Research of functional changes in foreign exchange rate EUR/UAH under conditions of economic transformation in Ukraine

Oksana Oliinyk[1, CDFMR], **Valentyna Ksendzuk**[2, CDFMR], **Larysa Sergiienko**[3, CDFMR], **Iryna Lehan**[4, CDFMR]

State University "Zhytomyr Polytechnic", Zhytomyr, Department of Economic Safety, Public Management and Administration Ukraine, [1]e-mail: oov76@ukr.net, https://orcid.org/0000-0003-2188-9219; [2]e-mail: walentyna_ksiedzuk@ukr.net, *(corresponding author),* https://orcid.org/0000-0001-7670-7350; [3]e-mail: sergiienko.lv@gmail.com, https://orcid.org/0000-0003-3815-6062; [4]e-mail: legan.i@ukr.net

How to cite:
Oliinyk, O. Ksendzuk, V. Sergiienko, L. and Lehan, I. (2020). Research of functional changes in foreign exchange rate EUR/UAH under conditions of economic transformation in Ukraine. *Bulletin of Geography. Socio-economic Series*, 48(48): 141-154. DOI: http://doi.org/10.2478/bog-2020-0018

Abstract. The article substantiates the need to carry out a research of the factors affecting the change in the exchange rate of EUR/UAH due to the fact that the devaluation of the Ukrainian hryvnia in the last few years destabilizes the economic environment of entrepreneurship development. Thus, this work analyzes the determinants of the exchange rate in Ukraine, and the investigated correlation between the dependence of the EUR / UAH exchange rate on a set of factors confirmed the tight correlation between the change in money supply and government debt and the rise / fall in the EUR / UAH national currency. Instead, other factors (GDP, budget deficit, export operations, the positive balance of payments, inflation, public debt) have statistically insignificant correlation to the studied indicator and are not included in the regression model. It is suggested to harmonize monetary policy that has the greatest influence on the formation of the exchange rate, as well as to analyze the connection this policy with the foreign trade policy of the country, which will enable to stabilize the exchange rate as well as to ensure the formation of suitable conditions for the economic development of foreign economic entities.

Contents:

1. Introduction

Opportunities and prospects in the development of foreign economic relations depend on the chosen direction of foreign policy of the country. According to the Law of Ukraine On the Principles of Internal and Foreign Policy, one of the main tasks of the country's foreign policy is: "ensuring the integration of Ukraine into the European political, economic and legal space in order to become a member of the European Union; support of development of trade-economic, scientific-technical and investment cooperation of Ukraine with foreign states on the basis of mutual benefit; providing for the purpose of full economic development, raising the well-being of the people of the integration of Ukraine's economy into the global economic system; expansion of international cooperation in order to attract foreign investments, new technologies and management experience in the national economy in the interests of its reform, modernization and innovation development"(Law of Ukraine On the Principles of Domestic and Foreign Policy 2010). Compliance with these tasks is impossible without the implementation of a number of reforms that are taking place in Ukraine today. According to the Strategy for Sustainable Development "Ukraine 2020", the goal of which is "the introduction of European standards of life in Ukraine and the emergence of Ukraine's leading positions in the world" in Ukraine, one of the vectors of reforms in Ukraine is characterized by ensuring sustainable development of the state, carrying out structural reforms and, as a consequence, raising standards of living. Ukraine should become a strong economy with advanced innovations. First and foremost, it is necessary to restore macroeconomic stability, ensure sustainable growth of the economy in an environmentally sound way, create favorable conditions for conducting economic activity and a transparent tax system(Strategy for Sustainable Development" Ukraine 2020" 2015).

The purpose of such economic reforms is to create favorable conditions for the stable development of business, which is a key source of investment attraction and the basis for economic growth. One of the directions of business activity is the output of business entities in the external markets of goods and services, capital.

Export and import transactions are carried out using foreign currency, incomes and expenses of exporters and importers are formed under the influence of exchange rate changes. Foreign exchange policy is a part of the financial sector of the country's economy, its main provisions and regulatory instruments affect the decisions taken by companies in the field of foreign business activity.

The comprehensive program for the development of the financial sector of Ukraine up to 2020 contains the goal of "creating a financial system capable of sustainable economic development through effective redistribution of financial resources in the economy through the development of a fully-fledged market competitive environment in line with EU standards". Among the systemic problems in the financial sector, in particular: "tough administrative measures (including withdrawal of deposits, currency exchange operations), introduced in connection with the deployment of a military conflict and the economic crisis; reducing the volume of trades on domestic exchanges by 38% in 2014 to UAH 76 billion, including trading in stocks and derivatives by 46%, up to UAH 36 billionaire identified". In addition, among the factors hampering the development of the financial sector is the "limited number of financial instruments, including risk hedging" (The National Bank of Ukraine 2015).

The foreign exchange market of Ukraine is characterized by the volatility of the national currency and the low level of development of transactions with financial instruments, which impedes the effective conduct of foreign economic transactions by economic entities and creates barriers for the enterprises to enter the foreign markets of goods and

services, capital. According to the World Economic Forum Ukraine, 2016 rankings ranked 95th among 136 countries in the 2017 ranking of the Enabling Trade Index, dropping by 9 positions in two years (World Economic Forum 2016). Over the past 10 years, the national currency of Ukraine has depreciated by almost 3.5 times in relation to the euro, as evidenced by the data of the National Bank of Ukraine (Fig. 1).

The devaluation of the EUR/UAH exchange rate first of all negatively affects the activities of importers. Considering the fact that exporters use imported raw materials in the process of production, the cost of export operations is also increasing. Thus, the level of competitiveness of companies in the foreign markets of goods and services decreases.

Creating a stable foreign exchange market is one of the terms for economic development of the country. The urgency of the research is obvious given the current conditions of transformational changes in the economic, political and social life of Ukraine.

2. Goal, task and hypothesis of the research.

The main objectives are:
• to analyze the determinants of Foreign Exchange Rate in Ukraine;
• to define which of the determinants is playing the main role in foreign exchange rate;

• to make appropriate suggestions for suitable policy implementation concerning the issues due to the appreciation/depreciation of currency in the light of finding of the study.

The UAH/EUR exchange rate has been chosen because of the growing integration of the Ukraine economy with the European Union.

Signing of the Association Agreement between Ukraine and the EU has become the basis for deepening the development of economic (including trade) relations between Ukraine and the EU. In 2016, the deep and comprehensive free trade zone between Ukraine and the EU started its functioning. Today, the EU is Ukraine's largest trading partner (in 2017, 33% of foreign trade turnover was attributed to EU member states).

The main hypothesis of the study is to confirm that the change in the exchange rate of EUR/UAH depends on a change in a number of macroeconomic indicators (GDP growth, inflation, interest rate, general government deficit, current account balance, financial account balance, exports and imports of goods and services, external debt stocks etc.) in accordance with the theory of exchange rates.

The solution of the task is realized in the context of the implementation of the goals of the economic reforms undertaken in Ukraine and has the following meaning:

- theoretical: the application of the theory of exchange rates to explain the peculiarities of the functioning of the foreign exchange market of Ukraine;

- practical: will provide the foundation for the development of a foreign exchange risk management system for Ukrainian companies. Determin-
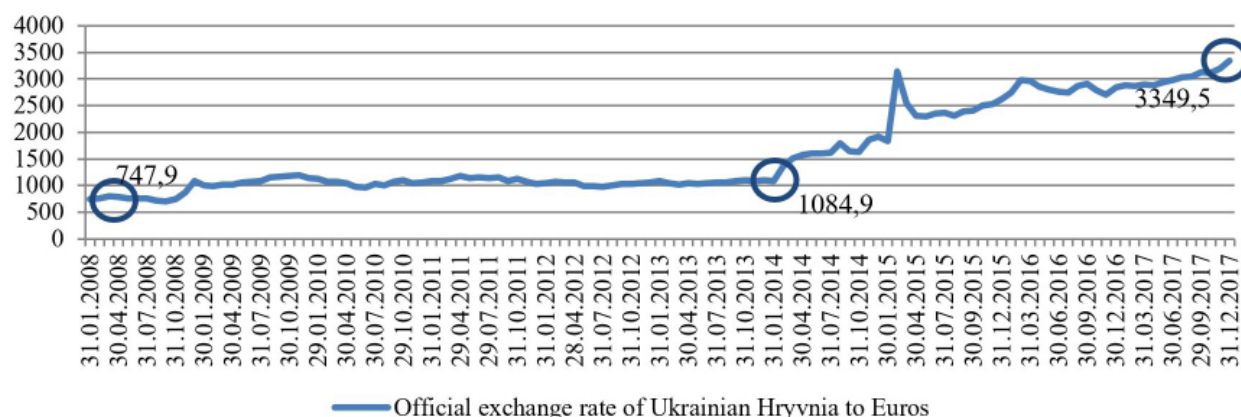

Fig. 1. Official exchange rate of Ukrainian Hryvnia to 100 Euros during the period 2008-2017
Source: (The National Bank of Ukraine 2018)

ing the effect of factors on the EUR/UAH exchange rate will allow Ukrainian exporters who make settlements in the euro on foreign markets of goods and services, to use the research data for planning and forecasting of foreign economic activity.

3. Theory of currency course

The research was conducted on the basis of the existing theories of exchange rates, which emerged in the 70's of the twentieth century. Each theory outlines certain principles that depend on which economic school they belong: Keynesian or monetary. "Theories of the exchange rate study the problems of the value basis in the relations of currencies, their dependence on the state of the balance of payments and the peculiarities of its dynamics, allow giving a clear idea of the data processes. It helps to choose the regime of exchange rates that are adequate to the specific economic situation and the methods of their realization"(Markusenko 2015).

The theory of purchasing power parity (PPP) is the first of the theories, its thorough analysis was carried out by Gustav Kassel, pointing out that "the willingness to pay a specified price for foreign money depends on the fact that the money in a foreign country has a purchasing value in relation to the goods and services" (Kassel 1995).

Such theory "assumes a causal link between the path of the price of a unit of one currency in terms of another and the relative dynamics of price levels in the respective two countries within a lengthy period of time" (Twarowska, Kąkol 2014). "The theory is aimed at searching for an "equilibrium course" that will maintain an equilibrium of payments balance. This is determined by its connection with the concept of automatic self-regulation of the balance of payments. Acknowledging the real exchange rate base, this theory emphasizes the role of market factors of alignment of exchange rates and thereby the balance of payments" (Markusenko 2015).

The market rate of the currencies almost never coincides with the parity of purchasing power. Analyzing the results of studies of the informal method of determining the parity of the purchasing power of the national currency, the data are slightly different in nature. According to the Economist maga-

zine, in January 2018, the Ukrainian hryvnia ranked first among the countries whose currencies are valued at The Big Mac Index. The purchasing power of the Ukrainian hryvnia is understated by 69.0%. The expected exchange rate of the national currency should be 8.90 UAH/USD (The Economist 2018).

"Proponents of the monetary approach to exchange rate determination view the exchange rate as the relative price of two monies. They therefore argue that variables affecting the supply of and demand for two monies will affect the rate of exchange between them. Quite a few studies have tested the monetary approach to exchange rate determination and some of the earlier ones are collected in Frenkel and Johnson (1978)" (Hartley1983).

Monetary models based on purchasing power parity of exchange rates determine the impact of the money supply, national income and interest rates on the formation of the national currency to the foreign currency.

Equally important are the foundations of the Keynesian theory (I. Fisher, 1925 and J. Keynes, 1978), according to which "it was recommended to reduce the rate of the national currency in order to influence prices, exports, production and employment in the country for the struggle for foreign markets". A representative of one of the Keynesian theories (R. Nurkse), i.e. the theory of equilibrium or neutral courses, emphasizes "the impact on the exchange rate of such factors as: customs payments, currency speculation, political and psychological factors" (Markusenko 2015).

Parveen S., Khan A.Q. and Ismail M. indicate, that "the empirical studies relating to the link between exchange rate variability and its factors are not conclusive. Exchange rates are basically the prices of one currency in terms of other currencies driven by the normal forces of supply and demand. There are a fixed number of Euros, Dollars, Yen, etcissued at any given time (although governments can and do print extra money to buy other currencies and impact their currencies value). As the demand increases or decreases for any single currency, it drives the clearing price for that currency" (Parveen, Khan, Ismail 2012).

Thus, according to the theoretical basis, the exchange rate is formed under the influence of a number of factors that have economic, political, legal, institutional character. The authors of various theo-

ries substantiate the influence of market factors and carry out research on the basis of empirical data in order to determine the relationship between factors and the rate of the national currency in relation to foreign.

4. Related Literature

The research is based on previous works of Ukrainian and foreign scholars regarding to outlined factors that determine the behavior of the national currency in the country.

"The first attempts to analyze exchange rates behavior was done by Rudiger Dornbusch (1973), Richard Meese(1979) and Kenneth Rogoff (1983)" (Boykorayev 2008, p. 22-23). Lane Philip undertook an empirical study of the formation of exchange rates in the long run and built its own models based on variables such as trade openness, country size, central bank independence (CBI) and government debt. The scholar analyzed 107 countries for the period 1974-1992 (Lane 1999).

The research of the 21st century scholars analyzes the influence of factors on the formation of the exchange rate based on the use of various methods: regression analysis (including simple linear regression model with the usual least method), the EGARCH method, an unrestricted vector autoregressive model (VAR), the econometric methodology and vector, econometric model of multifactorial regression. Table 1 systematized the views and results of such research.

Boykorayev B. analyzed the post - Bretton Woods period 1974 - 2004in 82 countries of the world. The

Table 1. The factors determining exchange rate in the scientific literature

Author (year)	Country and period of research	Method of research	The factors determining exchange rate
Boykorayev B. (2008)	82 countries of the world / the post-Bretton Woods period 1974-2004	Regression analysis	– nominal exchange rate: nominal exchange rate against USD; – real exchange rate: real exchange rate against USD; – inflation: nominal inflation as Consumer Price index; – openness: sum of Export and Import divided by GDP; – growth: per capita output (GDP) growth rate; – terms of trade: growth rate of Terms of Trade (Export/Import); – size: total GDP; – debt: government debt over GDP; – CBI: Central Bank Independence Index
Parveen S., Khan A.Q. and Ismail M. (2012)	Pakistan / the period 1975-2010	Simple Linear Regression model with ordinary least method	– Inflation; – Growth rate; – Exports; – Imports
Goudarzi Mostafa, Khanarinejad Komeil, Ardakani Zahra (2012)	Iran / the period of 1978-2008	the econometric methodology and vectorautoregressive model that is known as VAR	– budget deficit; – volume of money flows; – import restriction; – net foreign assets; – gross domestic product; – oil prices

Table 1. Continuation

Author (year)	Country and period of research	Method of research	The factors determining exchange rate
Abbas, Q., Iqbal, J., and Ayaz (2012)	African Countries / 15 years of data from 1996 to 2010	regression analysis	– GDP, – inflation, – interest rates, – income level, – government control; – future expectations of exchange rate
Twarowska K., Kąkol M. (2014)	Poland (EUR/PLN) the period of 2000-2013/	regression analysis	– the difference between the rate of GDP growth in Poland and in the euro area, – the difference between inflation rate (HICP) in Poland and in the euro area, percentage points, – the difference between money market interest rates (day-to-day) in Poland and in the euro area, percentage points, – current account balance in Poland (% GDP), – financial account balance in Poland (direct foreign investments, portfolio investments and other investments including currency speculation, % GDP). – the difference between government deficit as % GDP in Poland and in the euro area, percentage points
Hsing Yu (2015)	Poland (USD/PLN) / quarterly data ranging from 1999.Q1 to 2013.Q4 and has a total of 60 observations	the EGARCH method	– U.S. real federal funds rate; – polish real reference rate; – real GDP in the U.S.; – real GDP in Poland; – real stock index in the U.S.; – real stock index in Poland
Mariano Christine Niziel Q., Sablan Vanessa F., Sardon Joshua Ray C., Paguta Ronald B. (2016)	The Philippines / the period of 1973 – 2014	an unrestricted vector autoregressive model (VAR)	– GrossDomestic Product, – Volume of Money Flows, – Net Foreign Assets, – Budget Deficit, – Import Restrictions – Oil Prices
Krasnikova, L.I, Harmel, K.V. (2002)	Ukraine (USD/UAH)/quarterly data for 1996-2001	construction of an econometric model of multifactorial regression	- the growth rate of the consumer price index, - volume of external debt, - purchase of foreign currency by households, - refinancing rates

Table 1. Continuation

Author (year)	Country and period of research	Method of research	The factors determining exchange rate
LesnikT.M. (2017)	Ukraine(USD/ UAH) / 1996-2016	regression analysis	- nominal index of official debt, - annual average inflation rate, - average monthly salary, - GDP, - the population
Fatiukha N.H., Tsyhanok D.V. (2017)	Ukraine (USD, EUR, CHF, GBP, JPY/UAH) / 2009-2016	regressionanalysis	- GDP of the country - consumer price index - the amount of money supply M2, - volume of export and import

Source: formedonthebasis: (Boykorayev 2008), (Parveen, Khan and Ismail 2012), (Goudarzi, Khanarinejad and Ardakan 2012), (Abbas, Iqbal and Ayaz 2012), (Twarowska, Kąkol 2014), (Hsing 2015), (Mariano, Sablan, Sardon, Paguta 2016), (Fatiukha, Tsyhanok 2017), (Lesnik 2017), (Krasnikova, Harmel2002)

constructed regression model allowed the author to distinguish a number of factors of influence on the exchange rate, which are divided into two groups: "variables that affect the equilibrium long-run inflation rate and variables that affect the long run in the real exchange rate. Openness and per capita GDP growth variables are significant in explaining the rate of nominal depreciation when countries with inflation rate less than 30% are selected. For highly volatile countries Size (GDP) is found to be important for assessing nominal exchange rates. The evidence on other variables, such as CBI, Debt, Terms of trade are weaker for nominal value estimations" (Boykorayev 2008).

Peculiarities of exchange rate formation in Pakistan were investigated by S. Parveen, A.Q. Khanand M. Ismail, in particular, considered the following factors: inflation, growth rate and foreign trade indicators. In Pakistan "inflation is the most important factor that bring volatility in exchange rate in the country as it contributes more to variations in exchange rate"; "second important variable which bring more variation in exchange rate is economic growth, while order of export and import in variation lies at third and fourth position" (Parveen, Khan and Ismail 2012).

The causes of currency fluctuations in Iran for the period 1978-2008 were studied by M. Goudarzi, K. Khanarinejad and Z. Ardakani. "The most effect belongs to oil price and then volume of money flows that in fact represents greater relative importance of these variables in comparison with the other variables of model" (Goudarzi, Khanarinejad and Ardakan 2012).

Abbas, Q., Iqbal, J. and Ayaz made the regression analysis of the exchange rates of African countries. Results of the research showed, "that GDP is only variable which shows a significant relationship with exchange rate while other two variables i.e. inflation and real interest has shown non-significant relationship" (Abbas, Iqbal and Ayaz 2012).

Polish scholars K. Twarowska and M. Kąkol analyzed the impact on the formation of the exchange rate EUR/PLN of individual factors and identified the density of the relationship between dependent and independent variables:

- "the financial account balance and inflation rate are the most important factors determining the level of EUR/PLN exchange rate (a rise in Poland's financial account surplus contributes to appreciation of the country's currency, an increase in inflation rate has a negative effect and reduces the value of Polish currency);
- the market interest rate is the third most important factor determining the zloty exchange rate level (the relative rise in interest rates contributes to appreciation of the Polish currency);
- the fourth important variable which bring more variation in the zloty exchange rate is the government deficit, while the economic

growth and the current account are less significant"(Twarowska, Kąkol 2014).

Instead, Yu Hsing develops a slightly different direction in the study of the Polish currency market and, using the EGARCH method, reveals the link between market factors and the USD/PLN exchange rate. In particular, the scientist argues "that a higher Polish real reference rate, a higher U.S. real GDP, a higher Polish real stock index, and a higher expected exchange rate would raise the USD/PLN exchang rate whereas a higher U.S. real federal funds rate, a higher Polish real GDP, and a higher U.S. real stock index would reduce the USD/PLN exchange rate" (Hsing 2015).

Mariano Christine Niziel Q., Sablan Vanessa F., Sardon Joshua Ray C. and Paguta Ronald B. from the result of the variance decomposition concluded, "that GDP is responsible for most of the real exchange rate movement, contributing 29,22%, net foreign assets accounted for 6,64% of the variations of real exchange rate and import restrictions, oil prices and budget deficit only accounted 3,92%, 2,87% and 2,11%, respectively" (Mariano, Sablan, Sardon, Paguta 2016).

Ukrainian scholars also investigate the behavior of the exchange rate of the national currency in relation to foreign ones:

• Fatiukha N.G. and Tsyhanok D.V. analyzed the influence of market factors on the course of the Ukrainian hryvnia and determined that the largest impact on the dollar has the money supply M2, while the euro, yen, pound, franc - GDP (Fatiukha, Tsyhanok 2017);

• T.M. Lesnikresearched the USD/UAH exchange rate and concluded that "the country's external debt, economic and political crises, as well as money supply, internal supply of money, balance of payments, budget, currency policy of the state and the degree of confidence in the currency" are significantly influenced by the country's external debt (Lesnik2017);

• Krasnikova L.I. and Harmel K.V., unlike previous scientists, built an econometric model of multivariate regression and substantiated a direct correlation between the rates of growth of the cash exchange rate during 1996-2001 and the growth rates of the consumer price index, the volume of external debt and the purchase of foreign currency by households. Scientists have proven that in case of an increase of 1%:

"inflation rate of cash exchange rate increases by 2.54%; the volume of external debt - by 0,55%; volumes of purchase of foreign currency by households - by 0.11%. If the growth rate of the refinancing rate increases by 100%, the hryvnia will strengthen by 0.3%" (Krasnikov, Garmel 2002).

Consequently, the currency of each individual country, depending on its level of economic development and political and economic situation, is characterized by varying degrees of influence of factors. The main factors of the exchange rate change are the monetary and fiscal policies in the country, with the help of which the government of the country regulates the situation on the foreign exchange market.

Instead, this study relates to the exchange rate of EUR/UAH, so at the next stage we will analyze the factors that influence the formation of the rate EUR/UAH.

5. The factors determining exchange rate volatility EUR/UAH

In 2018, in accordance with the Fundamental Principles of Monetary Policy for 2018 and the Medium-Term Perspective, "The National Bank will adhere to the floating exchange rate regime, bearing in mind that the monetary policy will not aim at achieving a certain level or range of exchange rate"(the Council of the National Bank of Ukraine 2017). That is, it can be argued that the formation of the exchange rate of the Ukrainian hryvnia occurs under the influence of demand and supply in the foreign exchange market, as well as market factors affect the fluctuation of the exchange rate.

Considering the results of previous studies, the provisions of economic theory and analyzed statistical data (Figure 1) formed the hypothesis of the study. In particular, as shown by the analysis of previous studies, scientists using the tools of regression analysis, received results that confirmed or rebutted their hypotheses. So, the model was built by S. Parveen, A.Q. Khanand and M. Ismail (2012), which highlighted four factors (inflation; growth rate; export; import) on the exchange rate of Pakistan, indicates

that the results are good: R-square is 98.2%. Instead, scientists K. Twarowska, M. Kąkol (2014) who explored the exchange rate of Poland, revealed another set of factors: GDP growth, inflation rate, interest rates, current account balance, financial account balance, government deficit, and as a result the incomplete model data, because R-square amounted to only 62.3%, which indicates the failure to consider important factors affecting the exchange rate.

Ukrainian scholar (Lesnik T.M. (2017) and Fatiukha N.H., Tsyhanok D.V. (2017)), in their research, constructed models that considered such factors as: the nominal index of official debt, the average annual rate of inflation, the average monthly salary, GDP, population, M2 money supply, exports and imports, and received qualitative results from R-square, respectively, 0.98 and 0.88. It is worth noting that T.M. Lesnik (2017) conducted a study of the currency pair USD/UAH for the period 1996-2016, and N.G. Fatiukha, D.V. Tsyhanok (2017) EUR/UAH for the period 2009-2016.

Thus, we determine the correspondence of the dependence of the factors presented in Fig. 2, the theoretical basis outlined in economic theory.

Thus, the change of GDP as the main indicator of the country's economic development leads to the inflow of foreign investment in the economy, the growth of demand for the national currency and its strengthening. This statement is supported by the analyzed statistics, so we can assert that GDP and the EUR/UAH exchange rate have an inverse proportional relationship.

The balance of payments concept, which has become part of Mandell-Fleming's small open economy model, also explains currency fluctuations. "According to this concept, the negative balance of payments exerts pressure on the downward trend of the national currency, as the residents of the country have an additional demand for foreign currency to fulfill their obligations to the outside world. A positive balance of payments contributes to the strengthening of the national currency, as the supply of foreign currency in the domestic market increases" (Vakhnenko 2004, p. 26). These dynamics is observed during the analysis of dynamics of currency pair EUR/UAH, presented in Table 2.

The higher the rate of inflation in the country, the lower the rate of its currency, if do not concern other factors. In Ukraine, the EUR/UAH rate has grown along with an increase in inflation (except in 2005, 2009, and 2015, which is explained by the post-crisis effects in the country's economy).

The deficit of the state budget affects the increase in money supply in circulation and leads to a decrease in the national currency. Analyzing statistical data, Ukraine does not observe a clear correlation between the defined indicators.

Increasing interest rates leads to an increase in the amount of revenues of foreign capital in the country. In accordance with the fictitious pricing model developed by Jacob A. Frenkel (1976)and M. Mus, "The growth of domestic interest rates will have a consequence of the devaluation of the exchange rate, since in such conditions, the demand for money within the national economy will be reduced" (Vakhnenko 2004, p. 22). Instead, the monetarist rigorous model proposed by R. Dornbusch (1976) explains that "the growth of interest rates in response to tighter monetary policy stimulates the inflow of foreign capital to the national economy, which in turn leads to a significant revaluation of the nominal exchange course" (Vakhnenko 2004, p. 23). As for the EUR/UAH exchange rate, the dependence on interest rate changes is not followed, which may be explained by the influence of a number of other factors.

In accordance with monetary model with flexible prices developed by Jacob A. Frenkel (1976) and M. Mus, "the value of the exchange rate as the relative price of the two monetary units is determined by relative indicators of money supply". "The increase in the money supply within the national economy, as compared with the money supply of another country, causes the devaluation of the national currency" (Vakhnenko 2004, p. 22).In Ukraine, there is a situation where the growth of money supply is correlated with the increase of the exchange rate. This conclusion can be seen by analyzing the statistical data presented in Table 2.

Devaluation of the exchange rate of the national currency contributes to the increase of exports, and imports are more profitable when the national currency is strengthened. There is no clear relationship between the volumes of foreign trade in goods and services and the change of the exchange rate in Ukraine. This situation is explained by the fact that the effect of this indicator is visible in the long run.

One of the factors for strengthening the national currency is the increase in gold and foreign currency reserves. Analyzing the dynamics of the change in the currency pair EUR/UAH, we can conclude that Ukraine has a direct relationship between these indicators, except for some years (2008), when there were economic crises in the world.

Between the growth of public debt and the depreciation of the national currency, there is a straightforward dependence. However, it should be noted that during the analysis, it is necessary to consider the sources of state debt. For example, receiving financial assistance from the International Monetary Fund was aimed at stabilizing the exchange rate.

On the basis of the analysis, the hypothesis of the study is outlined in more detail:

- increasing GDP, deficit of the state budget, increase of gold and foreign currency reserves lead to a decrease in the national currency EUR/UAH, that is, the strengthening of the national currency;
- active balance of payments balance, increase of inflation, growth of money supply and public debt lead to increase of the national currency EUR/UAH, that is, devaluation of the national currency;
- change of interest rate, dynamics of volumes of foreign trade in goods and services in the short-term period do not affect the change of the exchange rate EUR/UAH.

Using the tools of the analysis methods during the study, the hypotheses were checked and the relationship density between the indices being investigated was determined.

6. Methodology

This study used annual data for the period 2006-2016.Data was collected from World Bank, Eurostat, European Central Bank, Trading Economics, the National Bank of Ukraine, the Ministry of Finance of Ukraine. Correlation-regression analysis was carried out using the MS Excel program.

At the first stage of the study, a correlation analysis of selected factors that have an impact on the change of the EUR/UAH exchange rate has been carried out. For the correlation analysis, an appropriate statistical sample was generated (Table2).

The main task of the correlation analysis is to determine the connection between random variables and to evaluate its intensity and direction (Rudenko, 2012, p. 56). Table 3 shows the absolute values of the correlation coefficients obtained on the basis of the analysis of data given in Table 2 using the "CORREL" function of the MS Excel program.

The tightness of the connection between the analyzed indicators is characterized by the obtained correlation coefficients. Those variables whose correlation coefficient exceeds 0.80 significantly affect the exchange rate change. Strong correlation is observed with variables: external debt stocks and the money supply M2.

In order to identify the type and characteristics of the relationship between dependent and independent changes, we use the regression analysis method. Using the MS Excel program, multiple linear regression (Table 4) is constructed, where the dependent variable is the EUR/UAH exchange rate, and the independent variables are external debt stocks and money supplyM2.

Assessing the quality of the results obtained, it should be noted that the determination coefficient R^2 is 0.93. This indicates that 93% of the value of the resulting sign (exchange rate EUR/UAH) is determined by the values of the investigated factors, and by 7% - by other indicators. F = 2,0699E-07%, i.e., R^2 and the regression equation as a whole are statistically significant with a probability of 95%.

The following empirical linear regression equation was obtained during the study(1.1):

$$Y = -5{,}018 + 0{,}1946\ X_{10} + 0{,}0022\ X_{11} \qquad (1.1)$$

The built model is statistically significant, and changes in the exchange rate of EUR/UAH are determined by the influence of the factors envisaged in the presented equation.

Table 2. Factors of influence on the change of currency exchange rateEUR/UAH

Data	Y	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
1999	5,24	-0,20	22,68	45,00	-1,50	5,25	0,72	-2,20	48,25	1,21	51,28	21,71
2000	5,06	5,90	28,20	27,00	0,40	4,29	1,42	21,50	57,41	1,63	45,88	31,54
2001	4,67	9,20	11,96	12,50	-0,30	3,48	1,24	2,90	53,83	3,10	59,46	45,19
2002	5,53	5,20	0,76	7,00	0,50	7,50	2,31	9,10	50,71	4,02	56,19	64,32
2003	6,66	9,40	5,18	7,00	-0,40	5,79	2,05	7,40	55,18	6,94	52,19	94,86
2004	7,22	12,10	9,05	9,00	-3,00	10,65	0,71	21,30	53,70	9,52	50,10	125,48
2005	5,97	2,70	13,57	9,50	-1,90	2,94	2,60	-11,20	50,64	19,39	41,21	193,15
2006	6,34	7,30	9,06	8,50	0,70	-1,50	-1,52	-5,60	49,47	22,26	51,18	259,41
2007	6,92	7,90	12,84	8,00	1,40	-3,68	-5,71	3,20	50,36	32,46	57,43	391,27
2008	7,71	2,30	25,23	12,00	-1,32	-7,10	-12,23	5,70	54,91	31,54	55,68	512,53
2009	10,87	-14,80	15,89	10,25	-3,89	-1,48	-0,79	-22,00	48,05	26,51	91,53	484,77
2010	10,53	4,20	9,38	7,75	-5,94	-2,22	-1,48	4,50	51,09	34,57	92,76	596,84
2011	11,09	5,47	7,96	7,75	-1,79	-6,27	-9,16	2,67	56,43	31,79	85,91	681,80
2012	10,27	0,24	0,56	7,75	-3,79	-8,16	-12,90	-5,65	56,37	24,55	77,26	771,13
2013	10,61	-0,03	-0,28	6,50	-4,45	-9,01	-17,22	-8,06	52,19	23,14	82,74	906,24
2014	15,72	-6,55	12,19	14,00	-4,98	-3,44	-3,66	-14,24	52,10	7,53	97,78	955,35
2015	24,23	-9,77	48,72	22,00	-2,28	-0,21	0,12	-13,17	54,48	13,30	134,93	993,81
2016	28,42	2,31	13,90	14,00	-2,94	-3,70	-3,88	-1,58	55,52	15,54	127,78	1102,39

Note: Y – The EUR/UAH exchange rate (annual changes); X1 – GDP growth (annual %) in Ukraine; X2 – Inflation, consumer prices (annual %) in Ukraine; X3 – Interest rate (%) in Ukraine; X4 – General government deficit (-) and surplus (+) in Ukraine, % GDP; X5 – Current account balance (% of GDP) in Ukraine; X6 – Financial account balance (bln USD) in Ukraine; X7 – Exports of goods and services (annual % growth) in Ukraine; X8 – Imports of goods and services (% of GDP) in Ukraine;X9 – Gold and currency reserves, bln.USD in Ukraine; X10– External debt stocks (% of GNI) in Ukraine;X11 – The volume of money supply M2 (bln. UAH).
Source: own calculation based on: (The National Bank of Ukraine, 2018), (Official site of World Bank Open Data), (Official site of Eurostat database), (Official site of the European Central Bank), (Official site of Ministry of Finance of Ukraine), (IndexMundi 2017), (Trading economics 2018).

Table 3. Correlation matrix depending on the exchange rate EUR/UAH

	Y	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
Y	1											
X1	-0,517	1										
X2	0,400	-0,400	1									
X3	0,317	-0,263	0,812	1								
X4	-0,434	0,509	0,113	0,131	1							
X5	-0,335	0,392	0,050	0,151	0,368	1						
X6	-0,126	0,140	0,247	0,287	0,321	0,858	1					
X7	-0,412	0,800	-0,097	0,115	0,412	0,503	0,192	1				
X8	0,210	0,258	0,211	0,428	0,053	-0,066	-0,217	0,466	1			
X9	0,041	-0,162	-0,098	-0,444	-0,271	-0,701	-0,578	-0,299	-0,254	1		
X10	0,929	-0,644	0,353	0,243	-0,563	-0,428	-0,190	-0,512	0,108	0,150	1	
X11	0,838	-0,595	0,171	0,072	-0,635	-0,736	-0,576	-0,563	0,139	0,370	0,869	1

Note: Y – The EUR/UAH exchange rate (annual changes); X1 – GDP growth (annual %) in Ukraine; X2 – Inflation, consumer prices (annual %) in Ukraine; X3 – Interest rate (%) in Ukraine; X4 – General government deficit (-) and surplus (+) in Ukraine, % GDP; X5 – Current account balance (% of GDP) in Ukraine; X6 – Financial account balance (bln USD) in Ukraine; X7 – Exports of goods and services (annual % growth) in Ukraine; X8 – Imports of goods and services (% of GDP) in Ukraine; X9 – Gold and currency reserves, bln.USD in Ukraine; X10 – External debt stocks (% of GNI) in Ukraine; X11 – The volume of money supply M2 (bln. UAH).

Table 4. Results of regression analysis

Regression statistics								
Multiple R	0,93							
R-square	0,87							
Normed R-square	0,85							
Standard error	2,50							
Observation	18							

Dispersion analysis								
Indices	*df*	*SS*	*MS*	*F*	*F value*			
Regression	2	640,8	320,4	50,8	2,0699E-07			
Balance	15	94,4	6,2					
Total	17	735,3						

Variables	Coefficients	Standard error	t-statistics	P-index	Low 95%	Top 95%	Low 95,0%	Top 95,0%
Y	-5,018	2,152	-2,330	0,034	-9,606	-0,429	-9,607	-0,429
X10	0,1946	0,044	4,355	0,0005	0,099	0,289	0,099	0,289
X11	0,0022	0,003	0,663	0,516	-0,004	0,009	-0,005	0,009

Note: Y - The EUR/UAH exchange rate (annual changes); X10 -External debt stocks (% of GNI) in Ukraine; X11 – The volume of money supply M2 (bln. UAH).

Source: own calculation based on table 2.

7. Conclusion

In the course of the analysis of the reasons for changing the exchange rate of EUR/UAH change for the period from 1999 to 2016 in Ukraine, we can conclude that the goal of the study has been achieved partially. The investigated correlation between the dependence of the EUR / UAH exchange rate on a set of factors confirmed the tight correlation between the change in money supply and government debt and the rise / fall in the EUR / UAH national currency. Instead, other factors have statistically insignificant correlation to the studied indicator and are not included in the regression model.

The constructed regression model allows us to confirm or refute the hypothesis outlined at the beginning of the study. After all, the factors used during the construction of the model in different ways affect the change in the exchange rate of the national currency in relation to foreign.

The constructed regression model is with a high probability (93%) correspond to reality - changes in the output variable (exchange rate) are determined by the influence of input variables (factors of influence on the exchange rate).

Rising public debt lead to an increase in the exchange rate of the national currency EUR/UAH, that is, the depreciation of the national currency. Ukraine's external debt is largely formed by the value of foreign currency loans. This, in turn, affects currency fluctuations in the financial market. As a conclusion, we can refute some hypotheses, as the study showed that there is no strong correlation between GDP, government budget deficit, foreign exchange reserves, active balance of payments, inflation, interest rate, foreign trade in goods and services with thechange in the exchange rate EUR/UAH.

Considering the peculiarities of the analyzed factors, there is a significant influence of monetary policy on the formation of the exchange rate of Ukraine. Therefore, the main proposals concerning the possibility of stabilizing the exchange rate of EUR/UAH should be based on the effective monetary policy. In addition, we should consider the fact that external public debt will increase in the coming years, which will also destabilize the financial market of Ukraine. Therefore, it is necessary to harmonize monetary policy, and then analyze the link between this policy with

the country's foreign trade policy. This will ensure the effective functioning of the country's domestic and foreign economic policies in the long run.

References

Abbas, Q. Iqbal, J. Ayaz (2012). Relationship between GDP, Inflation, and Real Interest rate with Exchange Rate Fluctuation of African Countries, *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 2(3): 132–142.

Boykorayev, B. (2008). Factors that determine nominal exchange rates and empirical evidence of cross-sectional analysis. MSc in Finance and International Business. *Aarhus School of Business*, 1-65. URL: http://pure.au.dk/portal/files/3262/Bahodir_ (accessed: 30.12.2018).

Dornbush R. (1976). Expectations and Exchange Rate Dynamics, *Journal of Political Economy*, 84(6): 1161–1176.

Fatiukha, N.H. Tsyhanok, D.V. (2017). Correlation-Regression Analysis of Currency Exchange Rate, *Ahrosvit*, 22: 39-41. URL: http://www.agrosvit.info/pdf/22_2017/8.pdf (accessed: 20.12.2018).

Goudarzi, M. Khanarinejad, K. Ardakan, Z.(2012), Investigation of the Factors Affecting Real Exchange Rate in Iran, Acta Universitatis Danubius: Œconomica, 8(4): 55-67. URL: http://journals.univ-danubius.ro/index.php/oeconomica/article/view/1299 (accessed: 21.12.2018).

Hartley, P.R. (1983). Rational Expectations and the Foreign Exchange Market. *Chapter in NBER book Exchange Rates and International Macroeconomics*, editor Jacob A. Frenkel, 153-188. Published by University of Chicago Press. URL: http://www.nber.org/chapters/c11379.pdf (accessed: 21.12.2018).

Hsing, Yu. (2015). Short-run determinants of the USD/PLN exchange rate and policy implications. *Theoretical and Applied Economics*, XXII, 2(603): 247-254. URL: http://store.ectap.ro/articole/1099.pdf (accessed: 20.12.2018).

IndexMundi (2017). Ukraine - Net financial account. URL: https://www.indexmundi.com/facts/ukraine/net-financial-account (accessed: 02.09.2018).

Frenkel, J. (1976). A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence, *Scand. J. Econ.*, 200–224.

Kassel, H. (1995), *Inflation and Currency Exchange Rate*. M: Elf-Press, 104.

Krasnikova, L.I. Harmel, K.V. (2002). Analysis of Factors of Formation and Dynamics of Currency Exchange Rate, *Scientific Notes*, 20(Economic Sciences): 21-25. URL: http://ekmair.ukma.edu.ua/bitstream/handle/123456789/9053/Krasnikova_Analiz_chynnykiv_formuvannya.pdf (accessed: 01.11.2018).

Lane, Ph. (1999).What Determines the Nominal Exchange Rate? Some Cross-Sectional Evidence, *The Canadian Journal of Economics / Revue canadienne d'Economique*, 32(1): 118-138. URL: http://www.tcd.ie/Economics/TEP/1998/9812.pdf (accessed: 30.11.2018).

Law of Ukraine On Principles of Domestic and Foreign Policy No. 2411-VIof 1 July 2010. URL: http://zakon2.rada.gov.ua/laws/show/2411-17 (accessed: 30.11.2018).

Lesnik, T.M. (2017). Influence of Macroeconomic Indices on the Exchange Rate of National Currency; Regression Analysis, Scientific Bulletin of Mukachevo State University, *Economics*, 2(8): 177-182. URL: http://www.msu.edu.ua/visn/?p=2871&lang=uk (accessed: 30.11.2018).

Mariano, Christine Niziel Q. Sablan, Vanessa F. Sardon, Joshua Ray C. Paguta, Ronald B. (2016). Investigation of the Factors Affecting Real Exchange Rate in the Philippines. *Rev. Integr. Bus. Econ. Res.*, 5(4): 171-202. URL: http://sibresearch.org/uploads/3/4/0/9/34097180/riber_s16-073_171-202.pdf (accessed: 29.12.2018).

Markusenko, M.V. (2015). *Theories of Exchange Rate and Balance of Payments, Their Role in the Formation of the State Monetary Policy in the Context of Globalization. Scientific works of the Belarusian State Economic University/Education Ministry of the Republic Belarus, Belarus State Economic University*. Editors.: V.N. Shymov et al., Minsk, BSEU, 8: 199-205. URL: http://edoc.bseu.by:8080/bitstream/edoc/27457/1/Markusenko%2C_M._V..pdf (accessed: 29.11.2018).

Official site of Eurostat database. URL: https://ec.europa.eu/eurostat/data/database (accessed: 02.09.2018).

Official site of Ministry of Finance of Ukraine. URL: https://index.minfin.com.ua/finance/budget/gov/ (accessed: 02.09.2018).

Official site of the European Central Bank. URL: https://www.ecb.europa.eu/home/html/index.en.html (accessed: 02.09.2018).

Official site of World Bank Open Data. URL: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2016&locations=UA&start=1988&view=chart&year_low_desc=false (accessed: 02.09.2018).

Parveen, S. Khan, A.Q. Ismail, M. (2012). *Analysis of the factors affecting exchange rate variability in Pakistan*. Academic Research International. 2(3) May, 670-674. URL: www.savap.org.pk (accessed: 30.11.2018).

Rudenko, V.M. (2012). *Mathematic Statistics: Textbook/ V.M. Rudenko*. – K.: Center of Academic Literature, 304.

Strategy of Sustainable Development "Ukraine – 2020" approved by the Decree of the President of Ukraine No.5/2015 of 12 January 2015. URL: http://zakon0.rada.gov.ua/laws/show/5/2015 (accessed: 20.12.2018).

The Council of the National Bank of Ukraine (2017). *The BasicPrinciples of Monetary Policy for 2018 and the Medium-Term Perspective. Approved by the Decree of the Council of the National Bank of Ukraine of 12 September 2017*. Kyiv. URL: https://bank.gov.ua/doccatalog/document?id=55564681 (accessed: 20.12.2018).

The Economist (2018). *The Big Mac index*. URL: https://www.economist.com/content/big-mac-index (accessed: 25.10.2018).

The National Bank of Ukraine (2015). *The Comprehensive Program for the Development of the Financial Sector of Ukraine until 2020 approved by the Resolution of the Board of the National Bank of Ukraine No. 391 of 18 June 2015*. URL: https://bank.gov.ua/doccatalog/document?id=43352266 (accessed: 25.10.2018).

The National Bank of Ukraine (2018). *Official Currency Exchange Rate*. URL: https://bank.gov.ua/control/uk/curmetal/currency/search/form/period (accessed: 25.10.2018).

Trading economics (2018). *Euro Area Current Account to GDP*. URL: https://tradingeconomics.com/euro-area/current-account-to-gdp (accessed: 02.09.2018).

Twarowska, K. Kakol, M. (2014), Analysis of Factors Affecting Fluctuations in the Exchange Rate of Polish Zloty against Euro, Management, *Knowledge and Learning*, 889–898. URL: http://www.toknowpress.net/ISBN/978-961-6914-09-3/papers/ML14-652.pdf (accessed: 30.12.2018).

Vakhnenko, T.P. (2004). Theoretical foundations of foreign exchange rate formation: concepts and models. *Economics and Forecasting*, 2: 21-30. URL: http://eip.org.ua/docs/EP_04_2_21_uk.pdf (accessed: 25.12.2018).

World Economic Forum (2016). *The Global Enabling Trade Report 2016*. URL: http://www3.weforum.org/docs/WEF_GETR_2016_report.pdf (accessed: 01.10.2018).