together with the decomposition of the variance of the VAR model was proved.

Keywords: monetary policy, public debt, modeling, analysis, monetary instruments, econometric model

JEL Classification: E52, E65, C54

INTRODUCTION

World experience demonstrates how the relationship between the financial market and the strategy of the central bank can significantly affect the effectiveness of public debt financing mechanisms. At the same time, fiscal policy is important for the quality and choice of approaches to debt management, as well as determining its volume. On the other hand, as Zettelmeyer T.W. points out, (2022), a well-thought-out and well-adjusted monetary policy based on the mechanisms of inflation targeting and reducing inflationary expectations can strengthen confidence in the central bank, as well as create prerequisites for increasing the level of public debt, which is determined by the state's capabilities.

According to studies conducted by the IMF (Steady Prices, Sustainable Debt. (2022, March 1), the governments of countries with developed economies can pay much less for debt service than those of developing ones because effective monetary policy allows to maintain more stable prices and low interest rates, which also minimizes interest rate risk.

Currently, world practice has made significant progress regarding models of debt policy management. From the set of existing models of institutional support for public debt

management, namely: the banking model (the central bank of the country manages the public debt - Cyprus, Denmark, Malta), the government model (the public debt is managed by a certain government structure - the Ministry of Finance, the State Treasury - the Czech Republic, Estonia, Spain, Lithuania, Luxembourg, Poland, Slovenia, Italy), agency model (a separate structure-agency chooses the most optimal methods of public debt management - Austria, Belgium, Finland, France, Greece, the Netherlands, Ireland, Latvia, Germany, Portugal, Slovakia, Sweden, Hungary, Great Britain) each country chooses the model that corresponds as much as possible to the realities of the mechanism of state regulation of the relevant processes (Pilko, A. (2015).

Central bank independence also plays an important role in protecting debt from undesirable monetization and inflation risk. The central bank can also use its powers to increase the demand for government bonds to prevent a sovereign debt crisis. Price stability insulates government debt from inflation risk, anchors inflation expectations, removes inflation-related risk premiums, reinforces the focus of macroprudential policy on inflation, and helps guide central bank balance sheet policy along with the extent of government fiscal support. Price stability also maximizes debt revenues and helps to maintain public debt sustainability.

The importance of separate management of debt and monetary policy is emphasized by Singh, Ch. (2015). At the same time, the priority remains to ensure and preserve the independence of the central bank, to ensure transparency and accountability, as well as to improve debt management by entrusting portfolio management with knowledge of modern risk management methods. Given the fact that the goal of debt policy management is to attract resources to the market with minimal costs while optimizing risks, and monetary policy management aims to achieve price stability, the concentration and monopolization of the means of influence by these two components of macroeconomic policy in the hands of one institution will not bring expected results and macroeconomic effect.

LITERATURE REVIEW

Due to such unpopular and mostly unsustainable policy options for reducing the real cost of debt in crisis conditions such as inflation or financial repression, attention has been renewed to market-based ways of debt restructuring, especially domestic debt restructuring. One of the steps prescribed in the IMF document on determining the type of restructuring is to ensure the normal operation of the central bank, including the payment system (Grigorian, D.A. (2023)).

Hurtado, S., et al. (2022) analyze the consequences of monetary policy and consider the consequences of discretionary inflation policy for the sustainability of public debt and welfare. It is also indicated that inflation, the target level of which is determined by the central bank itself, can become a tool for stabilizing large debt, and will also provide a quantitatively significant increase in welfare in situations of debt stress.

Correa, P. (2000) analyzes the main relationships between public debt policy and monetary policy in Colombia during 1995-1999 when Colombia's capital markets were experiencing significant shocks.

The results obtained by Miguel A., Martin-Valmayor, et al. (2024) based on the analysis of macroeconomic indicators of the USA, Great Britain, Germany, France, Italy and Spain, point to the high stability of the ratio of debt to GDP and debt per capita. Empirical results confirm the need for better coordination of fiscal and monetary policies to strengthen debt control in the countries under study.

A.F.H. Cavalcanti, M. et al. (2018) use a DSGE model to investigate the macroeconomic consequences of monetary policy shocks when fiscal rules are constrained to ensure public debt acceptability using the Brazilian economy as an example. It has been proven that under such conditions, an increase in the interest rate after a shock in monetary policy increases the cost of debt financing, which makes a fiscal adjustment necessary to guarantee debt sustainability. The simulation results show that the magnitude of GDP reduction after a monetary policy shock varies significantly depending on the adopted fiscal rule.

Alberola, E., Cheng, G., et al. (2023) adapt the stochastic debt sustainability model to the features of the Japanese economy within the monetary policy implemented by the central bank. The model takes into account the impact of non-conventional monetary policy on the dynamics of public debt. In particular, a wide range of monetary and fiscal variables were taken into account, and the agreed measure of risk made it possible to draw probabilistic conclusions about sustainability. The significant beneficial impact of the quantitative and qualitative easing (QQE) launched by the Bank of Japan in 2013 is identified and quantified.

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Duca M.L. et al. (2024) analyze the impact of macroeconomic and monetary policy shocks on corporate default risk, measured by firms' probability of default (PD), for the four largest euro area countries. The authors argue that the outstanding debt of companies and their ability to repay debts is an important channel of transmission of these shocks, but the accumulation of cash reserves helps to create resilience.

Inefficient government management of internal borrowings, and their abuse on the example of a small economy (Okeke V. et al., 2022) can lead to a negative impact on the welfare of citizens, development and growth of the economy, and domestic production.

The influence of international reserves on the exchange rate and its volatility is studied in (Vieira F., Silva C., 2022) using autoregressive distributional-lag (ARDL) models. The significance of the influence of reserves and, in particular, domestic debt on the stability of the national currency rate is also demonstrated.

The ARDL model was also useful when studying the impact of debt-to-GDP ratio, inflation, exchange rate and other macroeconomic factors on economic growth and found that the amount of debt becomes an obstacle to economic growth (Tabash, M. et al., 2022).

The NARDL model helped identify the short- and long-run asymmetric relationship between public debt and economic growth in most of the 10 selected Arab countries. At the same time, one of the studied indicators is inflation (Public Debt in the Arab World, May 3, 2023)). The results also show that the interaction between debt and growth can be unstable over time and change depending on different economic conditions.

The results of the study (Pilko, A., Chepyha, B., 2022), obtained through the use of applied econometric tools, namely simulative models (simultaneous structural equation systems) and vector autoregressive (VAR) models proved that monetary indicators have a statistically significant effect on the amount of domestic public debt.

A high level of public debt increases the risk of default, which threatens economic growth, increases inflation and complicates the process of price stabilization. The developed New Keynesian model by Clement, D. (2023) allows to integrate the sovereign default risk into the standard monetary policy. With the help of the FAVAR model (VAR family) on the example of a small open economy, the significance of the impact of a tight monetary policy on the growth of government bond yields was proven, which in turn increases debt service costs and inhibits economic activity (Hodula, M., Melecký, A., 2020).

Another type of model that can be implemented to study the influence of key factors on the resulting indicator is the vector error correction model (VECM), based on which the modelling results indicate the significance of the influence of public debt, inflation and other indicators in the short- and long-term on the unemployment rate (Panaite et al., 2022).

Ackah B. (2023) examines the relationship between discount rates and domestic debt in Ghana. Using time series data, the vector error correction model (VECM) was used to analyze the results of the study, which revealed that in the long run, domestic debt has a negative effect on monetary policy indicators, and in the short run, the reverse effect is observed. A statistically significant relationship was found between inflation and real GDP and the course of monetary policy in the long run, indicating a positive and negative impact, respectively. In the short-term period, only the effect of inflation turned out to be statistically significant.

Especially relevant in the conditions of a full-scale invasion is the study of the experience of analyzing the impact of military spending, monetary policy and public debt on economic growth. Such an analysis using the ARDL model on the example of the economy of Cameroon for the period 1980–2021 was carried out by Njamen Kengdo, A.A. (2023). It is quite obvious and predicted that the conclusions were drawn that public debt and military spending harm economic growth in the short and long term. At the same time, it was established that the interaction between public debt and military expenditures reduces growth efforts and emphasizes the existence of sustainability thresholds for public debt (56.42% of GDP) and military expenditures (between 1.29% and 1.47% of GDP), other things being equal conditions.

Marine C. André, et al. (2023) analyze the interaction of monetary and fiscal policy in the context of debt management in Mexico based on a calibrated semi-structural model for a small open economy using quarterly data from the first quarter of 2001 to the fourth quarter of 2019. The impact of the risk premium channel on the transmission of the threat from the fiscal bloc to the monetary bloc, urging the central bank to stabilize inflation, is described. Marine C. André, et al. (2023) proved that in a steady-state economy, an exogenous monetary policy shock affects the fiscal block mainly through the effect of the interest rate on debt service, prompting a fiscal response to stabilize the deficit.

Taking into account the results obtained by researchers of the problems of debt policy management, modelling of relationships between macroeconomic indicators and parameters of debt and monetary policy, it is worth specifying a part of

the general scientific problem, which, in our opinion, urgently needs to be solved, taking into account the realities of a country with a small open economy. It is about the development of several alternative classes of models of analysis and forecasting of the nature of relationships between macroeconomic indicators in order to determine the quantitative interdependencies between the results of the activation of monetary instruments and the parameters of domestic public debt.

AIMS AND OBJECTIVES

The purpose of the research, some results of which are presented in this publication, is to improve the existing approaches to conducting a comprehensive analysis of the nature of the relationship between the parameters of the monetary and debt policy of the state under conditions of a small open economy, in particular at the level of the internal state debt, international reserves, inflation, exchange rate and accounting rate. To achieve the goal, the expediency of using monetary policy tools in the context of optimizing the amount of debt is considered.

METHODS

The goal set was achieved along with obtaining scientifically based results according to the proposed methodology thanks to the use of such research methods as the collection and analysis of available statistical information, the extended Dickey-Fuller test to detect stationarity, the Granger and Johansen cointegration tests to detect the long-term relationship between the studied indicators, methods of parameter estimation and analysis of econometric models of time series.

RESULTS

Some issues of improving existing and developing new scientific and methodological approaches to the formation and optimization of debt policy management processes in the conditions of a small open economy for Ukraine at the moment are such, the successful solution of which will largely depend on the further possibility of ensuring economic and social security of the state. As Pilko, A. (2015) notes, the procedure of systematic analysis of the problems and tasks of public debt management requires the expansion of this scientific problem to problematics - that is, a set of interrelated and mutually determined problems, the consideration and solution of which is a necessary condition for the optimization of public debt management state.

From the point of view of administration, internal debt is characterized by certain advantages compared to external one. Its repayment is guaranteed and provided at the expense of internal sources and does not reduce the financial potential of the state (Sochka, K. (2022). It is easier for the central bank and the government to manage and service the debt of internal creditors with the help of various instruments. Also, from the point of view of restructuring, internal borrowings are more attractive, because the authorities can apply compulsory measures to optimize them.

The main instruments, the value of which the central bank can determine, taking into account various macroeconomic indicators and the current or prospective situation in the economy, are the discount rate, the exchange rate, the amount of gold and foreign reserves and the yield on government bonds.

First, the discount rate and its impact on the domestic debt should be noted. With an increase in the interest rate, payments on government bond debt also increase and vice versa, low rates allow the state to save its funds (Zamkova, N., Hnydyuk, I., 2022). Intrastate loan bonds are precisely such government bonds, due to which the debt grows, because banks, looking at the attractiveness of investments at a high rate and the macroeconomic situation in the country, choose such risk-free investments in their portfolio, rather than lending to the private sector of the economy and increasing consumption, which would lead to a positive effect on the national economy and debt sustainability will remain a major issue closely linked to interest rates in both advanced and emerging economies (Mitchener, K.J., Trebesch, C. (2021, March 22)).

Darvas, Z. (2022, December 24) emphasizes that an important factor in the sustainability of public debt is the difference between the discount rate and the growth rate of the economy. When the interest rate is higher than the growth rate, the government must maintain a primary budget surplus in order to prevent a sharp increase in the debt-to-GDP ratio. But when the interest rate is lower than the growth rate, the ratio can fall even if there is no primary surplus.

It is also believed that developing and less financially developed countries have a lower ratio between domestic and foreign debt and are more exposed to external shocks from interest rate fluctuations in developed countries. This effect can be overcome by the development of the domestic financial market with a simultaneous reduction in government bond rates.

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In turn, the amount of gold and foreign currency reserves is interrelated with the value of the exchange rate and allows to regulate the demand and supply of money, making interventions in the foreign exchange market. One such case is the implementation of an expansionary monetary policy, when the discount rate can be reduced, and the increased supply of currency leads to an increase in inflation and a decrease in the exchange rate. Reserves are also a kind of "standby" in case of external shocks. Their use allows to pay off part of the loans and save on paying interest on them. The independence of the state from foreign creditors and the stability of the financial system are also determined by the amount of reserves.

The impact of monetary policy and monetary unification on the formation and dynamics of public debt and debt policy in European countries was analyzed by Coccia, M. (2017). The conducted analysis showed that public debt indicators and debt policy parameters differ significantly between European countries. In particular, the countries that are members of the monetary union deteriorate the parameters of the debt policy at a higher rate than the countries outside the European monetary unification. Coccia, M. (2017) compares the dynamics of public debt and the general public deficit between European countries within and outside monetary unification for the previous and subsequent periods of the introduction of the euro and claims that the asymmetry in the development of public debt and public deficit trajectories in European countries is one of the factors that create uncertain scenarios and negative socio-economic consequences for the growth patterns of the general economy of the European Union.

Domestic debt is denominated in local currency in most cases. If the exchange rate changes, this can have a significant impact on the size of the country's domestic debt. A decrease in the exchange rate can lead to an increase in domestic debt. On the contrary, an increase in the exchange rate may lead to a decrease in the domestic public debt, just as the value of the foreign currency decreases. On the other hand, an increase in foreign currency debt may accelerate the expected rate of depreciation of the national currency (António Afonso et al. (2021, February 2). This is a currency risk. Therefore, monetary policy involves reducing it by adjusting the exchange rate itself, depending on the currency regime or the discount rate. Having an unproductive structure and inadequate governance can significantly inhibit the state's ability to ensure financial stability, which negatively affects the perception of risk by investors. It may also affect the central bank's ability to tighten monetary policy or the exchange rate policy.

In order to solve the problem of analysis and modelling of the impact of the main monetary instruments on the domestic public debt, the following variables were selected: the real amount of the domestic public debt (ID), the discount rate of the NBU (RTE), the average annual yield of the OVDP (YOOVDP), the official exchange rate of the hryvnia against the dollar (USDP)) and the real size of gold and foreign reserves (GR). The baseline observation period is January 2010, and the end period is December 2021. This data is taken from the monthly section (Official site of the Independent Association of Banks of Ukraine). The data is a time series, which must correspond to mental stationarity. The unit root expanded Dickey-Fuller test was used for this study.

Since it was found that the indicator is stationary only after the first operation, it was decided to test whether there is a long-term cointegrating relationship between the variables. For this purpose, Johansen and Granger tests were conducted. The results are presented in Table 1. A significance level of 1 at 5% confirms the existence of cointegration with rank 3, since in this case the statistical significance is not nearly critical.

Table 1. Results of cointegration tests.

	Johansen-statistic	5% critical value	Granger-statistic	5%critical value
r <= 4	2.52	9.24	2.52	9.24
r <= 3	11.35	19.96	8.83	15.67
r <= 2	30.52	34.91	19.17	22.00
r <= 1	59.71	53.12	29.19	28.14
r = 0	97.56	76.07	37.85	34.40

According to available methodical approaches to the analysis and modelling of time series, (Shrestha, M.B., Bhatta, G.R., 2018), it is possible to construct an autoregressive distributed lag model (ARDL) and vector error correction mechanism (VECM) model and compare their results. The model assumes that the variables are necessarily stationary, while the first-order transforms the variables and automatically transforms them to be stationary.

A set of criteria (Akaike, Schwarz, Final Prediction Error, and Hannan-Quinn) was used to determine the lag order of variables, and the maximum likelihood (ML) method was used to evaluate the models since the cointegration rank is

greater than 1. The model itself is represented by a system of equations, one of which, namely the equation of internal debt, is presented in Table 2.

Multiple criteria (Akaike, Schwarz, Final Prediction Error, and Hannan-Quinn) were used to determine the order of lag variables, and the maximum likelihood (ML) method was used to estimate the models because the cointegration rank is greater than 1, one of which is the internal equation, presented in Table 2.

Table 2. The coefficients of the VECM model volume of internal debt and its significance.

	coef	P > | t |		coef	P > | t |
ECTt-1	0.042	0.4	RTEt-3	-0.481	0.65
ECTt-2	-0.691	0.079	USDPt-3	1.835	0.24
ECTt-3	-0.394	0.33	YOOVDPt-3	-0.223	0.66
const	14.858	0.52	GRt-3	0.051	0.56
IDt-1	-0.062	0.57	IDt-4	-0.139	0.19
RTEt-1	0.233	0.82	RTEt-4	-0.225	0.82
USDPt-1	-2.82	0.02	USDPt-4	-0.146	0.92
YOOVDPt-1	-0.04	0.94	YOOVDPt-4	-0.401	0.37
GRt-1	-0.024	0.79	GRt-4	0.169	0.055
IDt-2	-0.025	0.81	IDt-5	-0.123	0.25
RTEt-2	-0.935	0.35	RTEt-5	-0.29	0.75
USDPt-2	-3.558	0.015	USDPt-5	-0.045	0.97
YOOVDPt-2	0.345	0.51	YOOVDPt-5	-0.524	0.16
GRt-2	0.142	0.14	GRt-5	0.073	0.41
IDt-3	-0.168	0.13			
R^2=0.9428					

As a result, we obtained a model of domestic debt with long-term ECT (Error correction term) and short-term coefficients, which are presented as variables in their differences. The interpretation of ECT is as follows: since only the estimate at ECT_{t-2} is both negative and statistically significant, the domestic debt will be able to return to its equilibrium state by 69% during each period after two periods from the beginning of the imbalance in the system. ECTs are described by the following long-term equation:

$$ECT_{t-1} = ID_{t-1} - 431.159005 * YOOVDP_{t-1} - 33.042432 * GR_{t-1};$$

$$ECT_{t-2} = -2.75 * 10^{-17} * ID_{t-2} + RTE_{t-2} + 3.101489 * YOOVDP_{t-2} + 0.3515506 * GR_{t-2};$$

$$ECT_{t-3} = USDP_{t-3} - 52.916855 * YOOVDP_{t-3} - 4.04197462 * GR_{t-3}$$

The compliance of the real and model-predicted internal debt values was checked in the differences in Figure 1, and indicators of the accuracy of the forecast of real values in Table 3.

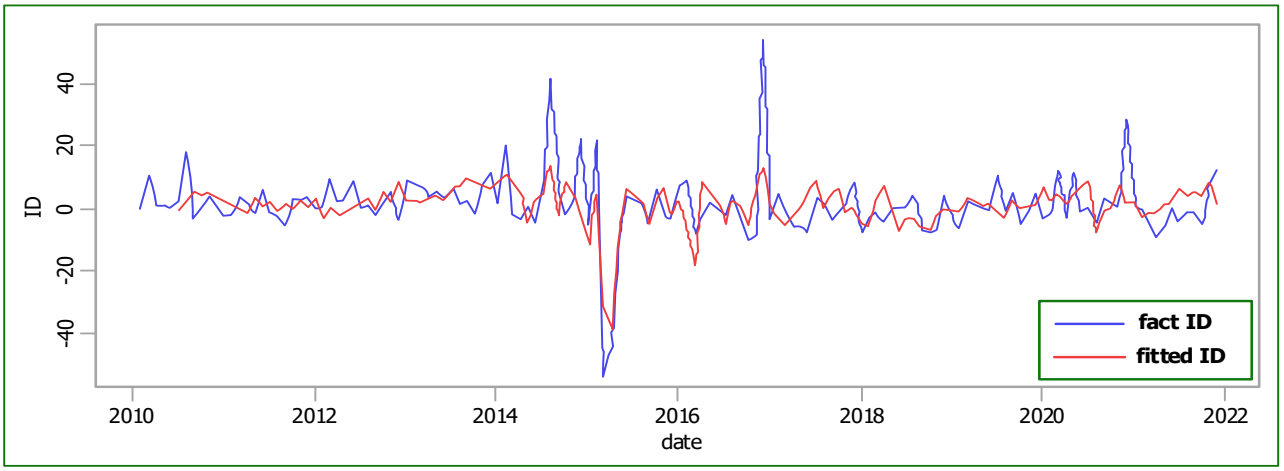

Figure 1. Actual and forecast values of domestic debt according to the VECM model.

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Figure 1 shows some similarity between the actual and trained values of the internal debt value of the VECM model, that is, how well the model tried to reproduce the dynamics of real data.

Table 3. Estimates of the forecast quality of the VECM model.

ME	RMSE	MAE	MAPE
8.196	16.236	13.205	5.195

The forecast quality score table contains absolute indicators such as mean error (ME), root mean square error (RMSE), and mean absolute error (MAE). The relative mean absolute percentage error (MAPE) is also displayed, which should be at most 5-10%, to better match the predictive property of the created model. In our case, it is 5.19%, therefore, in addition to the fact that most of the coefficients are not statistically significant, it is not possible to assert the adequacy of the model.

Instead of VECM, one should try the ARDL model, but before that, we need to learn more about the influence of one factor on another. Impulse Response Function (IRF) (Jung, W. (2022, March 23) and Variance Decomposition (FEVD) analysis require building a VAR model by first making the variables stationary.

Figure 2 demonstrates the dynamics of changes in domestic debt from changes in monetary indicators by one standard deviation. Domestic debt is most responsive to the pulse from the USDP variable and least responsive to the YOOVDP. It is not difficult to see that the shocks fade with time and almost completely decay within 48 periods. This means that the system is stable and able to return to its previous state.

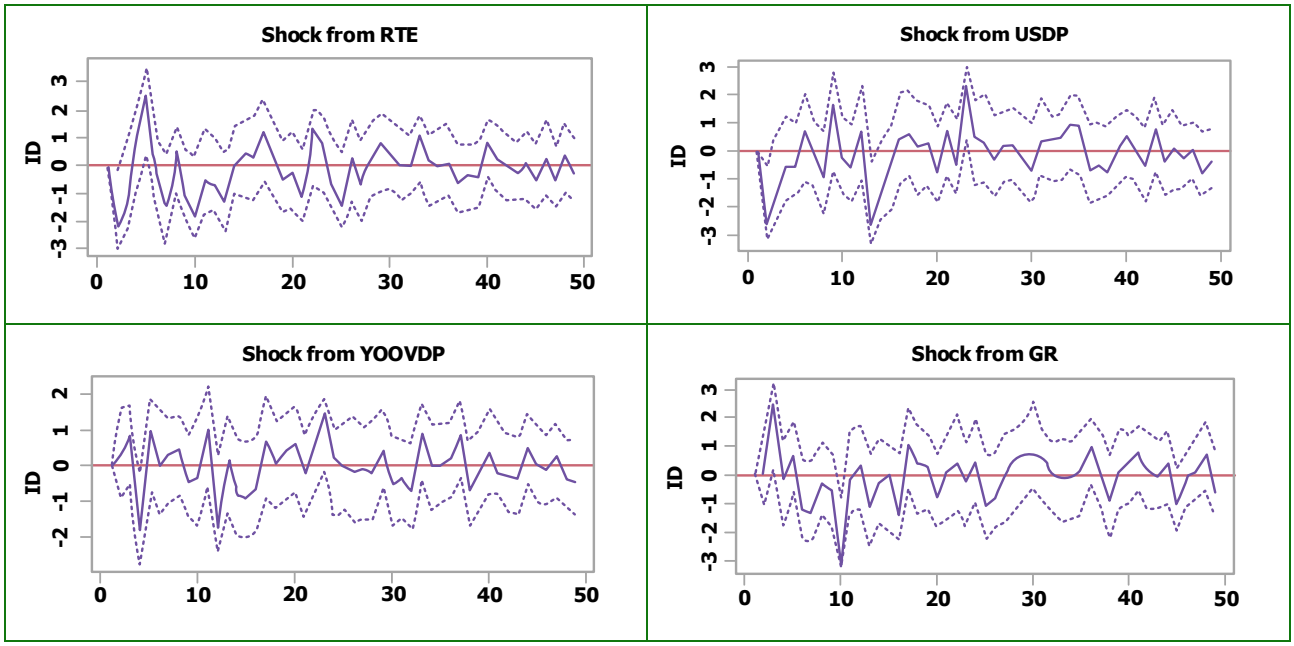

Figure 2. Response functions of domestic debt to shocks of other variables.

The debt has the biggest shock on the yield of OVDP and the exchange rate (Figure 3), and the smallest shock on gold and foreign reserves. It can be observed that the damping period from the shock is also approximately 48 periods.

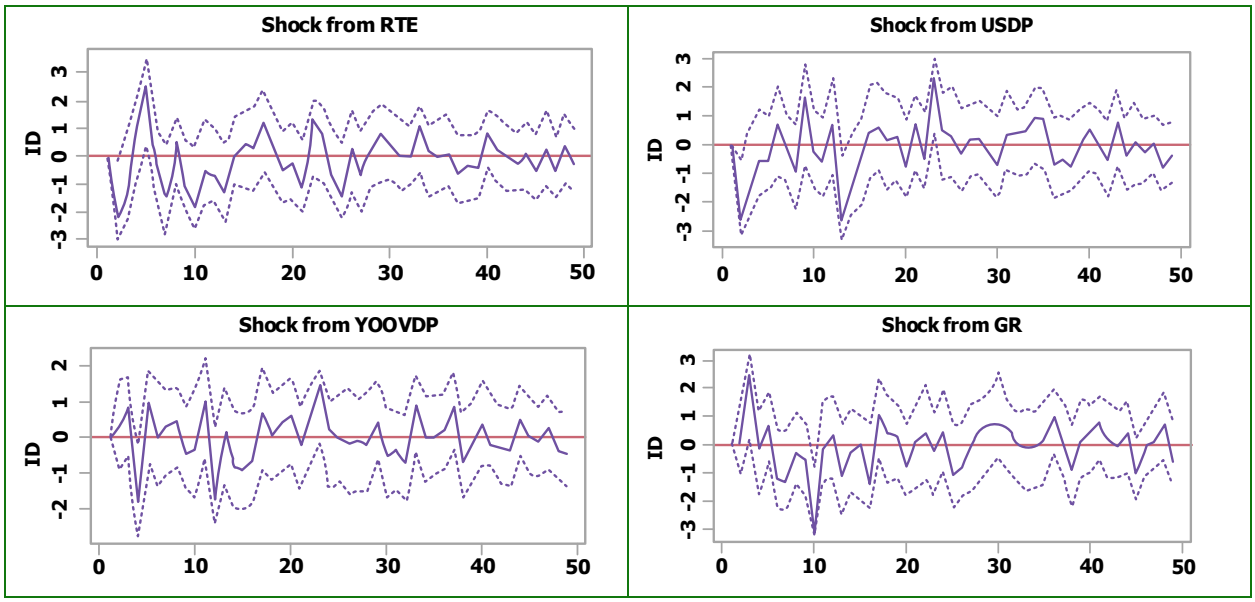

Figure 3. The response function of variables from domestic debt shock.

The conducted analysis of the variance of forecast error variance of the VAR model demonstrated the relative importance of factors influencing the dynamics of changes in a specific variable system and allows us to analyze the impact of various shocks on the variance of forecast errors over a certain period (in our case, 24 months). This is a relative indicator, so it is expressed as a percentage.

The greatest influence on the change in the size of the domestic debt (apart from the debt itself) is provoked by the exchange rate and the discount rate, which is no more than 15.76% and 14.58%, respectively, and the smallest is the yield of OVDP, which is no more than 7.1%. It is the effects of USDP and RTE that show constant growth, while other variables have a non-constant effect on debt.

At the same time, the internal debt has the greatest impact on changes in the discount rate and exchange rate, and is no more than 30.2% and 29.54%, respectively, and the least on the value of gold and currency reserves, no more than 9.29%.

The next step is to develop an ARDL model, which is not a system, but only a single equation with lagged values of the dependent and explanatory variables and also preserves the long-run relationship between the variables. The estimated model is presented in Table 4.

Table 4. ARDL coefficients of the domestic debt volume model and their significance.

	coef	P > | t |		coef	P > | t |
const	30.705	0.179	YOOVDPt-2	0.737	0.0068
USDPt	5.664	9.46*10-10	YOOVDPt-10	0.769	0.0027
USDPt-1	-5.012	8.1*10-6	GRt	-0.141	0.0291
USDPt-2	-3.065	0.008	GRt-1	0.144	0.0284
USDPt-3	1.873	0.011	GRt-9	-0.178	0.009673
USDPt-11	3.877	0.000127	GRt-10	0.191	0.009663
USDPt-12	-3.972	2.45*10-5	GRt-12	-0.126	0.0103
RTEt	-3.706	3.64*10-6	IDt-1	0.732	2*10-16
RTEt-1	3.421	7.82*10-5	IDt-10	0.225	0.0024
RTEt-5	-1.984	4.39*10-7	IDt-11	-0.222	0.0279
RTEt-10	-1.254	0.0113	IDt-12	0.307	0.0001
RTEt-12	1.608	0.0015			
R^2=0.986					

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The compliance of real and model-trained values of internal debt was checked during the entire period of observations in Figure 4, and the accuracy indicator of the forecast of real values in Table 5. All coefficients are statistically significant at the 5% level, except for the intercept.

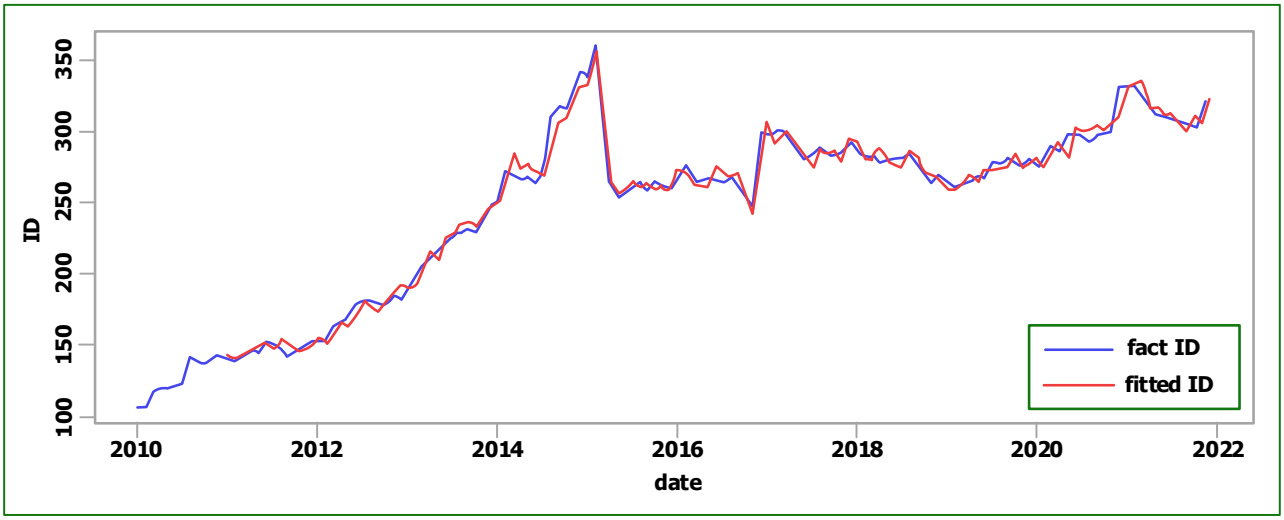

Figure 4. Predicted and actual values of the domestic debt indicator according to the ARDL model

Table 5. Estimates of ARDL model forecast quality.

ME	RMSE	MAE	MAPE
1.36	8.617	5.794	2.228

In the case of the ARDL model, we can say that the relative MAPE indicator is 2.23%, which does not exceed the threshold value of 5% and less adequately describes the actual amount of domestic public debt. Figure 4 is also a confirmation of this.

DISCUSSION

It is not a secret for anyone that in Ukraine during the transformation processes, the formation of public debt took place in the vast majority of cases chaotically, under the influence of the needs of operational financing of current budget expenditures, which left its mark on its structure and volumes Pilko, A. (2015). As Pilko, A. (2015) rightly notes, the actual conduct of hostilities in certain regions of the state and the conditions of external aggression with all the economic, social, and military-political consequences generally make it impossible to form an adequate applied system for optimizing and forecasting the parameters of debt policy, that is, it has the place is actually situational regulation by this component of the management of economic security of the state.

In our study, existing approaches to the analysis of the nature of the relationship between the parameters of the monetary and debt policy of Ukraine have been improved, in particular at the level of the domestic public debt, international reserves, inflation, the exchange rate, and the discount rate. In addition, the expediency of using monetary policy tools in the context of optimizing the amount of debt is considered.

The novelty of the obtained results lies in the development of the existing scientific and methodological tools of macro-econometric modelling and forecasting of the amount of domestic debt. Isolation of monetary policy indicators regardless of other macroeconomic factors, the use of the adjusted Akaike criterion to determine the value of the lag of variables made it possible to develop and evaluate a set of models that can be used in the process of evaluating the impact of monetary instruments on domestic debt and debt policy, which is a distinctive feature of this approach compared to similar developments.

Learning from the positive experiences of conducting time series analysis and modelling, in particular the results of (Shrestha, M.B., Bhatta, G.R. (2018), allowed the development of error correction models (VECM) and autoregressive distributional lag models (ARDL) to estimate the long-run equilibrium interdependence between variables that The duration

of lags is also determined and the lag effects of changes in the nature of the influence of monetary and debt policy factors on the amount of public debt are taken into account.

Since the developed models turned out to be adequate, and unlike the empirical results mentioned in the "Literature Review" section, they have the vast majority of statistically significant parameter estimates, we were able to make appropriate reasonable conclusions about the nature and strength of the influence on the change in the size of the domestic debt of such factors as exchange rate and discount rate. These monetary instruments affect the change in the amount of domestic debt, respectively, no more than 15.76% and 14.58%. At the same time, the influence of OVDP yield is no more than 7.1%. Other variables, as the analysis showed, do not have a systematic impact on debt.

On the other hand, domestic debt is most affected by changes in the discount rate and exchange rate. The corresponding indicators are no more than 30.2% and 29.54%, respectively. It is natural that the internal debt has the least influence on the amount of gold and foreign exchange reserves (no more than 9.29%).

It can be recognized that the results obtained by us based on the developed models are comparable to the results obtained by Hurtado, S., et al. (2022), Vieira F., Silva C. (2022), Tabash, M. et al. (2022) and Ackah B. (2023) as part of the analysis of the nature of the influence of monetary instruments on macroeconomic indicators and indicators of debt policy for countries with small open economies.

CONCLUSIONS

The proposed approach to the analysis of the influence of managed monetary indicators on the size of the domestic public debt proved that the use of the ARDL model gives somewhat better results than the VECM model when it comes to adequate description and forecasting of the studied process. At the same time, both models proved their ability to describe the change in the amount of domestic public debt, and have high values of coefficients of determination and low values of the indicator of the average absolute percentage error. Therefore, in the future, it is recommended to use it for the analysis of the causality of the influence, discriminant analysis and the expediency of changing monetary instruments independently of other instruments.

A causality analysis of the effect indicated that not reducing the discount rate could slightly reduce the amount of domestic debt, interacting with the OVDP rate, although the theory described the opposite events with a higher rate. This can be explained by the volatility of the period under study and the conditions that developed during the pandemic, which affected investor demand. In turn, smaller than real reserves would increase the size of the debt.

The use of applied econometric tools made it possible to determine the list of key factors that have the greatest impact on the size of the domestic public debt. According to the VECM model, the largest number of statistically significant parameter estimates characterizes the internal exchange rate and gold and currency reserves; according to the ARDL model - exchange rate; the analysis of the VAR model showed that the shock on the amount of debt has a much greater impact than the exchange rate.

Based on the formed models, it can be argued that the system is stable and will be able to return to its previous state after a shock for some time. This is confirmed by the fact that, on the basis of statistical tests, the existence of a long-term relationship between the studied indicators and the impulse response function together with the decomposition of the variance of the VAR model was proved.

It should be noted that with the appearance of new data, it is necessary to carry out an economic and mathematical analysis of the sample every time. It is quite obvious that in this case, the estimates of the parameters of the econometric models will differ slightly from the obtained ones. Accordingly, there will be new conclusions about the nature of the impact of individual monetary policy instruments on the size of the state debt.

Further research in this direction will make it possible to form a set of models for analyzing the impact of monetary instruments on the amount of domestic public debt, taking into account the active monetary regime, as well as the impact of changes in the amount of gold and foreign exchange reserves and aid from partner countries on the parameters of monetary and debt policy.

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ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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АНАЛІЗ ВПЛИВУ МОНЕТАРНИХ ІНСТРУМЕНТІВ НА ВЕЛИЧИНУ ВНУТРІШНЬОГО ДЕРЖАВНОГО БОРГУ

Стаття присвячена висвітленню результатів проведених досліджень, спрямованих на вдосконалення нинішніх підходів до проведення комплексного аналізу характеру взаємозв'язків між параметрами монетарної та боргової політики держави. До уваги серед іншого взято такі показники як величина внутрішнього державного боргу, розмір міжнародних резервів, рівень інфляції, обмінного курсу та облікової ставки.

Запропонований підхід до проведення аналізу впливу керованих монетарних показників на величину внутрішнього державного боргу засвідчив, що використання ARDL-моделі дає дещо кращі результати, аніж VECM у плані адекватності опису та прогнозування досліджуваного процесу. Водночас обидві моделі довели здатність описувати зміну величини обсягу внутрішнього державного боргу, мають високі значення коефіцієнтів детермінації та низькі значення показника середньої абсолютної відсоткової помилки. Надалі її рекомендовано використовувати для аналізу причиновості впливу, дискримінантного аналізу та доцільності зміни грошово-кредитних інструментів незалежно від інших інструментів.

На основі розроблених моделей отримано результати, які дозволяють робити висновки про те, що система продовжує залишатися стабільною після флуктуацій ключових чинників, здатних її дестабілізувати, і протягом певного часу після шоку зможе повернутися до свого попереднього стану. Підтвердженням цього є й те, що на основі статистичних тестів було доведено наявність довгострокового зв'язку між досліджуваними показниками та функції імпульсних відгуків разом із декомпозицією дисперсії VAR-моделі.

Ключові слова: монетарна політика, державний борг, моделювання, аналіз, монетарні інструменти, економетрична модель

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