

# Time Lag in the System of Financial Transformations



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**Abstract:** The system of financial transformations has certain inertia. The processes of financial transformations develop in a volatile dynamic environment and require constant search for additional resources. Accordingly, this process occurs in a time interval and is recorded by a given lag gap.

The purpose of this article is to study the lag as an indicator of the financial transformations process in the context of the "wave" differentiation, that is wave dynamics during the evaluation of the impact phase (wave push) and decline phase (wave surge strength).

Objectives for meeting the purposes:

- Build the interdependence of the GDP price deflator and the retail price index in the Russian Federation.

- To make a wave projection to the phases of maturity, formation (push) and the effect of recession (surge) using the polynomial dependencies of the monetary, fiscal and business mechanisms.

- Consider the time economics, as a category of economic theory for proposals in adjusting the institutions at different levels of housekeeping (economy).

Research methods: the technique of wave dynamics, methods of analysis, comparison, induction and deduction were applied in this study.

Results:

The process of detailing the study of the time lags structure allows concluding that the complexity and ambiguity of the phenomenon of financial transformations imposes the

ambiguous effect of time lags on the resultant feature, i.e. the effect of the wave force in the downturn (splash) phase. The ambiguous behavior of indicators, various subsystems instruments of monetary, fiscal and business mechanisms which are transforming and changing in each subsystem with different speed and turnover are of importance. This makes an impact both on the value of time lags and on their influence on the performance indicators of the system.

The impact force of each indicator causes the transformation process in the phase of the wave decline, i.e. in the splash stage and thus creates an interdependent interaction effect. Thus, the time lags of each subsystem are not equal and have inaccuracies due to different turnover positions of the various indicators of subsystems under study.

There are attempts to define the value of time, but there is no theoretical-methodological substantiation of the institutional processes for ensuring socio-economic national security considering the area development of the state, region, business, society and human by the means of identifying such a category of economic theory as time economics.

Index Terms: digitalization, financial transformations system, institutional processes, monetary policy, security, time economy, time lag.

## I. INTRODUCTION

The financial transformations system has certain inertia. The processes of financial transformation develop in a volatile dynamic environment and require constant search for additional resources. Accordingly, this process occurs in a time interval and is recorded by a given lag gap. Therefore, a lagging effect is formed in this process which is characterized by a lag, i.e. a certain period of time which sets the impact of the resource potential as an indicator of the conjugate effect of the financial transformation process.

Accelerated dynamics of changes in the external indicators of the financial transformations process and the time lags importance complicates the problem of ensuring the socio-economic development sustainability and stability. This defines the modern paradigm aimed at finding a new interpretation and a target task of using the time lag in the financial transformations system.

The study of time lags in modern and foreign literature began in the middle of the last century [1, pp. 34-36], [2, pp. 148-150]. These studies were aimed at considering time delays, primarily between the production and goods realization, capital investments and future returns from them, financial investments and profit from new developments.

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T.R. Kilmatorov and N.M Kapitonova make attempts to record time delays in the financial transformations system [3, pp. 36-40], [4, pp. 22-25]. However the problems of assessing the impact of the time lag on the final result of the financial process still stay behind the scientific research, although as early as 1949-1950 R. Bellman and A.D. Myshkis studied the mathematical apparatus for modeling time delays, which was tested in the system of practical queries for managing fast technological phenomena in financial transformations [1, pp. 34-37], [5, pp. 45-51].

Such processes were described using differential equations with divergent arguments, and this scientific direction itself was developed in the studies of L.E. Elszholtz, S.B. Norkin and L.A. Beklaryan [6, pp. 218-289], [7, pp. 184-128], [8, pp. 138-147].

The study of time lags conducted by N. Kobrinsky, E.Z. Mayminasam and A.D. Smirnov in 1982 which was aimed at assessing the relationship between the elements of the socio-economic process that stimulate such an impact and determine its effect is worth attention as well [9, pp.134-198]. The scientists formed the simplest lag model in their works.

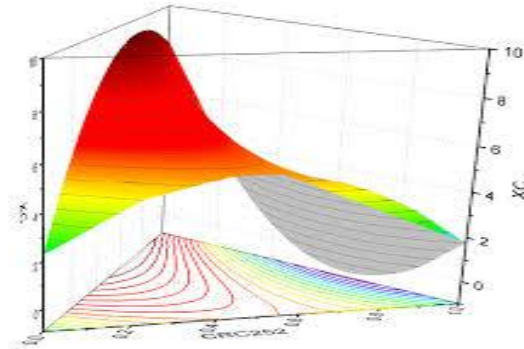
However, beyond the scope of scientific research there remain the issues of studying the lag as an indicator of the financial transformations process in the context of the “wave” differentiation, i.e., wave dynamics in evaluating the impact phase (wave push) and decline phase (wave surge strength).

“The need to study the wave in financial transformations is obvious. The ability to differentiate the wave into the implementation phase (wave push) and the maturity phase (splash) provides the ability to manage effectively the financial instruments depending on the state of external and internal indicators of the economic system. The authors did not include the possibility of considering this process spatially and using polynomial dependencies to record the effective sphere of financial indicators interaction when studying wave dynamics” [10, pp. 98-117].

If the problem of time lags had been solved, then the sphere of financial and credit transformations would have a higher degree of invulnerability and adaptability. In fact, the problem of time lags is a problem of temporary inconsistency. Temporary lags significantly complicate the system of financial and credit transformations and to the greatest extent this process mediates the cyclical nature of economic development under the influence of temporal factors.

**II. PROPOSED METHODOLOGY**

The theory of wave dynamics is based on the process of successive value converting and financial indicators transformation, which forms the limits of economic indicators and accumulates the wave effect (surge), i.e. in the maturity phase. This period covers a time lag, which is beyond the scientific substantiation of the wave functioning principle. The projection of the wave in different phases using the polynomial dependencies of the monetary, fiscal and business mechanisms is shown in Figure 1 [11, p. 24].



**Fig. 1. The projection of the wave in phases of maturity, forming (push) and decline effect (surge) using the polynomial dependencies of the monetary, fiscal and business mechanisms**

It is possible to fix time lags in the system of financial transformations using the range of changes in the GDP key indicator and effective indicators of monetary, fiscal and business mechanisms. Practical application of the wave theory of financial transformations process is possible using the Kolmogorov theorem which is a generalized approximation of neural networks. This theorem allows us to record nonlinear functions of the output signals and mark the time interval, in our interpretation – the phase of wave formation (push) and the nonlinear signal converter – the decline phase (surge) of the wave. This theorem allows us to determine the branch point in our interpretation – the interaction effect or the time lag indicator. “In particular, each continuous function of two variables (x; y) is presented in the form:

$$\sum_{i=1}^n a_1 \times (x_i \pm \varepsilon_{\Sigma}^i) \tag{1}$$

where

n – each continuous function of n variables defined on the unit cube of n-dimensional space, in this case the number of inputs, i.e., financial flows;

$(x_i \pm \varepsilon_{\Sigma}^i)$  – wave activation parameters, i.e. signals of input and output activator;

$\sum_{i=1}^n$  – summarizer of errors determining the correction of the turnover of financial flows rate” [15, c.84].

Whereas:

$$\begin{matrix} x_1 \pm a_1 \rightarrow \\ x_i \pm a_2 \rightarrow \\ x_n \pm a_n \rightarrow \end{matrix} \quad \boxed{\Sigma} \quad \frac{\sum_{i=1}^n = a_1 \times x_1 \pm \varepsilon_{\Sigma}}{\tag{1}}$$
  

$$\begin{matrix} x_1 \pm \overset{a_1}{\rightarrow} \\ \rightarrow x_i \pm \overset{a_2}{\rightarrow} \\ x_n \pm \overset{a_n}{\rightarrow} \end{matrix} \quad \boxed{\Sigma} \quad \sum_{i=1}^n = a_1 \times x_i \pm \varepsilon_{\Sigma}^i \tag{2}$$

“In the mathematical wave projection, the wave formation phase is initially represented, i.e. the push and the subsequent decline phase, i.e. surge.

If study the phase of the wave decline i.e. surge, in more details, then using the branch point as the mathematical rationale of the burst, it is possible to get:

$$\begin{aligned}
 &\rightarrow \\
 &\rightarrow A_i \left[ \varphi_1 \right] \begin{array}{c} \boxed{a_1} \\ \rightarrow x_1 \\ \frac{a_2}{x_2} \\ a_{n-1} \\ \boxed{x_{n-1}} \end{array} \quad \Sigma_0 \rightarrow \varphi_0 \rightarrow \gamma \\
 &\rightarrow \\
 &\rightarrow \\
 &\rightarrow \Sigma_n \xrightarrow{A_n} \varphi_n \rightarrow \\
 &\rightarrow
 \end{aligned} \tag{3}$$

Where:

$\Sigma_0 \rightarrow \varphi_0 \rightarrow \gamma$  – the effect of wave action resulting from the effect of the rate summarizer impact of change in financial flows, covering the system of financial flows movement  $A_i$  at different values of the financial flows turnover rate.

All continuous functions of many variables can be obtained from continuous functions of one variable using linear operations and superposition. Any polynomial from many variables can be obtained from one random nonlinear polynomial from one variable using linear operations and superposition” [12, p.84].

But the process of detailing the study of the time structure lags allows to conclude that the complexity and ambiguity of the phenomenon of financial transformations imposes the ambiguous influence of time lags on the resultant feature, i.e. the force of wave impact in the decline (surge) phase. The ambiguous behavior of indicators, instruments of various subsystems of monetary, fiscal and business mechanisms which are transformed and changed in each subsystem with different speed and turnover are of great importance. This leaves an imprint both on the value of time lags and on their impact on the system performance indicators.

The impact force of each indicator causes the transformation process in the phase of the wave decline, i.e. in the surge stage, and thus creates an interdependent interaction effect. Thus, the time lags of each subsystem are not equal and have errors due to different positions of rotating the various indicators of the considered subsystems.

Thus, the key transformer of the financial transformation system is the criterion “time – speed”, in our interpretation “time – turnover”. The ranges of these criteria errors will allow effective managing of this process, as well as determining the effective forecasting of the financial transformations system in a changing environment.

### III. RESULTS AND DISCUSSION

At the moment, cyclicity is considered to be a general form of the world economy and national economies movement, expressed by the uneven functioning of different national economy elements, the change of evolutionary forms and development stages. The case is about constant fluctuation of business activity and interchange of recessions and rises’ intensity. This situation in the financial and credit transformations system is characterized by the following:

- the growth of production volume on a global scale, the redistribution of capital;
- globalization of redistributive financial flows, contributing to the creation of new financial instruments;
- the choice of tools for the cyclical development of economic systems, which complicates the synchronization of different cycles types;
- none of the state regulation instruments can neutralize the cyclical process, but with the help of time lag indicators it is possible to reduce, extend and minimize the depth of the financial fall.

In the system of monetary regulation, the sphere of financial transformations is formed according to the criterion of internal and external equilibrium, where internal equilibrium is the full use of resources, and external equilibrium is the stability of the level of internal prices. The external equilibrium of the monetary regulation sphere is achieved under such a condition when the current account balance is in optimal state, i.e. when there is no deficit that does not cover debt obligations.

The deficit caused by expansive policies is a signal to restore the external equilibrium by changing economic course. An excessive surplus of balance of the current transactions account leads to a reduction in national production investment. Since the surplus implies the accumulation of assets abroad, it is necessary to interest investors in domestic investments by establishing a progressive tax system or increased competitiveness of domestic products.

The excess reflects superfluous borrowing made by foreign counterparties that were not returned. Thus, the goal of external equilibrium should be such balance levels of the current operations, which will allow obtaining benefits from international trade with the lowest risk. Therefore, the problem of considering time periods (lags) is faced when determining the stabilization directions of the financial transformations process.

It should be noted that monetary and fiscal policies in the financial transformations system operate in combination with long time lags.

The time lag in the financial transformations system is a gap between the moment of awareness of the need for action and the moment of the financial transaction implementation.

It is impossible to unambiguously characterize the duration of the time lag for operations in the sphere of financial transformations, since each operation is determined by the velocity of circulation, which affects the value of the time lag. Thus, the transactions for sale of securities on the open market are carried out faster than changes in the field of taxation. For automatic (built-in) stabilizers, the internal lag is zero (NDFL), as it stabilizes the economy smoothing the effect of the monetary multiplier on aggregate demand. Transactions in the external financial market have a longer time lag. Temporary lags significantly complicate countercyclical monetary policy. In the case of rising prices, it leads to an increase in aggregate demand.

## Time Lag in the System of Financial Transformations

Assessing the effectiveness of monetary policy in the field of financial transformations in terms of the money supply value is possible only in a time period. It should be noted that the time lag mostly appears in the financial transformations system in the process of managing inflation expectations.

The state budget surplus and an increase in the current account positions of balance of payments have eliminated the

motives for the occurrence of excess emissions aimed at financing the budget, and have helped to ensure the macroeconomic balance positive impact on the process of stabilizing inflation expectations.

Figure 2 illustrates the relationship between the GDP price deflator and the retail price index for the Russian Federation for the period from 2003 to 2018.



**Fig. 2. Interdependence of GDP price deflator and the retail price index for the Russian Federation**  
Source: composed by author based on data [13], [14]

Using such a systematic approach, it is advisable to study the influence of time lags in the sphere of interaction between fiscal, monetary and business mechanisms. These mechanisms should be studied in spatial projections, since in this situation their interaction is more clearly visible. "The projection of the presented polynomial dependencies provides the possibility of determining the sphere of effective interaction, both the integral system of the financial mechanism and its individual indicators, and the differentiation of the wave into the formation (push) and decline (surge) phases allows to define more clearly the effect of such phenomena and provides an opportunity to record some time period in this system. The consistency and complexity of the wave technique is most fully realized in the study of time lags in the course of the financial mechanism functioning mediated by the monetary, fiscal and entrepreneurship mechanisms. Thus, using the wave dynamics technique, "it is possible to record time lags in the sphere of financial space functioning which is quite adaptive to external changes and responds flexibly to the criteria of the target setting" [15, pp. 12-14].

### IV. TIME ECONOMICS

Constantly changing time makes the history of the socio-economic national spatial development at the level of state, region, business, society and human being: "yesterday", "today", "tomorrow", past, present and future. Time which is running forward is always fleeting and priceless, and perception of time itself is very subjective.

Ancient Greek philosopher Seneca said in his discourse on time that man has no greater value than time. It cannot be lent or borrowed from anyone like money or jewels. But the

biggest part of our time, of our greatest value is taken away by others. A man is insane if he does not catch time [16].

At any level of socio-economic national development there will be plenty and/or little time for what we really need and/or want to achieve goal. And if it is necessary and/or we want to change our future qualitatively, we need to change the present, which is achievable for subjects representing or conducting economic activity at any level.

Albert Einstein said that:

- "A man is a part of the whole, which we call the Universe, a part limited in time and in space. A man perceives himself, his thoughts and feelings as something separate from the rest of the world, which is some kind of optical illusion. This illusion has become a dungeon for us, limiting us to the world of our own desires and devotion to a narrow circle of people close to us. Our task is to free ourselves from this prison, broadening the sphere of our participation to every living being, to the whole world, in all its glory. No one will be able to accomplish such a task to the end, but the very attempts to achieve this goal are the part of the liberation and the basis for inner confidence" [17];

- "perfect means with unclear goals is a characteristic feature of our time" [17].

Thus, knowing the history (past) of socio-economic national development, in order to achieve high-quality rational management considering the institutionalization of the socio-economic security system, using sophisticated means in digitalization terms, it is necessary to set the exact (clear) goals, corresponding tasks and their implementation (plan-law or forecast plan), i.e.

use of strategic planning in time (short-term or long-term planning).

The society of post-Soviet period clearly understands (and sociological polls also confirm that fact) that society has ceased to plan for the long-term perspective. That is, they “look through” a certain 1-3 years long endpoint, and according to it they set appropriate goals and tasks, provided that the fundamentally basic components do not change.

Therefore, it is proposed to consider the economy of time itself, i.e. for proposals to adjust institutions at different levels of household (economy).

The ideas previously written are becoming extremely important now, when technical progress and integration processes in the global world are accelerated. This brings systemic changes and information flows which make it impossible to work out the adaptation mechanisms as of human inner world (the process of education, perception of the world, etc.) and rational economic relations within a human, business, region, country, world, as a whole. Therefore, the development of maintaining systemic rational sustainability and general security from internal and external threats becomes a critical activity of state structures. The development extends both to traditional spheres of influence such as the military-industrial complex, and also to those creating absolutely rationally new models of the society systemic organization based on new technical advances. [18]-[20]

Previous studies of local scientists have shown that it is possible to achieve maximum quality growth and development of a human, business, society, region, state only with certain components of safety criteria. These elements are not only economic ones which include social, financial, industrial, investment, food, macroeconomic, scientific-technological, external economic, energy, demographic, institutional but also military, political, environmental, informational, legal and cultural considering such a complex polysystem phenomenon, category and process of ensuring security [21], [22]

This is especially relevant with the digitization of socio-economic relations. The study of the new trends of the “classical” digital economic theory should reveal the strategic directions for the transformation of the economy through the modernization of technological processes based on digital technology tools. Identification of the relevant factors for the production sphere, development and approbation of provisions based on the theory which has the modern origin of “creative destruction” together with the emergence of the meanings theory create a methodological basis for new architectural forms of organizing social production, social and economic relations categories of “classical” digital economic theory [23], [24].

It is the technological paradigm of new economic thought which is able to interact with the categories of the “classical” digital economic theory and to form socio-economic relations, imputing digital technology tools in all areas of life to introduce current features in research activities. The significance level of new economic development architecture is based on the “classical” digital economic theory and obeys a different principle of “combinatorial growth”, including those expressed in the combination technologies of

partnership contracts, separating the production level (service provision) from the management level providing a system of technological processes. This will contribute to the development of a new quality, identifying changes in the weight of the driving factors which allows to adjust selectively the methods of public policy. The publications of scientists and specialists point this as well. [25]-[27].

## V. CONCLUSION

Thus, the process of detailing the time lags structure study allows to conclude that the complexity and ambiguity of the phenomenon of financial transformations imposes the ambiguous effect of time lags on the resultant feature, i.e. the force of the wave impact in the decline phase (surge). The ambiguous behavior of indicators, various subsystems instruments of monetary, fiscal and business mechanisms, which transform and change in each subsystem with different speed and turnover, are of great importance. This leaves an imprint both on the value of time lags and on their impact on the system performance indicators.

The impact force of each indicator causes the transformation process in the phase of the wave decline, i.e. in the surge stage, and creates an interdependent interaction effect. Thus, the time lags of each subsystem are not equal and have errors due to different positions of the various indicators turnover of the considered subsystems.

The key transformer of the financial transformation system is the criterion “time – speed”, in our interpretation “time – turnover”. The ranges of these criteria errors will allow effective managing of this process, as well as determining the effective forecasting of the financial transformations system in a changing environment.

Today, there exist the attempts to define the time value but there is no theoretical and methodological substantiation of institutional processes to ensure socio-economic national security considering the spatial development of the state, region, business, society, human by identifying such a category of economic theory as time economics.

Further research should be directed at forming a mechanism for the effective management of the financial transformations system in the context of digitalization.

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