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Research Article

Solution to “the Kuznets Riddle”

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Abstract
S. Kuznets's study that the average propensity to consume is a constant value were nexpected because they denied one of the basic provisions of the Keynesian theory. This fact was called "the riddle of Kuznets". F. Modigliani and M. Friedman, using the hypothesis of the life cycle and the concept of constant income, proposed two options that explain its solution. But models should not explain, but give a method of solution. The most controversial is the indicator of autonomous consumption. In the first model, it grows, and in the second it goes to zero. Creation of a method of simulation of consumption functions based on common methodological principles for the consideration of micro and macroeconomic systems. Having constructed a model that objectively describes the activity of a separate enterprise, the primary and primary links of the macroeconomic system, we can explore the whole system. At the exit of the economic system we consider two functions of the offer - cost and cost-price, and one demand. These functions form two types of Keynesian cross, which define two points: break-even and economic power (equilibrium In a three-dimensional space a chain of transformations is considered: profit, investments, fixed assets, growth of depreciation (constant costs) and output. The condition for the formation of a "proportional development economy" - the average propensity to consume should remain unchanged, which is achieved when the marginal values of the multipliers of fixed costs and return on assets are constant. Such periods were explored by S. Kuznets.
The proposed methods can not be used without formalization (generalization) of existing economic categories.

***Keywords*:** Consumption functions, Keynesian cross, Economics of proportional development, Types of multipliers.

1. Introduction

There are many scientists who have made a significant contribution to the development of economic doctrines. However, J. M. Keynes occupies a special place among them (Blauge 1994; Gontareva2019; Allen Lanev 2009). This is due to the fact that most of its theoretical positions were based on fundamentally new approaches. One of such is that he substantiated the expediency of state intervention in economic policy to overcome the crisis phenomena (Keynes 2007). It is important that these proposals have been used for a long time in the United States and other countries to overcome the crisis and have shown positive results (Vechkanov 2011).
However, in 1946, “National Product since 1869”, which summarized the statistical data of the US economy for 1869-1933, Simon Kuznets found that the ratio of consumption to income (ie, the average propensity to consume) was almost constant (Malyarets *et al.*, 1997). This result actually denied one of the basic provisions of the Keynesian theory, since it states that the constant must remain not the average but the marginal propensity to consume. In economic theory, this fact was called "The Kuznets riddle".
To explain the "The Kuznets riddle", scientists focused on further study of the function of consumption. Future Nobel Prize winners F. Modigliani and M. Friedman made the most significant contribution to solving this problem. To study the function of consumption, F. Modigliani suggested the use of the hypothesis of the life cycle, and M. Friedman - the concept of constant income. These models are based on the theoretical positions of intertemporal choice, proposed by well-known economist I. Fisher, in which consumer behavior is investigated from the standpoint of microeconomic analysis.
Positive in the approaches suggested by I. Fischer, F. Modigliani and M. Friedman, there is: the elements of microeconomic analysis are used for modeling of macroeconomic processes; when studying the function of consumption indirectly take into account the factor of time; the formulated concepts are substantiated mathematically. But, in our opinion, the most problematic question is that these approaches actually show two possible solutions to this puzzle, which fundamentally differ between themselves. However, due justification for these differences has not been made.
Let's consider the essence of the proposed models (Fig. 1), since this will enable us to identify the main differences that exist between them and formulate possible causes that influence the formation of the riddle of consumption.
Fig. 1 shows a graphic representation of the function of consumption proposed by I. Fischer. He wrote the analytical expression of this function as follows (Malyarets *et al.*, 1997):

$$C = Y_1 + \frac{Y_2}{1+r}, \qquad (1)$$

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where r – interest rate, Y_1 and Y_2 – used income in the current period and in the future.

We perform the analysis of the expression (1). But since we need to compare these functions with each other, it is expedient to bring them into comparable indicators.

If the expression (1) is rewritten as follows

$$C = Y_1 + c_F Y_2 , \quad C = C_a + c_m \cdot Y_d \ (2)$$

where c_F – the limiting inclination of consumption by Fisher, which corresponds to the expression

$$c_F = \frac{1}{1+r} , \qquad (3)$$

then it can be noted that expression (2) corresponds to the equation of a straight line passing through two points (as shown in Fig.. 1 a)

As argued in (Malyarets *et al.*, 1997), the most simple form of Keynesian function of consumption is the linear dependence of consumption (Fig. 1 b)

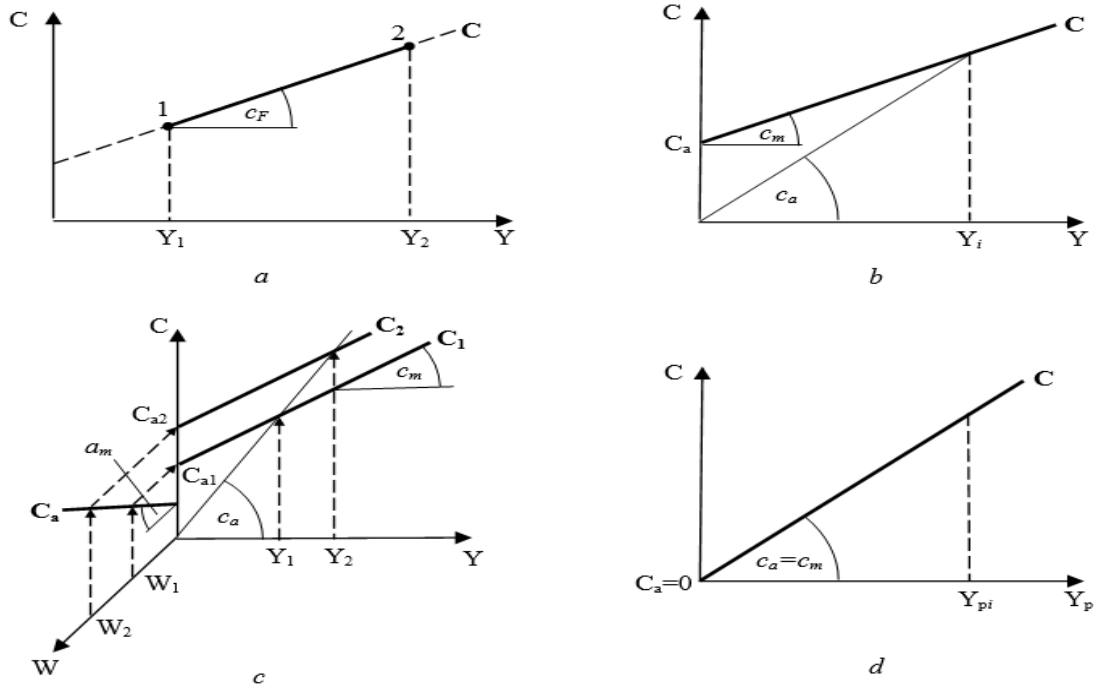


Fig. 1. Graphic models of the Fisher consumption function (a), Keynes (b), Modigliani (c) and Friedman (d)

$$C = a + b \cdot Y_d , \qquad (4)$$

where a – autonomous consumption, which does not depend on the income used (in other words, consumption, when the income is zero); $b \cdot Y_d$ – Induced consumption, which depends on income level; parameter b - marginal propensity to consume.

Let's rewrite the expression (4), replacing the letters denoting autonomous consumption C_a = a and marginal (m) propensity to consume cm = b, in a more general form

$$C = C_a + c_m \cdot Y_d . \qquad (5)$$

Assuming that the numerical values of the boundary inclinations for consumption by Keynes and Fischer are the same ($c_m = c_F$), the resulting dependencies will be similar (see Fig. 1 a and b). But the Keynes model of mathematical and economic positions is more general. First, it corresponds to the basic mathematical function of the straight line y = a + bx, and secondly, the parameter C_a – autonomous consumption, in our opinion, it is much easier to determine by performing a theoretical analysis or from practical observations, since it is determined from the present existing, than the indicator Y_2, proposed by I. Fischer, because it corresponds to the predicted value (Thaler, Fisher 1997).

The model proposed by F. Modigliani (Fig. 1 in) is the most complicated. But, in our opinion, it is the most realistic one, since it best describes the conditions in which the average propensity to consume will remain constant when the amount of income is changed (Dimand, 1998).

The general function of consumption of Modigliani and Brumberg during the life cycle is consistent with the formula (Thaler, Fisher 1997).

$$C = aW + bY, \qquad (6)$$

where a and b – Limit propensities to consume relative to accumulated wealth (property) and income; W - wealth (property) owned by the consumer; Y - expected income.

Limit propensities to consume are determined from the consumer's life cycle (Thaler, Fisher 1997).

$$a = \frac{1}{L - T} , \qquad (7)$$

$$b = \frac{R - T}{L - T} , \qquad (8)$$

where L – his life expectancy, R – the length of the working age, T – starting point of reference, (L – T) and (R – T) – expected periods of residual life expectancy and labor.

From the expression (6) it can be seen that the function of consumption depends on two independent variables - property (W) and expected income (Y). Therefore, it must actually consist of two functions. The first will determine the value of autonomous consumption (fig. 1 c)

$$C_{ai} = W_0 + a_m \cdot W_i, \quad (9)$$

where W_0 – the property of the consumer at the time of the beginning of labor activity, a_m – marginal propensity to consume relative to property, otherwise it is $a_m = a$ from the expression (7).

If we substitute this value in expression (6) and replace the marginal propensity to consume relative to the income cm = b from expression (8), then we obtain the final formula by which the function of consumption can be determined (Skvortsov 2003; Dmitriev 1904). This formula actually corresponds to expression (5), but it can no longer be regarded as Keynesian, since its limiting and average propensity to consume is constant values, as shown in Fig. 1 c.

"The hypothesis of the life cycle solves the riddle of consumption. So, we find the average inclination to consume, dividing the function of consumption (6) into Y:

$$APC = \frac{C}{Y} = a\frac{W}{Y} + b \cdot \quad (10)$$

If the ratio of property (W) to the used income (Y) is constant, then the ARS will be stable" (Thaler, Fisher 1997).

Milton Friedman considers end-use as a function that is proportional to permanent income (Malyarets *et al.*, 1997):

$$C = a \cdot Yp, \quad (11)$$

where a – a constant that determines the proportion of constant income that is consumed; Yp – expected permanent income.

In fact, expression (11) is the equation of a straight line passing through the origin (Fig. 1 d). If we divide this expression into the expected revenue or derive derivative from it, then we will get it

$$a = c_a = c_m \quad (12)$$

the Friedman constant a is equal to the Keynesian average ca and the limit of the propensity to consume c_m, but assuming that the autonomous consumption of c_a , is equal to zero.

The last phrase needs further explanation, since in all previous models this figure never equaled zero (Skvortsov 2003). There is a significant part of economists who simply argue that in the long run, autonomous consumption goes to zero, as it follows from the model of Kuznets. But this is an erroneous approach, since S. Kuznets has established the fact that in the long run, the average propensity to consume tends to remain constant. It's impossible to make any additional assertions regarding autonomous consumption with the statistical observations analyzed by him.

There is, in our opinion, the only explanation for this fact. Assuming that autonomous consumption corresponds to the minimum amount of money needed by a person to survive, then, comparing it with the actual average property owned by an individual in economically developed countries, one can come to the conclusion that these amounts will be hundreds and thousands of times different (Dmitriev 1904). And every year, this gap will only increase. Consequently, this indicator can indeed be considered that in the long run it will go to zero.

The following generalization can be made: the study of consumption, performed by S. Kuznets, provoked the emergence of a problematic issue with respect to the "average inclination to consumption" indicator. But the explanation for this riddle, in our opinion, provoked the formation of the next problematic issue, which already refers to "autonomous consumption". In fact, the function of consumption is not debatable until the last third indicator "marginal propensity to consume" (but this, we believe, for a short time) remains (Skvortsov *et al.*, 2012). All this testifies to the fact that the applied research methods give an opportunity to explain the possible variants of the process of consumption (Skvortsov *et al.*, 2018). But they are not able to justify how and why this process should take place (Babenko 2019).

The purpose of this study is to create a method for substantiating and modeling consumption functions based on common methodological principles for the consideration of micro and macroeconomic systems.

2. Materials and Methods

To confirm the above conclusion it is necessary briefly to consider the methods used by scientists to substantiate their allegations.

It is known that for the first time, the study of the dependence between demand and income used was carried out by I. Fischer. In "The Theory of Interest" (1930), he formulated the basic provisions of the theory of intermittent choice. The essence of this approach lies in the fact that during a lifetime a person takes and gives borrowing to "smooth out" the level of consumption during his life. That is, consumption depends on the current value of income in the period under review and the discounted value of future income. This approach is highly appreciated by many economists. R. Thaler and R. Diamond argued that I. Fischer not only predicted hypotheses of the life cycle and constant income, but also their critique from the standpoint of behavioral economics (Thaler, Fisher 1997; Dimand 1998).

Keynes's economic theory embraces many aspects. But its base is: "The main psychological law ... that is, people tend to increase their consumption with income growth, but not to the same extent as income" (Vechkanov 2011). Limit propensity to consume. Keynes justifies as a consequence of this psychological law.

However, in our opinion, one element of the Keynesian theory of economists did not pay due attention. Why does he describe the consumption function linearly? Some authors simply argue that this is the simplest model. However, they do not substantiate any justification, which factors are due to this linearity and, due to which it may be different, we will consider this below.

The hypotheses of F. Modigliani's life cycle and M. Friedman's constant income are also based on human hopes and inclinations to predict future developments. All this gradually evolved into the development of a behavioral economy. In general, this is an interesting direction, which from a special point of view deals with economic phenomena and processes. But there is a logical question: why spend so much on the development of a highly specialized direction, if the main front of the offensive is not investigated to overcome all fundamental problems and current issues?

Part of these issues was decided by Case itself. He proposed the following options to overcome the disadvantages of the classical approach to the analysis of economic phenomena and processes: abandoning the principle of optimization and methodological individualism as obligatory conditions for the definition of functions of economic variables and the construction of economic models; implemented a fundamentally new method of analyzing macroeconomic interaction, etc. (Vechkanov 2011). However, in our opinion, it was not possible to completely abandon the psychological methods of substantiating the essence of economic phenomena and processes.

The approach we propose is based on these principles:

1) since the subjects of the conditionally closed macroeconomic system are households, businesses and the public sector, all models should be based on them;
2) the main element of this system is the business sector, since it defines most basic macroeconomic indicators (Gross Domestic Product, Gross National Income etc.);
3) since the entrepreneurial sector is a set of all firms registered within the country, then (in the first approximation) most of the macroeconomic indicators can be determined by summing up the performance of these firms.

Conclusion: by constructing a model that objectively describes the activity of a separate enterprise, the first and primary links of the macroeconomic system, we can explore the whole system.

3. Results and Discussion

In order to model macroeconomic processes, we first propose a method for modeling enterprise activity. This approach is chosen by us not by chance. This is a general scientific method of cognition (we noted above that Keynes and most of the classics also used it constantly). Exploring a single element of any system is much simpler than the whole system at a glance. This is due to the fact that when combining necessarily there will be additional properties that are not inherent to a single element. Therefore, when moving to a macro level, this should also be taken into account.

The method we are considering is known in the microeconomy for a long time. But in it it is considered as a local issue (determining the break-even point), but also with many inaccuracies and without any generalizations. Therefore, research and modeling of the microeconomic system will be carried out in two stages: the first is the traditional modeling of the enterprise, but with additions and refinements; the second is the application of the methodology of the Keynesian crosses to the modeling of the enterprise.

The traditional calculation of the break-even point, which is used to study the activities of the enterprise, in our opinion, does not differ from the methodological positions from the macroeconomic study of the consumption function. Although there are two differences: the first one - in content, the same indicators have different names; the second - in the macroeconomy, consider the cost of space with monetary units of measurement, and in microeconomics mixed natural-cost. Each of them has its advantages and disadvantages. Therefore, in the second stage, we will also proceed to the consideration of the cost space, which makes it possible to simulate the Keynesian cross in microeconomics.

The greatest methodological problems arise because microeconomics incorrectly defines constant costs: they do not depend on volumes of production (they also fail to determine autonomous consumption in macroeconomics). The determination of any indicator should reflect its essence. That is, the definition of which should be given information on which this indicator depends (which does not depend on it, should be taken as additional information).

Continuous costs – These are those which do not depend on volumes of production, but depend on time [16]. We include in them (on a time basis) the following expenses: depreciation, administrative expenses, general production costs, auxiliary materials - special clothing, labor protection, etc..

Variable costs depend on the volume of production and do not depend on time [16]. These are the costs of basic materials, wages of workers, the operation of machines involved in the production of products (without depreciation deductions), etc..

The methodological difficulty lies in the fact that these indicators can be considered in three types: as a "flow", as a "stock" and in the "product prices". The first and third species are basic. We will denote them as follows: $C_{f.c}$ i $C_{v.c}$ – in the form of a stream; $P_{f.c}$ i $P_{v.c}$ – as part of the price. To calculate the break-even point you need to know three indicators: constant costs of the enterprise $C_{f.c}$, variable costs are considered as part of the price $P_{v.c}$ and the market price of products P_M.

But besides additional methodological information one needs to consider the following methodological: on what principles we will simulate different economic systems; to which market the considered enterprise is considered - competitive or monopoly; what price space we will consider - primary or secondary. Without this

information, it is practically impossible to understand the essence of the proposed method of modeling economic processes.

The main disadvantage of the methods of modeling the function of consumption, which used the scientists we have reviewed, is that they did not clearly indicate which system they are considering (explained below). This lack of clarity complicates understanding of many models and negatively affects the quality of the material provided in modern textbooks and scientific publications..

The essence of the system approach is simple - it is necessary in the considered system to clearly identify the input and output. In the economy, the elements of such a system can be called a separate employee (workplace), enterprise, region, state, etc. The main feature of the economic system is that each of its elements itself consumes something [endogenous consumption], and the results of its activity are consumed by other external elements [exogenous consumption].

Consumption at the input of the economic system, we consider as the cost of produced products (services rendered). Consumption at the exit from the economic system forms the cost of the output [the cost of the product released]. When these two types of consumption are considered from the standpoint of a separate element of the system (man, enterprise, state, etc.), this forms the process that we call the proposal.

Proposal – a set of internal indicators of the system element (enterprise, region, industry, etc.), with which their goods enter the market. The proposal can be viewed from the standpoint of management, marketing, economics, etc. From economic positions, there are two types of offers: the first - cost (prime cost) shows, with what costs the product enters the market; The second value-price shows with which the internal price (planned or actual) the product enters the market.

Demand – set of external indicators of the economic system (industry, region, state, etc.), which are used for comparison with the indicators of its constituent elements (enterprises, regions, etc.).

An important feature of the economic system is the kind of market in which the investigated element (enterprise) functions. In most cases, the simulation of economic processes begins with a market of perfect competition. The main feature of this market is that an individual company can not influence the price it has formed. This information is important because it forms the basis for modeling the economic activity of the enterprise.

Primary price space in micro and macroeconomics now, for unknown to us reasons, is not considered. Traditionally, the price is investigated in the secondary price space with the decreasing function of demand D and the increasing function of sentence S. For the first time, these two spaces offered and explored in detail the work of O. Curno (Cournot «Recherches sur les principes mathe'matigues de la the'orie des richefses" 1838. Chap. 4). This work was analyzed, and the model was supplemented by V.K. Dmitriev in 1904. Since they considered only a monopoly market, it narrowed the object of research. In addition, the proposed models do not take into account the distribution of costs for fixed and variables (but this is a conditional disadvantage, since these indicators have been introduced into economic scientific practice much later). A comprehensive study of these spaces for different markets has been made by us in [16]. The main dependences considered in these spaces are called Korno-Dmitriyev's functions.

In the primary price range, demand functions (D) and sentences (S) are considered especially. This is due to the fact that the price in it is used as a secondary indicator (as a corner coefficient). All attention is focused on modeling of "cash flows". Therefore, all definitions are executed exactly from these positions.

Demand (exogenous consumption of goods)– money paid by the exogenous system (external consumers) for the purchased product, which corresponds to the formula

$$C_D = C_{ex} = P_M \cdot Y_n, \quad (13)$$

where C_D i C_{ex} – demand functions and exogenous consumption (ie, it is the same function); P_M – market price; Y_n – production volumes in physical units of measurement.

Offer cost [endogenous consumption of resources] – total expenses for paid resources, which are formed in the element of the economic system (in the enterprise) in the process of manufacturing and production

$$C_S^c = C_{en}^r = \tilde{N}_{f.\tilde{n}} + P_{v.c} \cdot Y_n, \quad (14)$$

where C_S^c i C_{en}^r – the offer of cost and endogenous resource consumption; $C_{f.c}$ – constant costs of the enterprise; $P_{v.c}$ – variable costs as part of product prices.

Cost-price offer [endogenous consumption of funds] – total receipts for the issued products, which are formed in the element of the economic system (at the enterprise) in the process of its release

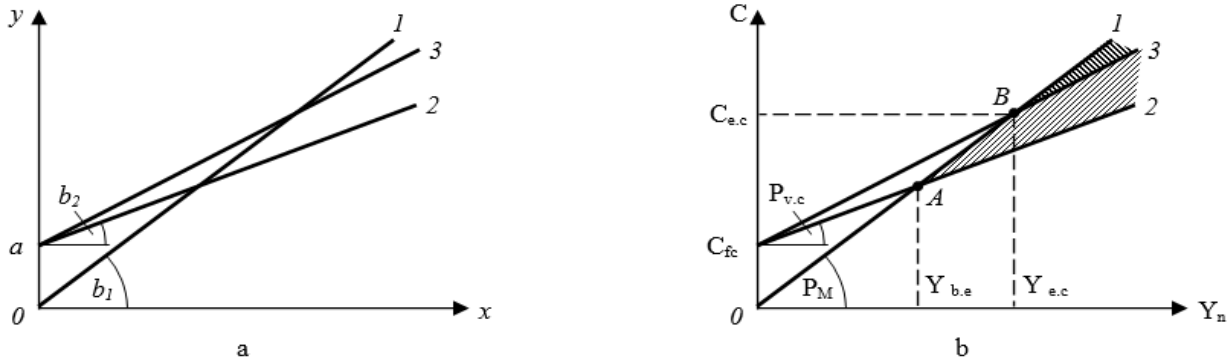
$$C_S^{cv} = C_{en}^f = C_S^c + C_{n.pr} = \tilde{N}_{f.\tilde{n}} + P_{v.c} \cdot (1 + r) \cdot Y_n, \quad (15)$$

where $C_{n.pr}$ – the total value of normal profit, which corresponds to the pricing scheme chosen by the enterprise (we investigated in [17]); P_r – the profitability of products, which determines the amount of profit relative to variable costs (this corresponds to the simplest pricing scheme, but there are other models).

If the received dependences (13) - (15) are considered from the mathematical positions, then it is evident that they are described by the following linear dependencies: y1 = b1 x, cost supply y2 = a + b2 x, value-price proposition y3 =

= a + b2 (1 + k) x, where a - is the coordinate of the point of intersection of the line with the axis of the Greeks (which corresponds to the constant costs of the enterprise Cfc), b1, b2 - the angular coefficients (they correspond to the price of PM and its component element - variable costs Pv.c); k is the numerical coefficient (profitability of

products Pr). We construct the obtained dependences, using their mathematical analogues (Fig. 2).



a b

Fig. 2. Mathematical (a) and economic (b) representation of linear dependencies where A is the break-even point; B - the point of economic power of the enterprise; $Y_{b.e}$ is the break-even point coordinate; $Y_{e.c}$ and $C_{e.c}$. - the economic capacity of the enterprise in natural and monetary units of measurement.

As you know, the break-even point shows, at which output the profit will be zero. The point of economic power of the enterprise was first proposed by us in (Malyarets *et al.*, 2019). Its economic content is much more significant than the previous point. As a result, its indicators are used to simulate various economic processes. One of its properties is that it corresponds to the equilibrium point. This means that production volumes should not be significantly rejected by it. If production exceeds the coordinate of this point, then the enterprise will begin to generate economic profit (surplus), which in Fig. 1 b is in the shaded area 1B3, and shaded zone 1A2 corresponds to accounting profit (Ramazanov *et al.*, 2019).

Based on Fig. 2 one can draw the following conclusion: economic processes will be described by linear dependencies if the price of the product and its constituent elements remain unchanged. For the market of perfect competition, these conditions are met automatically.

The corresponding disadvantage of the considered dependencies (13) - (15) is that the volumes of production in them are measured in physical units of measurement. If an enterprise produces one type of product, then no complications arise. But in the case when the nomenclature of manufactured products is large and its individual species have different units of measurement, then it is practically impossible to use such a model. To solve this problem it is necessary to transfer all this model into monetary units of measurement.

In order to realize this plan, it is necessary to use another property of the point of economic power of the enterprise. If the actual volume of the output of the enterprise corresponds to this point B (Figure 2 b), this means that its internal product price P_{in} corresponds to the market

$$P_{in} = P_M. \quad (16)$$

As a result, it can be written that the price (as the tangent of the tilt angle of line 1) corresponds to the expression

$$P_{in} = P_M = \frac{C_{e.p}}{Y_{e.p}}. \quad (17)$$

And in the general abstract case, the internal price as a category corresponds to the ratio of the quantity of manufactured products in monetary units of measurement Y_m to the same amount in physical units of measurement Y_n

$$P_{in} = \frac{Y_m}{Y_n}. \quad (18)$$

Hence, the abstract quantity of the manufactured product will correspond to the expression

$$Y_n = \frac{Y_m}{P_{in}}. \quad (19)$$

If this expression is put into the expressions (13) - (15), then we obtain the functions of demand, supply cost and value-price

$$C_D = C_{ex} = Y_m, \quad (20)$$

$$C_S^c = C_{en}^r = \tilde{N}_{f.\tilde{n}} + R_{v.c} \cdot Y_m, \quad (21)$$

$$C_S^{cv} = C_{en}^f = \tilde{N}_{f.\tilde{n}} + R_{v.c} \cdot (1 + R_{pr}^{v.c}) \cdot Y_m, \quad (22)$$

where Y_m – quantity of manufactured products in monetary units of measurement; $R_{v.c}$ i $R_{pr}^{v.c}$ – the norm (or rate) of variable costs and profits that correspond to the expressions,

$$R_{v.c} = \frac{P_{v.c}}{P_{in}}, \quad (23)$$

$$R_{pr}^{v.c} = \frac{P_{pr}}{P_{v.c}}, \quad (24)$$

where $R_{pr}^{v.c}$ – the rate of profit, which is determined by the variable costs ($R_{pr}^{v.c}$ =Pr); P_{pr} – profit within the product price.

The term "norm" is the name of an economic category that relates to one of the multipliers (Skvortsov 2003). The difference from multipliers is that their sum must be equal to one. And the value of the usual multiplier can be any (although there may be some exceptions). For

example, since the price consists of the cost and profit, then dividing both parts of the equation at a price, you can get a set of different norms

$$P_{in} = P_c + P_{pr} = P_{f.c} + P_{v.c} + P_{pr} \quad :P_{in},$$
$$1 = R_c + R_{pr} = R_{f.c} + R_{v.c} + R_{pr}, \qquad (25)$$

where R_c, R_{pr}, $R_{f.c}$ i $R_{v.c}$ – norms of cost, profit, fixed and variable costs; 1 – price norm ($R_p = P_{in} : P_{in} = 1$), which shows that in the model of the Keynesian cross, the angle of inclination of line 1 (Fig. 3) should be equal to one (the 45 ° mark is not correct, since $tg45^o = 1$).

The first-order Keynesian cross defines the relationship between demand functions (line 1) and cost proposition (line 2), and a Keynesian cross of the second type - between demand functions (line 1) and value-price offers (line 3) as shown in Fig. 3. The main advantage of this model over the previous one is that the axes of ices (abscissas) and igreks (ordinates) postponed indicators in monetary units of measurement. This enables the model of individual enterprises to add up and obtain aggregate indicators for the region, industry and the state as a whole. Consequently, this model can be used for the study of the macroeconomic system. In the first approximation, when not taking into account state consumption, exports, imports, etc., the indicators of this model will correspond to the following macroeconomic: constant costs → autonomous consumption, the rate of variable costs → the marginal propensity to consume. These two indicators allow reasonably simulate the consumption function at the macro level. Other indicators require a more thorough study. We have argued above that the disadvantage of many macroeconomic studies is that they do not specify what kind of system they are considering: the Keynesian crosses of the first or second type. In our opinion, Keynes, in our opinion, mainly considered a system, which we called the cross of the first kind, which corresponds to lines 1 and 2 (Fig. 3).

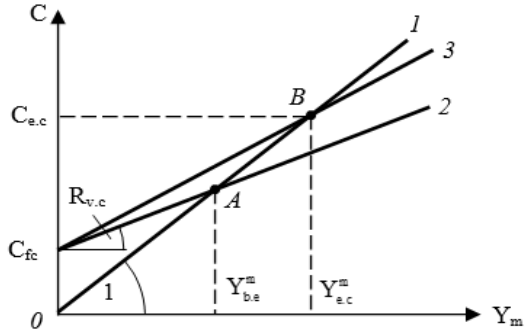


Fig. 3. Models of Keynesian crosses

If you use the functions of demand and sentence expressions (20) - (22) and take into account the value of the norms of expression (25), then you can obtain the model of the Keynesian crosses of the first and second types (Fig. 3). We investigated these models of crosses, they are in (Skvortsov 2003).

Researchers F. Modigliani, M. Friedman and others who considered the equilibrium point of the macrosystem (t. V) actually considered the Keynesian cross of the second species, which is formed by lines 1 and 3 (Fig. 3). But then the question arises: what is the inclination to consume, they investigate: the inclination of line 2 - the Keynesian approach, or the inclination of line 3 - the equilibrium model, since the inclination of these lines is different (although it is easy to move from one multiplier to another).

The model proposed by F. Modigliani is, from our standpoint, the most substantiated. However, there are three such remarks: the wealth (property) W is regarded as a separate indicator, which has no relation to the income Y used (Fig. 1 in), so it is unclear how these two functions are combined into one; We consider W as a stock, and Y is a flow, so it is also unclear how they are applied in one model; the content of the marginal propensity to consume relative to accumulated wealth (property) is not explained.

Our proposed approach, which is initially considered at the micro level, consists of the following elements:

1) the model shown in Fig. 3, forms the main plane of the three-dimensional economic space;
2) on the third axis of this space, the wealth (property) W is set aside, which we regard as the value of fixed assets, which corresponds to the model proposed by F. Modigliani (Fig. 1c);
3) the process of production development is modeled by a chain of transformations (fig. 4 and 5):

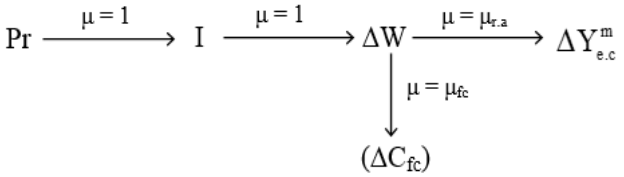


Fig. 4. The chain of transformations when the profit is directed to the development of production, where μ - different multipliers and their values.

- The profit received by Pr is used to invest I;
- Developed investments increase property (fixed assets) ΔW;
- the increase of property causes two events: the main one - the effect of the multiplier of the return on assets causes an increase in the capacity of the enterprise $\Delta Y^m_{e.c}$; secondary - depreciation of the property increases the fixed costs ΔC_{fc}, but this process does not belong to the x-axis, and therefore we show it in parentheses (see Fig. 5 a);
- property growth causes two events: the main one - the multiplier effect of asset productivity causes an increase in the capacity of the enterprise; secondary - depreciation of the property increases the constant costs ΔC_{fc}, but this process does not belong to the axis of the icons, and therefore we show it in the bracket (see Fig.5 a);

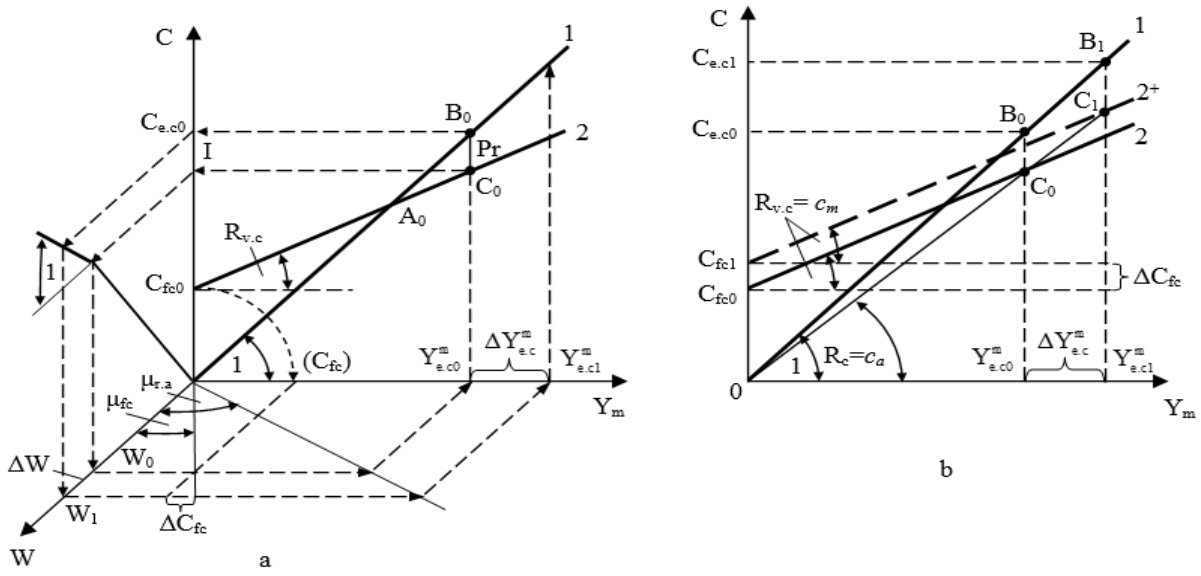


Fig. 5. The model of enterprise development in a three-dimensional economic space, where lines 1 and 2 form a Keynesian cross of the first type, and the segment B_0C_0 corresponds to the initial value of normal profit from which the development process begins; the + sign indicates a new functional dependency value

4) in the main plane of this space is shifted the function of the cost proposal (line 2) up by the value of the increment of fixed costs ΔC_{fc} as shown in Fig. 5b.

The multipliers of fixed assets and fixed costs, which include depreciation, are determined by the formulas

$$\mu_{fa} = \frac{Y^m_{e.c}}{W}, \quad (26)$$

$$\mu_{fc} = \frac{C_{fc}}{W}, \quad (27)$$

where C_{fc}, $Y^m_{e.c}$ i W – fixed costs, economic capacity of the enterprise and the cost of fixed assets.

4. Conclusion

On the basis of the completed research, one can formulate the following conclusions:

1. In the classical economy, most of the processes under consideration are executed correctly (even when their conclusions are opposite). This is due to the fact that researchers use the conceptual descriptive categorical apparatus, which makes it possible to determine the trends of such development (the result), but they can not accurately formulate its cause. This is easier to explain by a similar example. Everyone knows that poison can cure and kill (two answers are correct). It all depends on the exact dose and method of application. In the economy, we need to move on to such precise methods of research. But for this purpose it is necessary to switch to the formal economic categorical apparatus (it has long been fulfilled in most natural sciences).

2. Most economists do not understand - why we should to change something? This, in our opinion, is the biggest problem that hinders the development of this science. Ancient Greek culture created all visible mathematics, except one - algebra. Cause one: unsuccessfully selected numbers (categories). To record Roman numerals are no worse than modern Arabic. However, they have one drawback: they are non-positional. This means that they are not suitable for performing algebraic operations of addition, subtraction, multiplication, etc.

Modern economic categories are actually Roman numerals. They are completely unsuitable for a mathematical description of economic processes. Their main disadvantage is that they are not positional. Simply put, this can be explained as follows: all economic indicators, which are located on the same coordinate axis, should belong (to be generalized) to one category. Our study shows (Ramazanov 2019) that almost all of the economy can be described by ten categories (three primary and the rest secondary, which are a priori and axiomatically defined by the primary). This approach has actually been used by V.K. Dmitriev (1904), but he did not form economic categories. Therefore, he recorded some indicators as a multiplication result of the other two. For example, he wrote the volume of output, as a multiplication result of Q products at its price p. He himself argued that he was doing this to better explain the work of O. Kurnot (O. Kurno's economic work in the Soviet Union did not exist, since marginalism as a scientific direction was forbidden, at the same time, his mathematical work existed). Unfortunately, such publications are not known to the authors anymore.

3. In the conducted research the possible variant of formation of formalized economic categories, which is adapted to the American-European economic school is offered. Visually, that this approach is applied, it can be seen from the fact that on all individual axes of coordinates and planes of the economic space are written linear and angular indicators that belong to one generalization concept (category), which is written in capital letters. The indexes in the category record

additional information that explains the content of the category. We know that the first attempt is rarely successful, but one has to start once.

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Conflict of Interest

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

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