

# Simulation of temporary mechanism for self-organization of production and consumer activities of operating entities

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**Abstract.** The essence of the proposed scientific hypothesis lies in the multiplicity of time forms in the economy which reflects the specifics of the fundamental economic relationships between subjects, determines the direction and pace of economic development, reveals the ability to control and regulate the process of self-organization of production and consumer activities of subjects. The purpose of the study is to investigate the structure of time in the subject's economic space based on the methodology of interdisciplinary interaction of the concept of multiplicity of time forms. As a result, based on the synthesis of Marxist, neoclassical and evolutionary methodologies of economic theory, we justify the control effect of time on the individual's production and consumer activities according to his/her preferences in the distribution of the calendar budget of time for working and free time. On this basis, the authors propose a model of a temporary mechanism for self-organization of both production and consumer activities of economic entities and the market economy as a whole.

## 1. Introduction

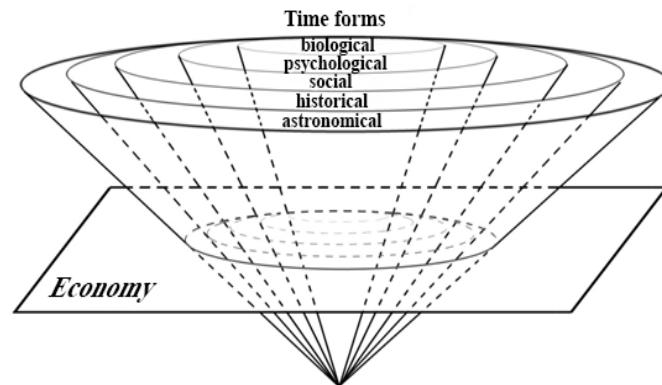
Time in the economy is a special category that reflects the diversity of types of human transformative activity and relationships inherent in economic activity. In modern conditions of multidirectional, multiscale, and arrhythmic development of social, historical, economic, technological, and other processes, the study of time as a synthetic scientific category serving as a universal parameter of quantitative measurements of motion, a qualitative index of the level of economic development, and a fundamental factor capable of exercising a controlling, regulating effect both on the economic activities of economic entities and on the processes of evolution and self-organization of the market economy as a whole.

Fundamental theory of the political economy of time and social reproduction of K. Marx [1], the Becker's neoclassical theory of the distribution of the time budget [2] and the Walras's general market equilibrium [3] as well as the main provisions of the evolutionary economy served theoretical and methodological basis for the study of time in the process of self-organization of production and consumer activities of subjects.

## 2. Structure of time in the space of an individual economic activity

Economic time is a systemic set of astronomical, historical, social, psychological, and biological forms of time that manifests itself in the course of realization by individuals of various types of activity in the space of the economy (Figure 1). Economic time is a "time-multiplicity" and reflects the position of the concept of the multiplicity of forms of time [4].





**Figure 1.** Forms of time in the space of an individual's economic activity

The presented system demonstrates the important ability of time in the economy to change its form, depending on the types of interactions between the internal structure of a person and the external structure of the environment. At the same time, the internal time of a person in society actively influences the local and global time of the socioeconomic environment in which the economic activity is carried out. The external time of the environment actively affects the time of a person, stimulating his/her production, consumer, and other activities as well as personal growth. Thus, the variety of functions, concepts, and properties of various forms of temporary relationships in the economy is due to various types of human interaction with the environment, which manifest themselves in the following forms of the temporal organizational structure: astronomical, social, historical, psychological, and biological.

### 3. Time budget as a basis for the allocation of production and consumer activities

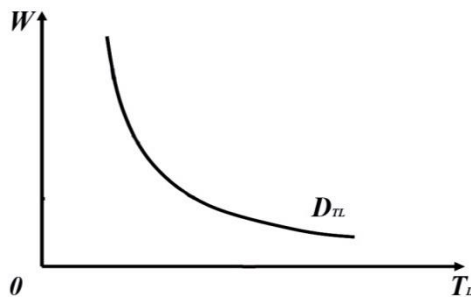
The authors use the approach of Becker to the division of time and consider the time associated with production activities (in fact, it can be not only working time but also separate groups of non-working time, including spare time) as working time and time characterizing consumption to meet various needs (material, spiritual, intellectual, aesthetic, etc.) as spare time [2]. In other words, the production of material and non-material goods occurs in working time and their consumption in spare time.

Proceeding from the neoclassical concept, in a market of perfect competition, the size of the demand for labour on the part of employers, and therefore also for working time, can be determined with the help of two indicators: the wages and the marginal product of labour (working time) in monetary terms. When these figures are equal to  $MP_L=W$ , the increase in workers or working time for the additional unit will stop. In accordance with this concept, working time appears as a dependent quantity.

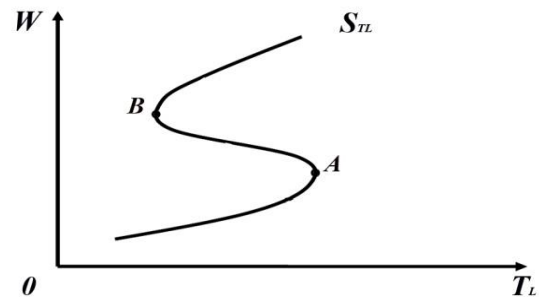
The functional dependence of the size of the entrepreneurial demand for working time on the amount of wages is expressed in the form of the following demand curve for working time (Figure 2).

The offer of working time on the part of the employee is also determined by the amount of wages earned for labour. Figure 3 shows the dependence of the duration of the employee working time on the size of his/her wages.

The working time offer curve  $S_{TL}$  is directed up to the right in accordance with the growth of the wage level, but, after reaching point A, it changes its direction upwards to the left. This situation can be explained by the fact that the attainment of a certain critical level of wages gives the employee the desire to have more free time to meet the needs caused by this level of income (income effect). Further, the supply curve  $S_{TL}$  changes direction to the right upwards after reaching the critical point B, which means the following: a high level of payment generates higher needs for the individual, who requires adequate solvency to satisfy them. Therefore, the individual sacrifices free time in favour of the worker (the effect of substitution).

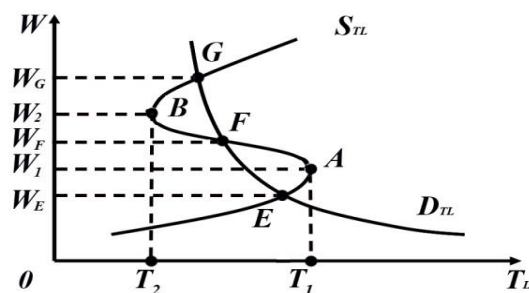


**Figure 2.** Curve of entrepreneurial demand for working time, where  $W$  is the wage rate;  $T_L$  is the amount of working time required by the entrepreneur; and  $D_{TL}$  is the curve of entrepreneurial demand for working time



**Figure 3.** Curve of the supply of working time by the employee, where  $W$  is the wage rate;  $T_L$  is the amount of working time offered by the employee; and  $S_{TL}$  is the curve of the supply of working time by the employee

By combining the curves of the demand and supply of working time, the authors obtain several points of intersection, at which the demand for working time is equal to its offer, that is, when the market of working time is in equilibrium (Figure 4).



**Figure 4.** Equilibrium in the labour market depending on the amount of wages

The first point of intersection  $E$  means that entrepreneurs find the required number of working hours on the market at wage rate  $W_E$  and their demand for the necessary working time for the production of a given output is satisfied. In addition, the offer of working time on the part of the employee allows him/her satisfying his/her needs at the expense of the free time remaining at his/her disposal. Before reaching the first equilibrium point, the substitution effect of free time with working time is applied to increase the possibility of consumption for a growing salary. This effect leads to an increase in the supply of working time to the level of  $T_1$ . It is supported by the income effect, when the value of both working time and lost free time increases with increasing income. The first equilibrium point  $E$  characterizes the moment of equality of the value of working and free time for an individual measured by  $W_E$ . Further, the contradiction between the desire to earn at the expense of working time and the desire to relax in free time reaches the critical point  $A$ , which leads the employee to a decision to waive  $W_1$ -level wages and reduce the working time in favour of the free time. As a result, the supply of working time will decrease and will be accompanied by the effect of substitution of the working time with free time up to the  $T_2$  level. The next equilibrium point  $F$  also characterizes the moment of equality of the higher value of working and free time for an individual equal to  $W_F$ . With an increase in income, the level of the individual's needs grows, which forces him/her to direct his/her ability at point  $B$  to increase his/her ability to pay by increasing the length of working time and the level of wages. This process is cyclical and characterized by a set of equilibrium (at points  $E$ ,  $F$ , and  $G$ ) and transitional non-equilibrium states from one critical turning point to the other. The income effect acts in the direction of increasing leisure and the substitution effect in the direction of its reduction.

Thus, the economic value of the calendar economic time of the individual is the unity of the value of working time as the cost of labour purchasing and the value of free time of consumption as the utility of labour and goods, of which the first is the wages and the second is the consumption per unit of time or intensity of consumption.

#### 4. Control action of time on production and consumer activities of the individual

Neoclassical theory provides an opportunity to disclose the logic of the implementation of production and consumer activities of the individual based on his/her preferences in the distribution of the calendar time budget for the working and free time.

The authors will assume that the individual carries out production and consumer activities in a stable economy and receives a decent income. They also recall that working time for an individual is external time, because it has a socially regulated character and is formed under the influence of various kinds of exogenous factors of the environment surrounding the individual. Free time is the internal time of an individual reflecting his conscious desire for an independent choice of various activities. The authors denote two sub-periods of the aggregate time of the individual: the external – this is the working sub-period ( $T_{\text{total}} - T_f$ ) when the individual receives an income; and the internal – this is the free sub-period  $T_f$  when the individual spends the income received in the sub-period ( $T_{\text{total}} - T_f$ ).

In general, the equilibrium distribution of the individual's time will be achieved if the income obtained in the working sub-period is equal to the income spent in the free sub-period as part of the aggregate time of the individual or if the values of working and free time are equal, which can be expressed by the following formula [5]:

$$\frac{(T_{\text{total}} - T_f)Rv}{T_f} = R(1 - v) \quad , \quad (1)$$

where  $R$  is the aggregate volume of the individual's needs, the possibilities of satisfaction of which are measured by the amount of salary received in the working sub-period ( $T_{\text{total}} - T_f$ );  $v$  is the value of the individual's aggregate time or the ratio of the individual's wage to the total volume of his needs ( $w/R$ ).

The left-hand side of formula (1) characterizes the value of the consumption time in the free sub-period  $T_f$ , and the right-hand side is the value of the production time in the working sub-period ( $T_{\text{total}} - T_f$ ). Hence, we obtain:

$$v = \frac{T_f}{T_{\text{total}}} \quad , \quad (2)$$

Expression (2) shows that the value of the aggregate time of the individual depends mostly on the share of free time  $T_f$  in the composition of  $T_{\text{total}}$ . The relative amount of free time in the composition of the aggregate time determines the value norm of consumption of the individual or the intensity of his consumption.

It is obvious that the social level of distribution of individual funds of the calendar time is non-linear and depends on the temporal preferences of different individuals. Therefore, for each individual, different values of consumption are formed as a result of different relationships between the value of working time and the value of free time. However, striving for high money income while saving working time to increase free time, individuals redistribute the aggregate time, which leads to the formation of an average value norm of consumption of society or the amount of socially necessary free time. Thus, at the macro level, the ratio between the socially necessary free time of consumption and the total available time of society determines the level of consumption of the latter by means of a value norm of consumption: the greater the amount of socially necessary free time in the aggregate calendar time of society, the higher the average consumption rate. This indicates a regulatory function of socially necessary free time in the process of consumption and self-organization of the economy. The market economy is self-organizing thanks to the continuous distribution of the society's economic time through the receipt of earned income in the sphere of production and its use in the sphere of consumption [6].

### 5. Temporary mechanism of production and consumer activity distribution

In the interaction of production and consumption processes, the mechanism of the self-organization of the market economy is traced, in which the social level of production and consumption is formed at the expense of individual preferences in the distribution of working and free time of the producer and consumer combined in one person. As the quantitative forms of being of social production and consumption, the following qualitatively homogeneous time values appear:

1) socially necessary working time (SNWT) is a measure of the necessity for individual productive work for the whole society;

2) socially necessary free time (SNFT) is a measure of the provision of the society's needs with socially necessary productive labour;

3) socially necessary economic time (SNET) is the own time of the market system determined by the ratio of the values of socially necessary working time and socially necessary free time.

In order to understand the self-organizing function of socially necessary economic time in the mechanism of a market economy, we should use, in our opinion, the theory of general economic equilibrium, developed by the French economist Walras (1834–1910), leader of the Lausanne school of marginalism, in the late nineteenth–early twentieth century.

Methodologically, the Walras model provides an opportunity to present the market not as a simple system based on the exchange of goods but as an increasingly complex system of markets reflecting the production and consumption of goods, resources, finance, and so on. The theory of Walras provides mathematical justification for the existence of non-equilibrium states on local markets and the formation of a global equilibrium at the macroeconomic level. This is consistent with the position of the general scientific concept of the multiplicity and hierarchy of time levels in a complex market system.

The mathematical notation of Walras's law is as follows:

$$\sum_{j=1}^m (D_j - S_j) P_j + (W - M) = 0, \quad (3)$$

where  $D_j$  and  $S_j$  are the demand and supply on the  $j$ -th commodity market, respectively;  $P_j$  is the price of the  $j$ -th product; and  $W$  and  $M$  are the demand and supply of money.

Walras's identity leads to the thesis that, if most markets have a situation of excessive supply, then there must be a market with excessive demand [7]; vice versa, situations of prevailing excessive demand should counteract the market with excessive supply.

In our opinion, according to the general market equilibrium theory of Walras, the market of socially necessary economic time is the market that underlies the non-equilibrium states on the one hand and balances the position of commodity and money markets on the other hand, in the situations of both excessive supply and excessive demand.

In this regard, we propose to extend the desired equation of Walras to the variant of the Balatsky equation, taking into account the introduction of the socially necessary economic time instead of the market of free time:

$$\sum_{j=1}^m (D_j - S_j) P_j + \sum_{l=1}^y ((D_{ITL} - S_{ITL}) + (S_{ITF} - D_{ITF})) k_l w_l + \sum_{i=1}^n (W_i - M_i / V_i) C_i = 0, \quad (4)$$

where  $D_j$  and  $S_j$  are the demand and supply on the  $j$ -th commodity market, respectively;  $P_j$  is the price of the  $j$ -th product;  $W$  and  $M$  are the demand and supply of money; and  $V_i$  and  $C_i$  are the speed of circulation and the price of the  $i$ -th type of cash. The state of the market of economic time is characterized by the ratio  $((D_{ITL} - S_{ITL}) + (S_{ITF} - D_{ITF})) * k_l w_l$ , where  $w$  is the time value of the  $l$ -th individual expressed in terms of the average hourly wage with a certain "surcharge"  $k > 1$ . It reflects the "subjective preferences of individuals in assessing the cost of overtime hours of work, for which the employee refuses his 'legitimate leisure'" [7].  $l$  is the index of the individual characterizing each person's own preferences in the formation and use of aggregate time.

This equation takes into account the two phases of the cyclical movement of the market system under the influence of the mechanism of socially necessary economic time:

1) The situation of recovery and rapid growth of the market. Excessive demand for goods in the first term of the left side of the ratio  $D_j > S_j$  is formed by exceeding the value of free time over working time, expressed in the amount of lost earnings in the case of refusal of overtime hours, or excessive demand for free time in the second term ( $D_{ITF} > S_{ITF}$ ). The general market equilibrium is established due to the excessive supply of working time ( $D_{ITL} < S_{ITL}$ );

2) The situation of the economic crisis in the market. The first term on the left side of the relation  $D_j < S_j$  is negative (excessive supply in the commodity market) due to the excess of the value of working time over free time expressed in the cost of overtime hours, or the excessive supply of working time in the second term ( $D_{ITL} < S_{ITL}$ ), which is compensated for by excessive demand for free time ( $D_{ITF} > S_{ITF}$ ).

The introduction of socially necessary economic time to the theory of the general market equilibrium of the market demonstrates interconnection and interaction of two main areas of activity: production and consumption. It is shown that the mechanism of socially necessary economic time provides the oscillatory movements of the market from equilibrium to disequilibrium, from chaos to order, that is, self-organization of the economy as a whole. The nature of economic cycles is embedded in the operation of the temporary mechanism.

## 6. Conclusion

Using the interdisciplinary methodology of the concept of the multiplicity of forms of time allows representing the structure of time in the space of economic activity of the subjects as an integrated system of astronomical, historical, social, psychological, and biological forms, each of which is characterized by the appropriate functions, concepts, and properties that reflect the specifics of internal and external economic interactions of man with society and nature.

The methodology of the neoclassical theory of the redistribution of the calendar fund of time between individuals makes it possible to justify time as a regulator of society's the level of consumption, which determines the value norm of consumption as a result of the ratio of the socially necessary free time to the total time of society.

The theory of the general market equilibrium of Walras, taking into account the market of socially necessary economic time, demonstrates a market equilibrium based on individual preferences in the distribution of production and consumer activities and allows substantiating the effect of the temporary mechanism of self-organization of the market economy.

## References

- [1] Marks K 1983 *Capital* (Moscow: Politizdat)
- [2] Becker G S 1965 *Economic J.* **75(299)** 493–517
- [3] Harris L 1999 *Monetary theory* (Moscow: Progress)
- [4] Zhelaeva S E 2015 *The 4 Int. sci. and pract. Conf. in socio-economic development of Russia and Mongolia* **1** pp 139–42
- [5] Mayewsky V I 2010 *Issues of Economics* [in Russian – Voprosy Ekonomiki] **3** 65–85
- [6] Zhelaeva S E 2017 *Methodology of time research in the process of self-organization of the economy* (Ulan-Ude: East Siberia State University of Technology and Management Press)
- [7] Balatsky E V 1999 *Bulletin of the Russian Academy of Sciences* **12** 1018–28

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