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N. M. Dubovikov,
Ph.D (Technique),
Luhansk

MATHEMATICAL MODEL OF THE OPEN MARKET

The problem.

The modern design of the economic development does not allow to estimate for certain the dynamics of interaction of capitals of subjects of the free market and to predict the result of this interaction in time.

It appears to be valuable for practice to reveal laws operating interaction of capitals during the periods of maximum freedom of the market (market freedom) and the absence of the determined influences. It will also allow to predict partially determined processes occurring at free market barter.

The analysis of the last researches and publications.

The modern neoclassicism economic theory, which is the "basic flow" of the modern economic science, offers limited general legal norms for all individuals. In this case, the market becomes the sphere of free exchanged commodities [1-3]. It is supposed that a market is a natural process for all individuals. The individuals can pursue their aims. There is a "spontaneous order" in chaos of their actions, providing them freedom of choice. According to neoclassic, the main difference between market and directive types of economic coordination is that the liquidation of spontaneous self-development destroys the economic freedom. For example in [4] it is established that the forecasting degree goes down in the periods of chaotic conduct of the market, i, e. in the conditions of the ideal free chaotic state. Usually, for description of interaction of capitals at the free marker the mathematical vehicle of game theory is used, as the most adequately describing the conduct of subjects of market relations, aspiring to maximization of the profit in the process of barter. This interaction takes a place, as a rule, in pairs.

The result of it is getting the profit by either both of the subjects of the barter, or by one of them.

The commodity price is exposed to fluctuations depending on the state of affairs of market and the cost price of commodity. It results in that the got profit of each subject of the market is exposed to casual fluctuations, depending on numerous factors and can change from positive to the negative values and the capital of subjects of the market barter is exposed the vibrations of the increase.

The aim of this article.

The aim of this article is to create a mathematical model, describing the interaction of capitals in the open market and allowing to predict their change.

Main body.

For description of change of capitals of market subjects the use of vehicle of stochastic functions [6] is comfortable, where the change of individual capital would be described as realization of stochastic function of increase of capital. For example, as it is shown on a fig.1, a few realizations describe the conduct of individual capitals: f 1 (x) f 10 (x).

In its turn, the conduct of a stochastic function is described by the average parameters: by the function of the expected value M (x) and the function of dispersion and by the coefficient of correlation corr (x1, x2) as well. These parameters allow to describe the conduct of the examined stochastic function reliably enough. For simplicity of analysis it is necessary to examine the simple unextended reproduction of capital. In this case M(x) of stochastic function of an increment of capitals will be a constant, as the total capital in such system will flow only from one subject of the market to another.

We will consider a situation, when probability of receipt arrived it will be higher, than at other at some part of commodity producers, I.e. will take a place primordial preference between commodity producers, conditioned uneconomic reasons. Barter will be, naturally, made in pairs, where probability of receipt arrived by a commodity producer, and for a commodity producer with preferences $kp(n)$.

On the terms of setting of norms (1):

$$p(m) + kp(n) = 1 \qquad (1)$$

and probability of event of receipt arrived by one or another commodity producer will correspond the polynomial law of distributing (2):

$$p(m,n) = \frac{(m+n)1}{n1 \times m1} \times p(m)^m \times (k \times p(n))^n \quad (2)$$

Where $p(m,n)$ is probability of event of receipt simultaneously without preference $p(m)$ and receipt it was arrived by a commodity producer $p(m)$ by a commodity producer with preference $kp(n)$.

Consequently, a task is taken to find derivative function (2) which can be calculated numerally or graphically (fig. 2).
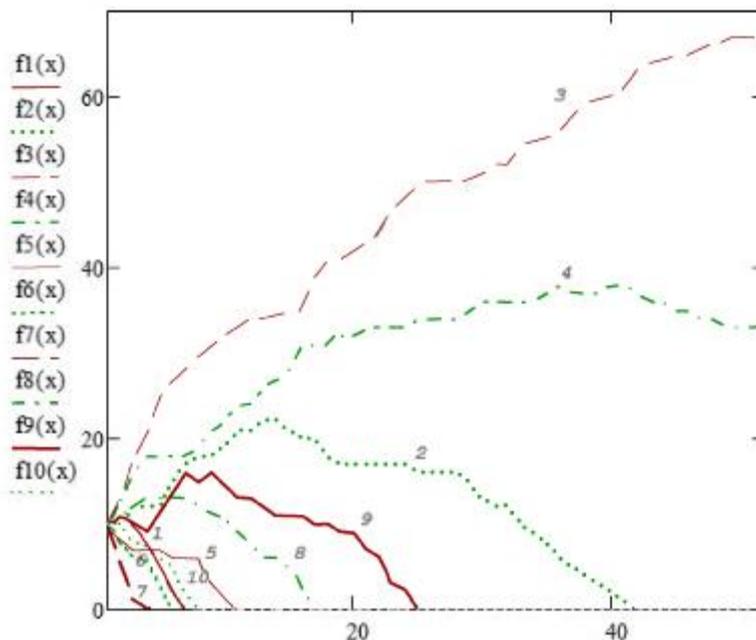
Fig. 1. Dynamics change of the system from 10 individual capitals:
f1(x), f10(x) **through 50 acts of barter,** *x*

From (1) and (2) follows that at aspiring k k to endlessness the stake of additional product of commodity producers with preference aims by 1, and for commodity producers without preference stake of the got additional product — by 0. It means that in this case the additional product of society practically fully flows in accordance with probabilistic laws to the commodity producers with preferences. As a result the most credible distributing of additional product among commodity producers such, that for commodity producers with preferences the most credible amount of additional product will be in k one times more than at the others, I.e. will take a place uneven distributing arrived, increasing with every act of exchange.

In the case of absence of preference at a barter a situation will coincide with a situation in a task from the theory of chances about destruction of a player [8], in obedience to which probability of receipt arrived by a player will be proportional its capital, i.e. will take a place preference in connection with the difference of capitals, and a task will be taken to previous one.

Consequently, the examined casual function of increase of capital will look like as presented on a fig. 1, where curves 3 and 4 have a tendency to the increase of capital, and other curves — to its loss up to 0. Dispersion of such function will look like as resulted fig. 3, i.e. will increase with motion of barter, here will be stratification of the system of commodity producers:

The large sum of capital provides preference at barter and without any economical preference. At consecutive increase in certificates of barter it is possible to see dynamics of change of capitals of commodity produces on a fig. 4.

Cross-correlation function of the examined casual function is more than 0 and continuously increases from 0 in an initial point to 1, that can be seen from the resulted graphs (fig. 1, 3, and 4).

Thus, the assumption supposition that free market barter between equal and free commodity producers does not result in the redistribution of additional product between them, doesn't correspond to falls short of objective historical experience and mathematical laws of functioning of such systems. There is a correlation between the presence of additional product at separate commodity producers after the acts of barter and by the presence of additional product for the same commodity producers as a result of subsequent acts of barter.

Consequently, in accordance with the developed mathematical model of open market, having a free market barter between free commodity producers, that, actually is the ideal condition of market economy, system of commodity producers, inevitably, through the open market, disintegrates for eventual time and eventual number of acts of barter on groups with all by the increasing difference of capitals, inevitably arising up because of the act of mechanism of the open market. Thus any intermediate groups under incomes in this case are not formed, and vice versa, they more diminish, that can be seen from the change
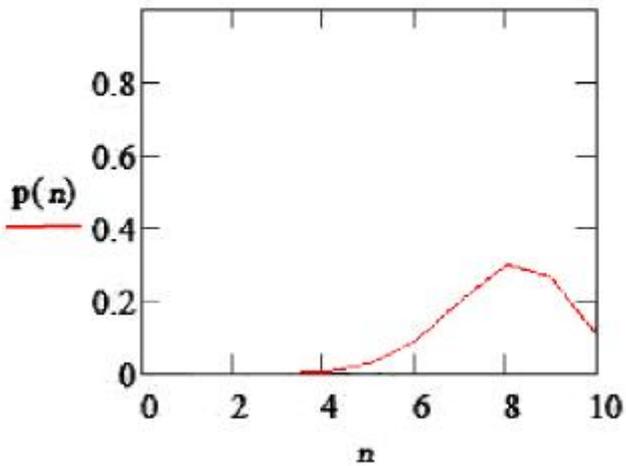
Fig. 2. Function of the most credible correlation of incomes: general an income is equal to 10; stake of the most credible income of commodity producers with preferences, n=8
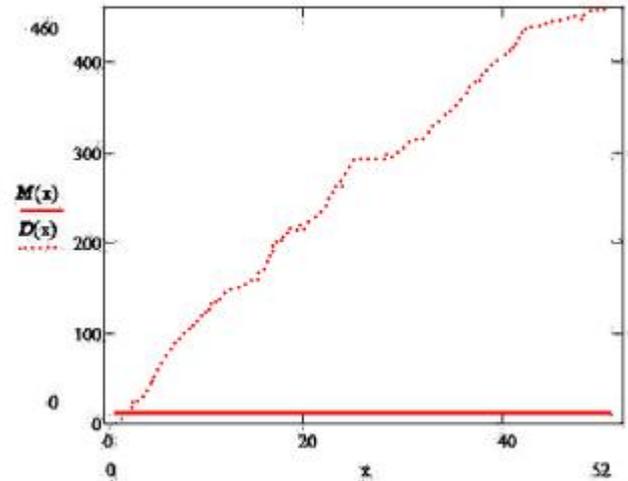

Fig. 3. Expected value and dispersion of casual function of dynamics of capitals
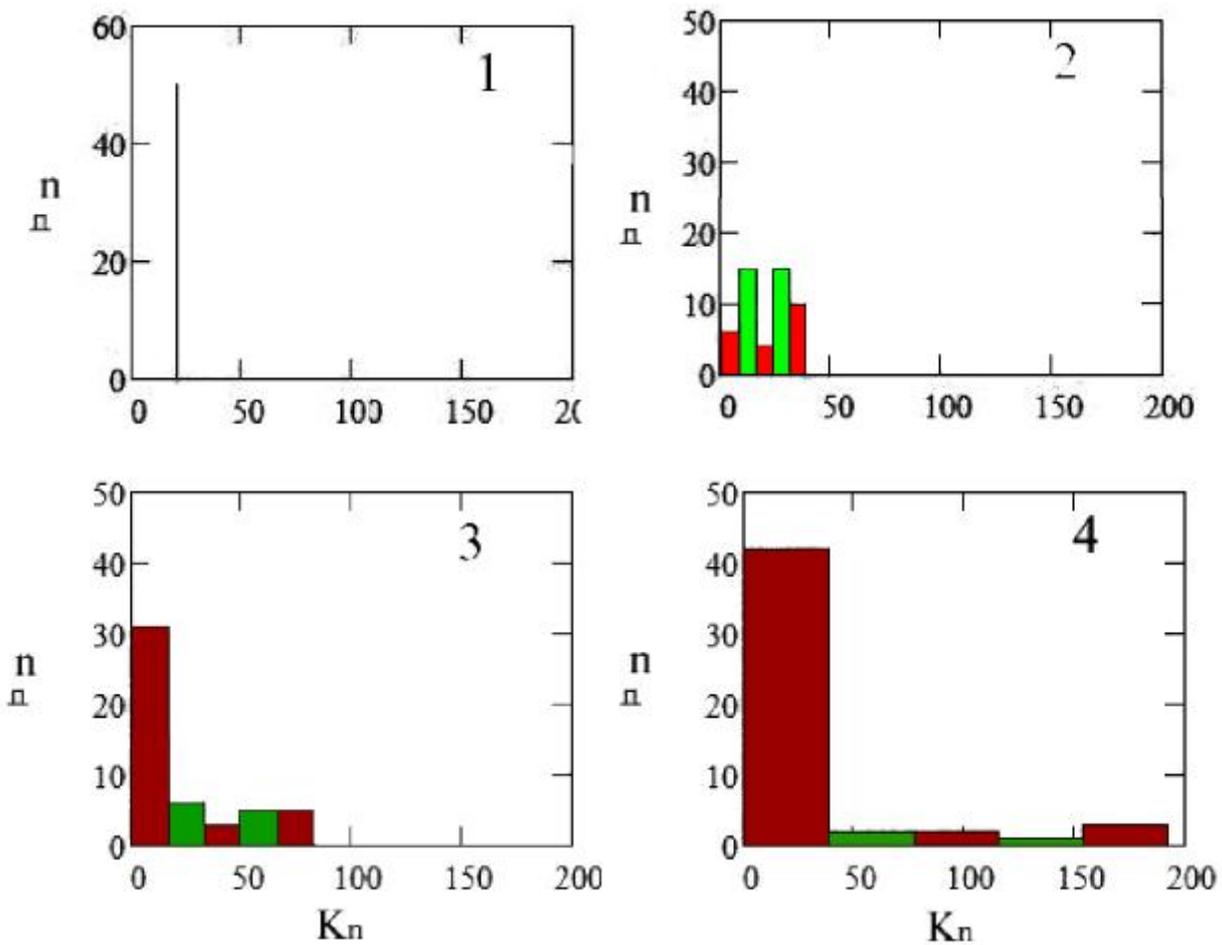

Fig. 4. Dynamics of stratification of the system from 50 commodity producers — n with an initial capital, 20 in accordance with a mathematical model, consistently the stages 1, 2, 3, 4.
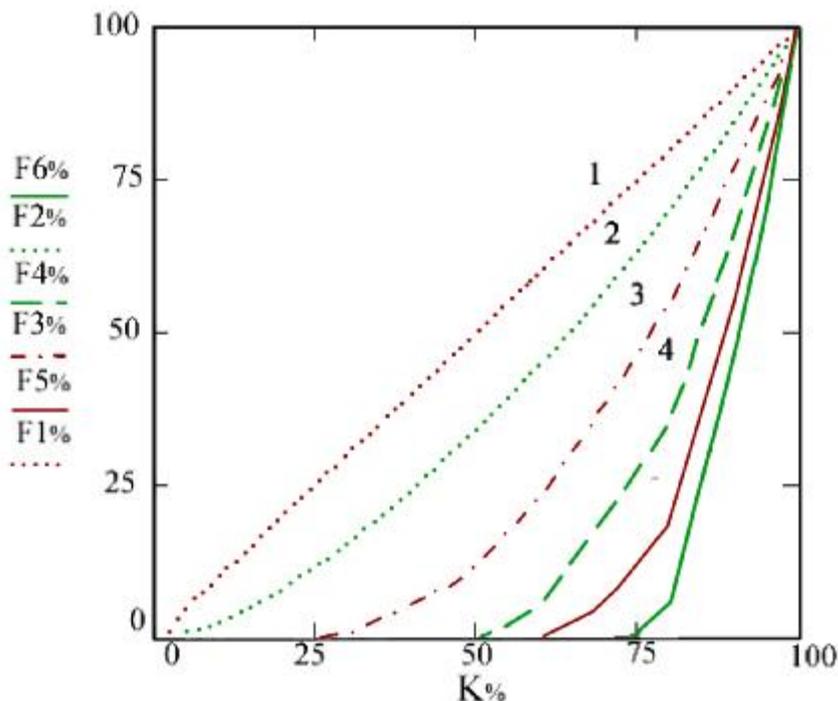
**Fig. 5. Successive change of the calculation curve of Laurence 1, 2, 3, 4, 5, 6
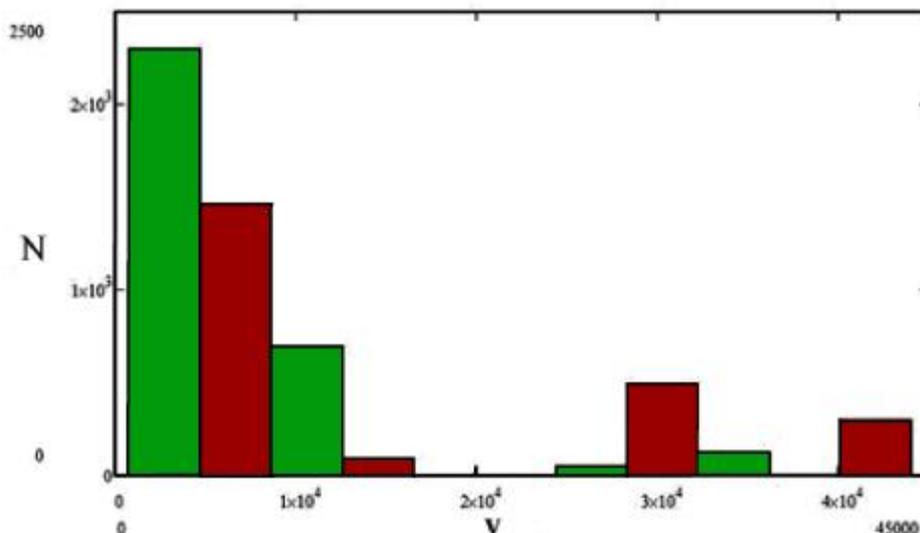for the examined model of commodity producers**

Fig. 6. A histogram is an amount of population, N is a gross product per capita, v

of calculation curves of Laurence for the examined system of commodity producers (fig. 5), and there is continuous increase differentiation between commodity producers.

The increase of amount of commodity producers and their capitals does not influence on end-point of the offered model.

For confirmation of adequacy of the developed model of open market we will compare its results to functioning of the real market with parameters, near to free. The world market of international trade can be the example of such market, where as a result of action of rules WTO [9] there is relatively an equal in rights free barter, therefore this system of barter can exemplify verification of the developed model. The histogram of the indicated world market is resulted on a fig. 6.

We will consider every habitant of countries of world market, as individual buyer or seller, possessor of

individual capital and, according to data of the World Bank [10], will build a histogram an amount of population is a specific gross receipt per capita.

On a histogram an inexplicable failure is obviously looked over in its middle part, that provoke untiglobal organizations on various speculations on this occasion. In our opinion, this situation fully coincides with the conclusions of the offered model of the open market and is investigation of mathematical laws of functioning of the systems of free barter of free commodity producers (see of fig. 4), i.e. the offered model is confirmed practice of the real open market of international trade.

Conclusions.

1. The mathematical model of barter of free commodity producers is developed, adequately describing the real open market and allowing forecasting the dynamics of its changes.

2. The economic market system of free commodity producers can be examined as an aggregate of realization of casual function of stock accumulation for the subjects of free market barter.

3. Accumulated by the subject of free market barter an additional product is increasing preference in the subsequent acts of barter in the conditions of open market.

4. The presence of preference at barter in the conditions of the open market conduces to stratification of capitals of commodity producers, and the presence of increasing preferences — to unlimited stratification.

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Dubovikov N. M. Mathematical Model of the Open Market

The mathematical model of barter of free commodity producers is developed on the basis of vehicle of casual functions and game theory, adequately describing the real open market and allowing forecasting the dynamics of its changes, coming from its primary descriptions. Model adequacy is confirmed by the world statistical information.

Key words: mathematical model, the free market, algorithm, barter.

Дубовиков М. М. Математична модель вільного ринку

Розроблена математична модель товарообміну вільних товаровиробників на основі апарату спадкових функцій та теорії ігор, яка адекватно описує вільний ринок та дає змогу прогнозувати динаміку його змін на базі його початкових характеристик. Адекватність моделі підтверджується світовими статистичними параметрами.

Ключові слова: математична модель, вільний ринок, алгоритм, товарообмін.

Дубовиков Н. М. Математическая модель свободного рынка

Разработана математическая модель товарообмена свободных товаропроизводителей на основе аппарата случайных функций и теории игр, адекватно описывающая реальный свободный рынок и позволяющая прогнозировать динамику его изменений, исходя из его первоначальных характеристик. Адекватность модели подтверждается мировыми статистическими данными.

Ключевые слова: математическая модель, свободный рынок, алгоритм, товарообмен.