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# MATHEMATICAL METHODS FOR DETERMINING THE COST OF MONEY IN THE NATIONAL ECONOMY

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**Abstract.** *Money, currency in circulation and production of gross domestic product are essential cumulative factors of macroeconomic stability of the State. Cost variation of a money unit influences level of prices in economy and income level of economic agents. In particular money stock, volume of currency circulation and gross domestic product are constituents of determining value of money on a nationwide scale.*

*In the article problems of determining value of national currency in economy were studied; general-theoretical approaches to building the model of determining value of money unit were formulated.*

*Theoretical and methodological procedures of the scientific study are fundamental premises of the quantity theory of money.*

**Keywords:** *money, monetary circulation, gross domestic product, value of money unit, money stock, velocity of turnover of money unit.*

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## Introduction

The value of money for society and its purchasing power in the domestic market contribute to or hinder economic growth. When a society loses confidence in national money, it loses confidence in itself.

*Problem.* One of the problems in the development of the country's economy is the change in the value of national money. The value of money affects the price level and the income level of business entities and, accordingly, the aggregate demand and aggregate supply of goods and services in the economy. In a real economy, a change in the money supply does not always lead to a change in the price level and, as a result, in the value of the monetary unit. The reason for this is that money and money circulation are closely linked to the volume of production of goods and services in the country.

The problem of the formation and determination of the value of national money in the process of interaction between production and money circulation in the state determines *the relevance* of choosing the topic of scientific research.

*Research task* — this is a solution to the problems of the formation and determination of the value of national money by building modern mathematical models. The proposed models allow us to reveal a new mechanism for determining the value of a monetary unit. The mechanism of interaction of gross domestic

product, monetary circulation and their aggregates determines the value of national money.

In the process of research, a new macroeconomic indicator was introduced — the value of the monetary unit, taking into account the turnover of its value.

*Research concept.* The concept of determining the value of a monetary unit is based on the postulates of the quantitative theory of money, mathematical calculations and logical conclusions. The study is based on the basic equation of monetary economic theory — the equation of exchange of the quantitative theory of money [1]: $M \cdot V = P \cdot Q$, where $P$ is the price level in the economy; $Q$ — annual real product; the expression $M \cdot V$ represents the product of the money supply and the velocity of the currency, forming the economic category — money circulation.

The equivalent equation of exchange: $M \cdot V = GDP$ has been used in our research, where *GDP* is the gross domestic product.

*Object of an article* is to represent general-theoretical and practical approach to evaluation of influence of alteration in production and currency circulation on value of national currency unit on the ground of mathematical methods.

With this aim in mind following problems have been solved:

1) approaches in economists' works to formation and determination of value of money were considered;

2) problems of determining value of national currency in economy were studied;

3) general-theoretical approaches to building the model of determining value of money unit were formulated.

*The result of investigation* appears in following:

1. Construction of a mathematical model for value determination of a money unit on alteration of gross domestic product, currency circulation and store of money in economy: $P_G = (GDP_{R0} \pm \Delta GDP_R) / (M_A \cdot V_0 \pm \Delta S \cdot V)$, where $P_G$ is value of a money unit; $GDP_{R0}$ is gross domestic product, calculated by total expenditure; $\Delta GDP_R$ is alteration of gross domestic product; $M_A \cdot V_0$ is currency circulation; $\Delta S \cdot V$ is alteration of store of money in economy for the period under review.

2. Building the model of determining value of money unit taking into account its turn-round of value: $P_G \cdot V = (GDP_0 \pm \Delta GDP) / (M_A \pm \Delta S)$.

*The subject* of research in this article is the determination of the value of the monetary unit when changing the production of gross domestic product and the components of monetary circulation.

**Literature Review**

The issues of the importance of money in the economy and the determination of their purchasing power were dealt with by world-famous economists: K. Marx, I. Fisher, J.M. Keynes, M. Friedman, F. Hayek, P. Krugman, M. Obstfeld, etc.

D. M. Keynes noted the importance of money in the economy: "We cannot get rid of money even by destroying gold, silver and other legal tender. Specific problems of the monetary economy will arise as long as there are any non-expendable assets that can take on the function of money" [2].

The importance of money stems from the fact that they are the link between production and consumption, between seller and buyer. By the words of K. Marx, "the goods are always on the side of the seller, money is always on the side of the buyer as a means of purchase" [3]. Both production and consumption are characterized by the indicator "gross domestic product", which is served by the presence of a certain amount of money supply, taking into account the speed of turnover of the monetary unit. Based on this, you can argue that the main purpose of using national money in any country is to service domestic production and consumption of goods and services. The amount of money and money circulation are completely dependent on the monetary policy of the state.

Economists of the past and present tied the value of money:

to the value of gold (K. Marx, Nathan Lewis);

to the amount of goods that can be bought for a given amount of money (I. Fisher);

to the mass of goods, which corresponds to one nominal monetary unit (M. Fridman);

to the volume of aggregate demand (P. Krugman, M. Obstfeld).

K. Marx associated the value of paper money with a known amount of gold: "Paper money is only insignificant signs of value, since they are representatives of known quantities of gold, and the quantity of gold, like any other quantities of goods, is at the same time cost " [3].

I. Fisher, a well-known American economist and mathematician, defined the value of money as "the amount of other goods that can be bought for a given amount of money. The lower the price of goods, the greater their number can be bought for a given amount of money, the higher, therefore, the purchasing power of money. The higher the price of goods, the smaller their number can be bought for a given amount of money, the lower, therefore, the purchasing power of money" [4].

M. Friedman, the founder of monetary theory, proposed defining the value of a monetary unit as income, the value of which "in real terms from one nominal monetary unit is determined by the mass of goods to which this unit corresponds" [5].

Modern American economists P. Krugman and M. Obstfeld linked the value of money with their aggregate demand, which is determined by three main factors:

1) interest rate: an increase in the rate leads to a decrease in the demand for money and, as a result, for their supply to the economy; rate reduction — to increase the demand and supply of money;

2) the price level: reflects the monetary value of a fixed set of goods and services;

3) a real national product (GNP) [6].

The first factor changes the supply of money in the economy and, accordingly, affects the value of money.

The second factor suggests that the value of money changes when prices for a fixed set of consumer goods change: when prices for a fixed set increase, money loses its value, and when prices decrease, money becomes more expensive.

Consequently, P. Krugman and M. Obstfeld tied the value of money to the price level for a fixed set of goods and services.

The third factor determines the dependence of demand for money on changes in GNP production: with an increase in GNP, the demand for money grows due to an increase in the number of real transactions and their value in the economy, while a decrease in GNP, the demand for money decreases due to a decrease in the number and value of transactions in the economy.

To determine the aggregate demand for real money, they proposed the following formula [6]:

$M^D / P = L\ (R,Y)$, where $M^D$ — is the aggregate demand for money; $P$ — is the cost of the consumer basket; $R$ — is the interest rate; $Y$ — real GNP; $L\ (R,Y)$ is called the aggregate demand for real money.

American economists have defined aggregate demand for real money as the ratio of aggregate demand for money ($M^D$) to the value of the consumer basket *(P)*. The mathematical expression $M^D/P$ determines the number of consumer baskets that can be purchased for money supply (income) in the economy.

According to P. Krugman and M. Obstfeld, the real value of money is determined by the number of consumer baskets that can be purchased for the money supply, which determines the aggregate demand for money. In our opinion, the aggregate demand for money is nothing more than the active money supply serving consumer demand.

P. Krugman and M. Obstfeld:

— do not take into account the speed of turnover of a monetary unit as a component of monetary circulation;

— consider the value of the benefits of the consumer basket, and not all goods produced in the economy.

It is necessary to clarify separately the formula for determining the aggregate demand for real money P. Krugman and M. Obstfeld: $M^D/P= L\ (R, Y)$.

This formula only takes into account the money supply as the demand for money. But in the real economy, money is being circulated, so it will be mathematically correct to take into account cash flow in this formula $M \cdot V$: $M^D \cdot V / P= L\ (R, Y)$.

The supporter of free money, Friedrich von Hayek, in the book "Private Money" proposed determining the real value of a monetary unit based on the competition of several free private currencies within the country. He "completely independently came to the idea of the advantages of independently issued competing currencies" [7]. He considered the state's monopoly on money emission to be useless and even harmful.

Despite the proposed new approaches proposed by F. Hayek for monetary circulation, the principle of "free monetary circulation" of different competing currencies in the economic system, in our opinion, cannot be applied due to its complexity and imperfection.

American economist Nathan Lewis proposed fixing the value of major world currencies to gold, which will ensure the stability of national currencies, since gold

retains its inherent monetary value better than anything [8]. He suggested that the value of the currency is to be tied to a fixed weight of gold (for decades, the US dollar has corresponded to 1/35 ounce of gold) and defined the objective of monetary policy — this is to maintain the currency at a fixed level.

Given the current realities of the development of the global economy, Nathan Lewis's proposal is worth considering. In this regard, we compare the trend in the change in the cost of an ounce of gold in relation to the US dollar for 2000 – 2019. The average price of gold for 1 ounce (troy) was [9]: 2000 – $279.11; 2005 – $444,74; 2015 – $1160,06; 2018 – $1268,49; 2019 – $1392.60.

Over 19 years, the price of gold per troy ounce increased against the US dollar by 398,9% ((1392,60·100 / 279,11) – 100) or by $ 1113.49. The likelihood of a gold price growth trend will continue in the future. This indicates a decrease in the value of paper money to gold.

It must be emphasized that the issue and supply of paper money is completely dependent on the actions of the central banks of countries (in the USA it is the Federal Reserve System), which do not always take into account the interests of society and, almost always, take into account the interests of governments.

From the above it follows that, according to prominent economists of the past and present, the value of money depends on:

— a known amount of gold in the monetary unit (K. Marx);

— the amount of goods that can be bought for a given amount of money (I. Fisher);

— income, the value of which is determined by the mass of goods to which the monetary unit corresponds (M. Fridman);

— aggregate demand for real money, determined by the interest rate, price level and GNP production (P. Krugman, M. Obstfeld);

— the value of the monetary unit, which is established on the basis of competition of several free private currencies within the country (Friedrich von Hayek);

— Linking the value of world currencies to a fixed weight of gold (N. Lewis).

Despite various and well-grounded approaches to the formation of the value of money in the economy, economists did not offer practical guidance on the application of mathematical methods for determining the value of money. They did not pay enough attention to money circulation in the formation of the value of the monetary unit.

## Materials and Methods

### 1. Currency value

I. Fisher formulated the algebraic equation of exchange, which plays an important role in the theory of money and is the main equation of the quantitative theory of money [4]:

$M \cdot V = \Sigma p \cdot Q$, where $M$ — is the average amount of money in circulation in a given company during the year; $V$ — the number of revolutions of the national currency during the year; $p \cdot Q$ — price multiplied by the purchased quantity of each product or service. The equation of the quantitative theory of money I. Fisher became

the theoretical and methodological basis of the author's study in determining the value of the national monetary unit. In our study, the expression $\Sigma p \cdot Q$ is assumed to be equal to the gross domestic product produced.

Money is a commodity for exchange operations for other goods and services and, like a commodity, has value. The cost of money for the domestic economic space is determined by various factors. In the General case, the main such factors include:

1) the amount of money in circulation is characterized by the supply of money in the country's economy and depends on:

— money issue;

— interest rate of the central bank;

— reserve standards established by the central bank;

— issues and sales – purchases of government securities;

— tax policy.

2) the amount of consumed products (consumed GDP), which is served by monetary circulation;

3) the influence of external factors:

— export of goods and services;

— import of goods and services;

— the volume of external debt;

4) political and social factors.

In this study, all factors affecting the value of national money for the domestic economic space are taken into account in two macroeconomic indicators: gross domestic product *(GDP)* and monetary circulation $(M \cdot V)$.

Consequently, the volume of production in monetary units and the amount of money in circulation, taking into account the speed of their turnover and determine the value of money.

We have proposed a new mathematical mechanism for determining the value of a monetary unit in the interaction of gross domestic product and monetary circulation.

The main points of our study:

1) money circulation of national money should be equal to the number of goods and services produced (consumed) in the country;

2) the value of the national currency is determined by the number of goods and services that can be purchased for this currency.

The following notation is used in the article:

gross domestic product *GDP* (Gross Domestic Product, is the main macroeconomic indicator);

money circulation (money circulation) — $M \cdot V$;

monetary unit value as $P_G$, where $P$ — is the price; index $G$ — money ("Geld — money, from the word 'gelten' — to execute, pay, 'Geld' in German means a means of payment in general" [10]).

The formula for determining the value of a monetary unit, proposed by us as a basis, has the following form: $P_G = GDP / M \cdot V$.

From the formula it follows that the value of the monetary unit is directly proportional to the volume of gross domestic product and inversely proportional to the volume of money circulation.

It should be noted that from a mathematical point of view, the result of dividing two numbers is a number that shows how many units of the numerator are per unit of the denominator. Therefore, the indicator of the value of the currency unit РГ indicates that for one currency unit, taking into account the speed of its turnover, you can purchase goods and services for a certain amount. Therefore, in the equation $P_G = GDP / M \cdot V$ the unit of "money turnover" $M \cdot V$ accounts for a certain amount of gross domestic product *GDP*, which determines the value of money within the country.

In conditions of economic equilibrium of gross domestic product and monetary circulation, we have the unit value of the monetary unit: $P_{G0} = GDP_0 / M \cdot V_0 = 1$. In this case, the unit of value of the *GDP* produced is acquired per unit of monetary circulation. Changes in the numerator and denominator lead to a change in the value of money, namely:

— an increase in *GDP* production leads to an increase in the value of the monetary unit, a decrease in *GDP* — to a decrease in the value of the monetary unit;

— an increase in the monetary turnover $M \cdot V$ leads to a decrease in the value of the monetary unit, and a decrease leads to an increase in the value.

— a simultaneous change in the *GDP* and $M \cdot V$ indicators can lead to both an increase and a decrease in the value of the monetary unit.

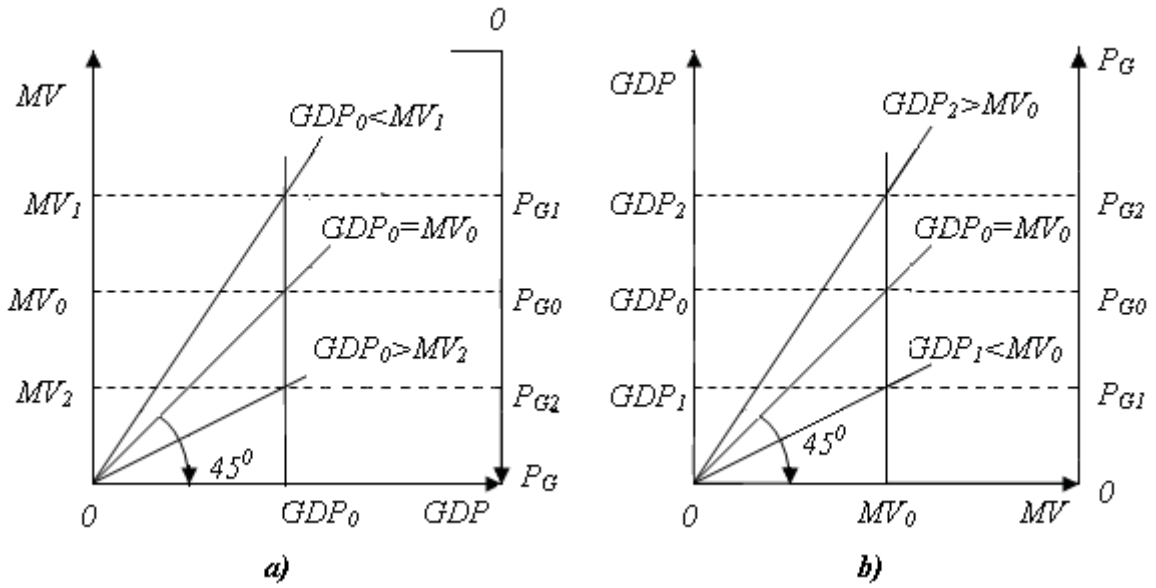


**Fig.1. The model for determining the value of the monetary unit in the national economy in the interaction of gross domestic product and monetary circulation**
**Figure 1a shows the effect on the value of a monetary unit of a change in money circulation M · V with a constant GDP.**
**On Fig. 1b — there is the impact on the value of the monetary unit of a change in GDP with a constant monetary circulation M · V.**

*Source: author's calculations*

The relationship between *GDP* and the value of money ($P_G$) is direct; between money turnover *(M ⋅ V)* and the value of money is the opposite.

Based on the equation $P_G = GDP / M \cdot V$, we construct and analyze a graphical model for determining the value of a monetary unit in the national economy in the interaction of gross domestic product and monetary circulation (see Fig. 1).

As indicated above, with the economic equilibrium of gross domestic product and monetary circulation, we have the unit value of the monetary unit. On Fig. 1 (a) and (b), this shows the equilibrium line, which is the bisector of the right angle. At any point on the equilibrium line, the equality $GDP = MV$ and, accordingly, $P_G = GDP / MV = 1$.

Figure 1a shows the effect on the value of a monetary unit of a change in money circulation with a constant gross domestic product ($GDP = GDP_0 = const$), that can be formulated as a mathematical formula:

$$P_G = GDP_0 / (M \cdot V_0 \pm \Delta M \cdot V), \quad (1)$$

where $\Delta M \cdot V$ the amount of change in monetary circulation.

An increase in the denominator by "$+\Delta M \cdot V$" reduces the cost of the monetary unit, and a decrease in the denominator by "$-\Delta M \cdot V$" — increases the cost of the monetary unit. With an increase in money circulation on Fig. 1a from $M \cdot V_0$ to $M \cdot V_1$ unit value decreases from $P_{G0}$ till $P_{G1}$, and with a decrease in cash turnover from $M \cdot V_0$ till $M \cdot V_2$ monetary unit value increases from $P_{G0}$ till $P_{G2}$.

The percentage change in the value of a monetary unit, with a change in the volume of money turnover and a constant volume of gross domestic product, is presented in the following equivalent form:

$$\Delta P_G (\%) = GDP_0 / (M \cdot V_0 \pm \Delta M \cdot V) \cdot 100 - 100 \quad (2)$$

On Fig. 1b, with a constant volume of money circulation, any change in the volume of gross domestic product leads to a change in the value of the monetary unit, which can be formulated in the form of a mathematical formula:

$$P_G = (GDP_0 \pm \Delta GDP) / M \cdot V_0, \quad (3)$$

where $\Delta GDP$ — gross domestic product change.

Numerator increase by "$+\Delta GDP$" leads to an increase in the value of the monetary unit, and a decrease in the numerator by "$-\Delta GDP$" — to reduce its cost. On Fig. 1b, with the growth of gross domestic product with $GDP_0$ till $GDP_2$, monetary unit value is growing from $P_{G0}$ till $P_{G2}$, while reducing gross domestic product from $GDP_0$ till $GDP_1$, the value of money is reduced from $P_{G0}$ till $P_{G1}$.

The percentage change in the value of a monetary unit, with a change in the volume of gross domestic product and a constant volume of money circulation, is presented in the following equivalent form:

$$\Delta P_G (\%) = (GDP_0 \pm \Delta GDP) / M \cdot V_0 \cdot 100 - 100 \quad (4)$$

With a simultaneous change in gross domestic product and monetary circulation, the value of a monetary unit is determined by the formula:

$$P_G = (GDP_0 \pm \Delta GDP) / (M \cdot V_0 \pm \Delta M \cdot V) \quad (5)$$

Clarify equality (5) by replacing the money supply indicator with the indicators of *active money supply and net savings*. $M_A$ - the amount of money directly involved

in the economic turnover "income – expenses"; $S$ — net savings, or money in the hands of the population, at the box office of enterprises, unused funds in the accounts of financial institutions. Then the total money supply will be equal to: $M = M_A+S$.

In a country's economy, net savings in national currency can both increase and decrease. Based on this, the money supply for any reporting period is determined as follows: $M = (M_A \pm \Delta S)+ (S \pm \Delta S)$, where $\Delta S$ — is the change in the amount of net savings and active money supply in the reporting period. Moreover, an increase in active money by ΔS leads to a decrease in net savings by $\Delta S$, and a decrease in $M_A$ by $\Delta S$ leads to an increase in net savings by $\Delta S$.

To determine the value of a monetary unit, the amount of active money is taken into account. Therefore, we transform formula (5) as follows:

$$P_G = (GDP_0 \pm \Delta GDP) / (M_A \cdot V_0 \pm \Delta S \cdot V), \quad (6)$$

where $(M_A \cdot V_0 \pm \Delta S \cdot V)$ — cash turnover for the period under review; $M_A \cdot V_0$ — cash turnover in the previous (base) period; $\Delta S \cdot V$ — injection into cash flow or withdrawal of net savings from circulation.

It should be noted that the active money supply serves consumption, therefore, in the formulas presented, the gross domestic product is calculated from the total = expenses, that is, it is consumed $GDP_R$, then $\Delta GDP_R$ — change in consumption. Gross domestic product for total costs equal to [1]: $GDP_R=R=C+I_g+G+X_n$. Considering this aspect, formula (6) can be written as follows:

$$P_G = GDP_{R0} \pm \Delta GDP_R) / (M_A \cdot V_0 \pm \Delta S \cdot V) \quad (7)$$

Formula (7) is universal for determining the value of a monetary unit when changing gross domestic product, money circulation and net savings in the economy.

## 2. The value of the monetary unit, taking into account the turnover of its value

An important and problematic point in determining the value of money is the rate of turnover of a monetary unit, which is almost impossible to calculate. For the reporting period, it is determined mathematically with the already known indicators of gross domestic product and the amount of money in circulation. From the formula $GDP = M_A \cdot V$ we determine the speed of turnover of the currency:

$$V = GDP / M_A \quad (8)$$

The turnover rate of the currency is stable [1] or changes slightly. By $V \approx const$ it is the change in the active money supply that affects the price level in the economy and, as a consequence, the value of the monetary unit. Therefore, we can use a new indicator for determining the value of money, taking into account the turnover of their value $P_G \cdot V$. From formula $P_G = GDP / M_A \cdot V$ we determine $P_G \cdot V$:

$$P_G \cdot V = GDP / M_A \quad (9)$$

We draw attention to formulas 8 and 9, the right side of which is identical. In the formula (8), the value of a monetary unit is equal to one: $P_G = 1$. Follows from $GDP/ M_A \cdot V = 1$, wherefrom $V= GDP / M_A$.

The price turnover of money, or the value of a monetary unit, taking into account the turnover of its value, is the product of the value of a monetary unit and the speed of its turnover.

If we consider it as a special case for $V = 1$, then formula (9) can be written as follows: $P_G = GDP / M_A$.

Therefore, when the turnover rate of a monetary unit is equal to one, the value of money depends on the gross domestic product and the money supply in circulation.

Using formulas (7) and (9), we can formulate a general formula for determining the value of a monetary unit, taking into account the turnover of its value:

$$P_G \cdot V = (GDP_0 \pm \Delta GDP) / (M_A \pm \Delta S) \quad (10)$$

Formula (10) allows you to determine the value of a monetary unit, taking into account the turnover of its value when changing the gross domestic product and active money supply, taking into account the infusion into circulation or withdrawal from circulation of net savings.

**Discussion**

The scientific article outlines a mathematical approach to determining the value of money. Since money serves the production and consumption of gross domestic product, the real value of the monetary unit is also determined by the amount of money supply in the economic turnover, taking into account the rate of turnover of the monetary unit. The amount of money supply is determined by central banks, which form the value of money in the country by regulating the supply of money. The initial monetary emission of the country's central bank (for example, in the case of monetary reform) should be oriented to the level of gross domestic product production and the estimated value of the monetary unit.

Modern Ukrainian and Russian economists often associate the value of a monetary unit with the prices of goods and services of a consumer basket. The main factor in reducing the cost of money is considered to be the increase in prices for such goods, that is, inflation. According to American economists, Campbell R. McConnell and Stanley L. Brue raising the general price level “does not mean that all prices are necessarily rising. Even during periods of rather rapid inflation growth, some prices may remain relatively stable, while others may fall ” [1]. In their opinion, this is "one of the main sore spots of inflation." Consequently, inflation can be tied to the indicator of the value of money in some segments of the general market; in the rest of the market space, the value of money remains relatively stable.

In practice, the value of a monetary unit decreases at a slower rate than the rate of inflation. This is because the inflation rate is tied to the cost of goods and services included in the consumer basket, and the value of the monetary unit to the production of gross domestic product.

If we consider the general market in the country (goods, services, investments, labor, financial market), as well as net exports, then, in our opinion, the mathematical

models proposed in the article are more accurate determination of the value of national money. These models take into account the impact on the value of money aggregates of GDP and the supply of money in the economy.

The proposed formulas determine the purchasing power of a monetary unit and the value of a monetary unit, taking into account the turnover of its value.

From the formula (7) it follows that:

1. If the growth rate of gross domestic product exceeds the growth rate of the money supply, then the value of the monetary unit is growing.

2. If the growth rate of the money supply exceeds the growth rate of the gross domestic product, then the value of the monetary unit decreases.

It should be noted that earlier in the article "Theoretical and mathematical aspects of determining the price level in the economy" ("Economics and Finance", No. 8, 2017, pp. 23-32), the following formula was proposed for determining the price level in the economy: $P = M \cdot V / GDP$. This formula is the inverse of the formula for determining the value of a monetary unit and determines the number of monetary units per unit of value of a manufactured product in a country. The formulas for determining the level of prices and the value of the monetary unit in the national economy are closely linked and depend on changes in factors affecting economic processes in the economy.

The value of formulas (9) and (10) is that they simplify the calculations for determining the purchasing power of money by introducing an indicator of the value of money, taking into account the turnover of their value. For this, only indicators $GDP$ и $M_A$ are needed, which, unlike $V$, are subject to statistical accounting.

**Conclusion**

At the present stage of development of society, there is a need to improve and develop new approaches to determining the value of money in monetary theory.

The research methodology and the proposed mechanism for determining the value of the national monetary unit do not contradict the basic principles of the theory of money and are a continuation of its development.

The article proposes mathematical methods for determining the value of national money and formulates general theoretical approaches to solving this problem. When determining the value of money and the monetary unit, taking into account the turnover of its value, the gross domestic product, money circulation, money supply, savings are combined into a single economic system and their interaction is considered. Their effect on the value of the currency is mathematically proven and graphically revealed.

The main results of the study can be formulated as follows:

1. Mathematical formulas are proposed for determining the value of a national currency and changing its value when changing gross domestic product production and monetary circulation:

a) $P_G = GDP / M \cdot V$;

b) $P_G = (GDP_{R0} \pm \Delta GDP_R) / (M_A \cdot V_0 \pm \Delta S \cdot V)$.

2. A graphical model "gross domestic product – monetary circulation – monetary unit value" is proposed, which allows analyzing the effect of changes in gross domestic product and monetary circulation on the value of the national monetary unit.

3. The mathematical formulas for determining the value of a monetary unit are proposed taking into account the speed of turnover of its value:

a) $P_G \cdot V = GDP / M_A$;

b) $P_G \cdot V = (GDP_0 \pm \Delta GDP) / (M_A \pm \Delta S)$.

Suggested mathematical methods for value determination of a money unit are compatible with fundamentals of market economy, present a generic approach to evaluation of influence of gross domestic product and currency circulation on value of money, offer the possibility to carry out analysis and factor score of alteration of value of national currency and to apply the given models in practical life of society.

*The practical significance* of the obtained results consists in the possibility of applying the theoretical expositions proposed in the paper in a practical dimension, namely:

— determination of the value of money in the national economy;

— analysis of the reasons for the change in the value of money;

— regulation of the money supply to ensure stability in the economy

Further research in the aspect of determining the value of money should be aimed at finding a more accurate methodology for determining the active money supply and savings in the economy.

The proposed theoretical studies contribute to the development of the theory of money in the aspect of determining the value of national money and can be used as practical recommendations for the analysis of determining their purchasing power.

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