

Analysis and Forecasting of Ukraine's Economic Development Cycle

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Abstract—The aim of this paper is to identify a new cyclic stage of Ukraine economic development and its forecasting. Objectives of the study are: determination of development cycles in different sectors of Ukraine economy and its general trend, construction of economic and mathematical model for forecasting the development cycle of the national economy. Research methods are: dialectic, complex and systematic approaches, induction and deduction, taxonomic analysis, mathematical gnostic analysis, graphical method. The main results of the study are proposed indexes for assessing economic cyclicality and created a model for forecasting the index of Ukraine economic development. The structure of the economic development cycle has been determined. It includes: equilibrium of development, equilibrium of crisis, their static states and transient stage of bifurcations. Indexes are proposed for assessing cyclicity in agriculture, industry, construction, trade, and consumption and investment processes. The results of the analysis showed a distorted economic structure and Ukraine's doom to shock. The economic and mathematical model for forecasting of Ukraine economic development index depending on the dynamics of industries, consumption processes and investments is constructed. The toolkit for forecasting economic processes has evolved. The outlook for the economic development cycle in Ukraine has shown a likely deepening recession if the state's economic policy does not change. The results of the study are aimed at improving economic management. The use of the economic and mathematical model for estimating Ukraine economic development index allows improving the objective analytical substantiation of decisions in the sphere state's economic policy.

Keywords—*cycle, cyclicality, economic development, model, index, equilibrium, forecast*

I. INTRODUCTION

Cycle in economics theory is one of the priorities for modern science. Any economic development has a non-linear, dissipative character. Its vector is determined by cyclical fluctuations of various economic processes. Development dynamics national economic system is a set of cycles in production, construction, circulation and consumption spheres. The cyclicality of national economic development is multifaceted. Its structure includes wave dynamics in all institutional sectors of the economy. Enterprises economic cycles merge into industries cycles. The wave dynamics of supply and demand are determined by them. They flow into the macroeconomic cycle eventually. Cycle's coherence is a very complicated problem. Chain reaction of recessions in various economic spheres leads to

stagnation. The consistent rise in the functioning of enterprises, industries, and the market forms an increasing wave in any economy. Smoothing of cyclicality is important to ensure sustainable economic development. Sustainable development is linked to the equilibrium in time and space, that achieved by the ordering of the formation and use of technical, scientific, environmental, economic and social resources [1, p. 231].

II. THEORY OF QUESTION

A. Cycles

Economic theory distinguishes cycles in duration: short-term business and agrarian cycles (J. Kitchin), medium-term fluctuations of capital investment in industry (C. Juglar), long-term building cycles (S. Kuznets), change of technological methods (N. Kondratev) [2, 3]. Basic provisions of cyclical development have already been formulated by science [4, p. 107; 5, p. 15]:

- cyclicity is an evolutionary development, combining discontinuous and continuous;
- static equilibrium is the starting point of the cycle;
- dynamic equilibrium is an indispensable attribute of cyclicity without which development is impossible;
- crisis is an optional element to update the trajectory of development, a tool for the formation of a new, higher quality system of structural links and the corresponding equilibrium.

Significant efforts in the history and modernity of economic science to study the laws of cyclic development are made. However, A. S. Halchinskyi emphasizes «the lack of cyclicality fundamental studies as complex in its content of systemic phenomena» [5, p. 17].

B. Equilibrium

The reasons for the occurrence of cycles are different. Their common feature is the desire for balance. Equilibrium as the starting point for analyzing of economic cycle was defined by K. Marx [6, p. 368]. This approach was accepted by many other Western scientists. «The initial wave grows freely from the state of a fully balanced equilibrium, and then decreases, passing to the same equilibrium state», – is said by J. Schumpeter [7, p. 47]. The scientist examined the cyclical dynamics of economic development and discovered it new understanding. It's not a result of an equilibrium shift. It's a process of a transition between varying equilibrium

states [7, p. 154]. Internal needs of system are recognized by J. Schumpeter as a cyclicality cause. Such needs are the desire for change and equilibrium [7, p. 188, p. 427]. In fact, their alternation causes some wave dynamics of economic development.

Consequently, any cyclicality is some movement from one to another static equilibrium. Depression's static equilibrium is disturbed by innovation. The growing dynamics of the cycle is begun [7, p. 50]. The renewal of any economic system is being progressed through the crisis. The old elements are dying and new quality is born.

According to N. D. Kondratev, cyclicality is generated by the fluctuations of «economic elements» around equilibrium's state, which «constantly evolves» as the national economy develops [8, p. 15]. Different types of equilibrium are inherent in different contingency waves [3, p. 345; 8, p. 216-217]:

- Equilibrium of the first order is inherent in market conditions for short cycle (up to three years). It manifests itself in establishing equilibrium market prices for goods and services.
- Equilibrium of the second order is the balance between consumption and expanded production. It is observed in the period of an average of eleven years.
- Equilibrium of the third order is new market equilibrium achieved after the expansion of fixed capital for some technological upgrade. It is formed during fifty or sixty years.

The cyclical fluctuations are due to the deviation of «the real level of system elements from the evolving equilibrium point» [8, p. 262]. The conditions for the growth of a cycle are formed on its downward wave. The main ones are release and accumulation of capital, and development of innovation. The beginning of the rise corresponds to the moment when capital accumulation reaches such a tense, in which it becomes possible to make profitable investment with the purpose to create the main productive forces and radical technological re-equipment [8, p. 226].

C. Long waves and Ukraine

Today the world is at the roots of the sixth Kondratev cycle (2018-2060) [9]. The transition to the sixth technological structure is associated with the convergence of nano-, bio-, informational and cognitive technologies [10]. In Ukraine, the third and fourth technological modes [11] are dominant nowadays. The innovation development strategy implementation in Ukraine requires a change of its economic management model. The modern Ukrainian model is a peripheral model of capitalism, where clan-oligarchic groups prevail. It does not provide for economic development mechanisms [12]. Technological renewal of Ukrainian fixed capital is possible on the basis of public-private partnership expansion. It corresponds to a mixed model of economic management.

III. METHODOLOGICAL ASPECT

An important methodological problem is the temporal structure of economic development cycle. At the heart of economic development is a dynamic equilibrium. It represents a balance of economic processes. They must be

ordered and subordinated to one goal: sustainable development.

A. Dialectics

The increasing cycle phase is dynamic equilibrium stage of the economic system. Stopping on this path means achieving a static equilibrium. It's crisis' harbinger. Static state conservation is devoid of development. The next stage is bifurcation.

From here there are two outputs. The first simple leads to a crisis. The second complex requires an effort to reach the stage of a qualitatively new dynamic equilibrium. It's due to innovation. Innovations deny static equilibrium and crisis states. That is the dialectical law of double denial. It is the basis of any progressive development. Innovations bring the economic system into some dynamic state of qualitative transformation.

B. Components of cycle

Consequently, the temporal structure of economic development cycle includes: evolution equilibrium, crisis balance, their static states and transitional bifurcation stage.

IV. METHODOLOGICAL TOOLS

A. Effective indicator

An aggregate indicator is proposed to determine the cycle of economic development. That is an economic development index. It includes the following indicators: growth rate of gross value added, intermediate consumption, GDP per capita, capital investment, gross accumulation and consumption of fixed capital, as well as a share of innovative products and share of completed scientific and technical work in GDP.

B. Impact factors

In order to assess cycles in agriculture, production, construction and trade, a special index of enterprises financial and economic status is proposed. It includes: the first and the second financial equilibrium indicators, fixed assets depreciation level, working capital share in current assets formation, balance value corporate rights, net income profitability and capital turnover.

Individual indices are offered to assess the cyclicality of consumption and investment processes. Consumption index includes: growth rate of population real incomes, households bank lending, consumer spending, wage arrears and living standards of Ukrainians.

Economy investment potential index includes: household savings transformation level into investment capital by financial intermediaries, «financial depth» indicator, broad money, growth rate of long-term bank loans and enterprises long-term bonds, Ukrainian economy capitalization level.

All proposed indexes are determined on the basis of taxonomic analysis [13].

V. ANALYSIS OF THE SITUATION IN UKRAINE

The branches of agriculture, industry, construction and trade are covered by the survey. Their businesses are in the net borrowing area. Creditors' funds predominate in financing these economy spheres. This is some common feature.

A. Agriculture

The best situation is in agriculture. After the financial crisis of 2008, there is a growing phase of the agricultural cycle (Figure 1).

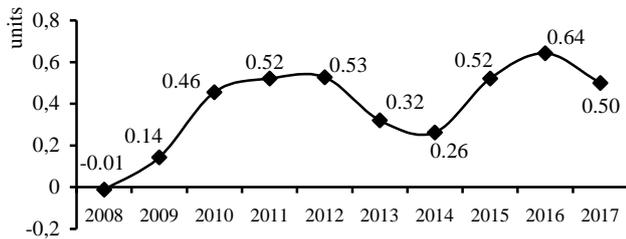


Fig. 1. Index of financial and economic state at agricultural enterprises in Ukraine for 2008-2017 (source: authors on the base of [14] data)

The main reason is profit. Agriculture in Ukraine was keeping profitable during the biggest difficulty 2013-2014. However, profitability rate had been fluctuating throughout 2008-2017. Agricultural enterprises equity was regularly being replenished by profits in that period. The participation of working capital in current assets formation had grown above 25%. This is twice the optimum. The fixed capital was updated. Fixed assets depreciation level was not higher than 40%. All these contributed to some stable growth of corporate rights value. Agricultural industry was at the point of financial equilibrium in 2016. Subsequently, there were slight deviations from financial equilibrium state. Up to now agricultural sector has been in the upgrade phase of the economic development cycle. Dynamic equilibrium is inherent in it. But it's unstable.

B. Industry

Ukraine is undergoing the de-industrialization process of its industrial. Since the first years of Ukraine's independence the industry share in the total GDP has been decreasing. Over the last ten years, one fifth of the producers have been lost. In 2017, the share of industry gross value added amounted to 18%, whereas in 1991 it was 36% [14]. Production with a low share of gross domestic product in the gross output is widespread in Ukraine economy. It is energy intensive raw material production. These enterprises produce intermediate consumption products. Over the past ten years intermediate consumption share in industrial production has approached 80% [14]. Its fluctuations are related to inflationary costs during times of increasing instability in the economy. As a result, there is limited internal capacity to meet economy basic needs. It contributes to the development of finished products' import. This situation destroys the domestic producer. Domestic industry is in downward phase of economic development cycle (Figure 2).

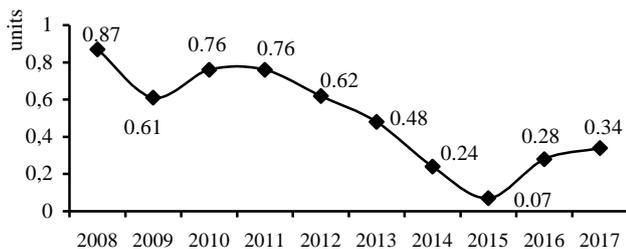


Fig. 2. Index of financial and economic state at industrial enterprises in Ukraine for 2008-2017 (source: authors on the base of [14] data)

The long decline in industry is due to the lack of technical and technological updates. Fixed assets depreciation level is close to 60%. Domestic producers lack their own financial resources for innovative transformations. The solvency of industrial enterprises is broken. Their financial assets cover only half the liabilities. Working capital deficit increased sixfold during 2008-2017. The main reason is loss-making. Industry overcame the break-even rate only in 2017. However, industrial corporate finance remains unbalanced. There are no economic foundations for increasing the efficiency of industrial production. In the first place, we have a high level of operating expenses in industrial. Since 2008 it has been exceeding the net sales revenue. Industrial operating costs amounted to 99.2% in 2017. Ukrainian industrial production is material, electric and energy intensive. Industrial products cost is constantly under pressure from energy prices, raw materials and materials. Therefore, the operating profitability in industry is low. It causes some self-financing deficit. The high cost of industrial products negatively affects domestic enterprises competitiveness both in the domestic and world markets.

C. Construction

Construction sector's situation is the worst. The slowdown at construction cycle has been lasting from 2008 (Figure 3).

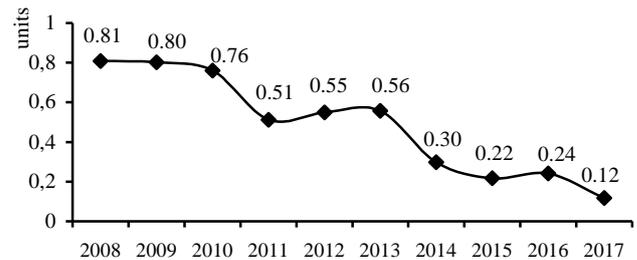


Fig. 3. Index of financial and economic state at construction enterprises in Ukraine for 2008-2017 (source: authors on the base of [14] data)

Today, crisis static state in construction has been achieved. We have the following features: some deficit of net assets and working capital, chronic losses with fluctuations to 18%, fixed assets depreciation level increase to 60%, creditors' claims are not covered by liquid assets, and a slowdown in capital turnover by seven times [14].

Ukraine faces the threat of losing some niche in the domestic construction market. There is a set of problems in domestic construction. Some shadow economy is present in this sector. There is corruption in tendering, at preparing the project documentation. The smallest construction estimate cost becomes the winner. While in world practice, the criteria for the quality of construction work are taken into account. Economically justified prices in construction are absent. To date, the contractor may increase the investor's estimate cost at the construction process. Therefore, the return on investment remains an open question until construction completion. We have some outflow of skilled labor abroad. New technologies lack in construction is tangible. Consequently, the preservation of Ukrainian construction industry requires the elimination of non-observed economy, the new regulatory support for the implementation of investment projects, investors' rights protection and restoration human capital.

D. Trade

The trade sphere in Ukraine is experiencing some revival. After a long recession, a new cycle of trade development began in 2015. However, quickly reached in 2016 financial equilibrium point by this area is unstable (Figure 4).

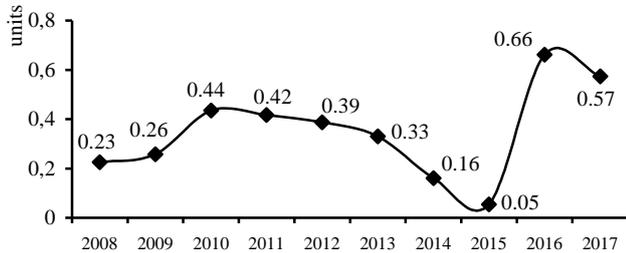


Fig. 4. Index of financial and economic state at trade enterprises in Ukraine for 2008-2017 (source: authors on the base of [14] data)

Trading intensification and the decline in domestic production indicate saturation of the market with imported goods. The deficit of Ukraine export and payments balance in 2017 is 4.6 times more than in 2009. Since beginning of hostilities in Ukraine Eastern, the trade has been entering the losses zone. It was lost 30% of trade enterprises [14]. However, investments to charter capital have been increased. Only in 2016 this growth was twofold. It allowed overcoming the deficit of self-financing and reaching some break-even level of trading. Increasing capital turnover is stable. It contributes to the increase in profits. Trade fixed assets depreciation level does not exceed 40%. The value of corporate rights in the commercial business sharply increased in 2016-2017. The continuation of trade increasing cycle in Ukraine depends on the solvent demand.

E. Consumption, investment and economic development

Unlimited consumption is the reason for the economic collapse. At the same time, the market should expand with production growth. That is one of economic development classic requirements. The five-year cycle of the consumption process in Ukraine began after the global financial crisis of 2008. The quenching of the inflation surge and devaluation contributed to it. The wave of consumption cycle reached its bottom in 2014-2015. This is a period of economic and political instability escalation in Ukraine. It aggravated by the war with Russia. There is now a wave of rising demand from 2015. Together with the consumption curve the index of economic development is changing (Figure 5).

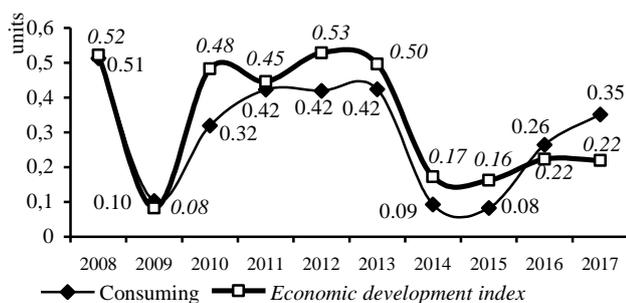


Fig. 5. Indexes of economic development and consumption in Ukraine for 2008-2017 (source: authors on the base of [14], [15] data)

Ukraine has 20% of fertile soils in the world, all types of minerals and various natural resources. However, the cycle of its economic development is determined by consumption activity, not production. Own political situation was played a key role in the formation of Ukraine import-dependent. Until now, the contradictions that arose at the beginning of its independence have not been resolved. Ukraine has difficulties and threats associated with paradoxes and understandings by their own national elites of the place and role of the nation in the modern world, with their inability to think and act in a patriotic manner. As a result, there was a substitution of concepts. The formation of a powerful corrupt apparatus is presented as a process state-building.

Due to such economic and political specificity Ukraine cycle of economic development lost accumulation period of investment capital. Its dynamics determines long cycles in the economy. For 2008-2017 Ukrainian investment potential economy was being depleted (Figure 6).

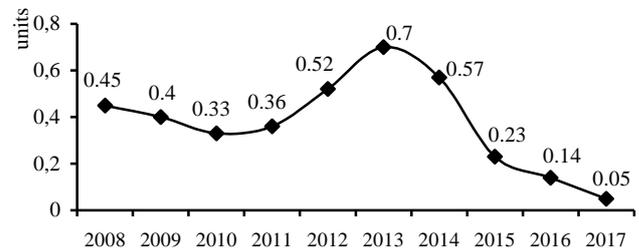


Fig. 6. Index of investment potential in Ukrainian economy for 2008-2017 (source: authors on the base of [15], [16], [17] data)

Ukraine has reducing of the «financial depth» (up to 20%), the broad money (up to 40%) and the economy capitalization (up to 55%). The situation is complicated by significant depreciation of fixed assets. So, the next economic cycle in Ukraine is in turn false, without development. Free capital that does not find its application in industry and construction, involved in the import trading. It, of course, does not create preconditions for GDP growth.

The modern stage of economic development cycle is a period of demand for industrial capital products, but it's acutely lacking. Reasons for that are the disproportions of the national economy. They are formed by the depreciation and non-reproduction of fixed capital. There is also an incorrect allocation of investments. The funds are aimed at expanding the sphere of consumption, not production. In its turn, supported by bank loans solvent demand stimulates high prices and importing. A high level of dependence on imports makes Ukraine vulnerable to imported inflation. In addition to raising prices it threatens the destruction of domestic production and the transformation of our state into the market for sales to world exporters. At the same time, the export of capital from the country increases the demand for foreign currency. It contributes to the devaluation of national money.

Depreciation of fixed capital, high cost of domestic export, reduction of production capacity, stable loss-making of enterprises are the objective consequences of the lack of state economic policy and owners' inaction to re-equip production technology in accordance with modern scientific and technical achievements.

VI. ECONOMIC-MATHEMATICAL MODEL

To study the relationship between the cycles of economic processes in Ukraine, mathematical gnostic analysis was used. This method offers a new way of analytical processing of inaccurate data. It is based on a combination of quantification theory, Riemann geometry, relativistic mechanics, thermodynamics, and algebra. Mathematical gnostic analysis methodology of economic processes was unveiled by the Czech scientist Pavel Kovanic [18].

A. Model

The economic-mathematical model of economic development in Ukraine has the form:

$$Y = 0.185 \cdot X_1 + 0.292 \cdot X_2 + 0.259 \cdot X_3 + 0.316 \cdot X_4 + 1.038 \cdot X_5 + 0.152 \cdot X_6 \quad (1)$$

where Y is the index of economic development of Ukraine;

X1 – index of financial and economic state at agricultural enterprises;

X2 – index of financial and economic state at industrial enterprises;

X3 – index of financial and economic state at construction enterprises;

X4 – index of financial and economic state at trade enterprises;

X5 – index of consumption;

X6 – index of investment potential in economy.

B. Characteristics of the model

Parameters of the model (1) are shown in the Table 1. The forecast of economic development index depends the most on consumption dynamics in the country. It confirms the consumer nature of the Ukrainian economy. The ruling neoliberal concept of development deliberately puts the economy dependent on monetary factors. They are unstable and very sensitive to external and internal influences.

TABLE I. CHARACTERISTIC OF THE ECONOMIC-MATHEMATICAL MODEL FOR THE FORECAST OF UKRAINIAN ECONOMIC DEVELOPMENT INDEX

Factor	Coeffs	Std (C[k])	Mean (x[k])	Mean (Cx[k])	Probability value
X ₁	0.185	0.031	0.424	0.078	0.001
X ₂	0.292	0.096	0.476	0.139	0.019
X ₃	0.259	0.075	0.492	0.127	0.010
X ₄	0.316	0.044	0.338	0.107	0.001
X ₅	1.038	0.073	0.266	0.276	0.001
X ₆	0.152	0.035	0.407	0.062	0.003

^a.calculated by the author

Monetary policy is the first violin in regulating the economy. First, it indicates a tight interplay between the financial and real sector of the economy. It's especially due to the percentage channel. Secondly, the emphasis is on the technical stability of prices, and not on their economic justification. Thirdly, in the economic life of domestic enterprises there is no negative feedback between the

financial equilibrium and innovations that play an anti-crisis role.

Let's quantify the coherence of economic processes cycles in Ukraine. Cycle boost phase in agriculture, industry, construction and trade stimulates economic growth. With every percentage of agriculture growth economic development index is increased by 0.185 units. Similarly, at the expense of the industry, index growth is projected to average by 0.292 units. In the absence of other conditions, the positive impact of construction development on the economy is estimated at 0.259 units, trade – at 0.316 units. The most coherent cycles of economic development and consumption in Ukraine. Their direct correlation coefficient is 1.038. The influence of consumption index (X₅) is higher than the impact of other factors in 2-4 times. Investment potential index (X₆) has the least impact on economic development. Its coefficient is 0.152.

The probability of zero hypotheses for each factor is low (less than 0.02). It's considered to be ineffective. The forecast volatility (0.024) is seven times less than the average deviation of economic development index (σ_Y = 0.176). Consequently, the model (1) is considered fair for the current conditions in Ukraine.

C. Forecasting

In the unchanged conditions, economic instability is expected in Ukraine. High dependence on the level of consumption causes it (Figure 7).

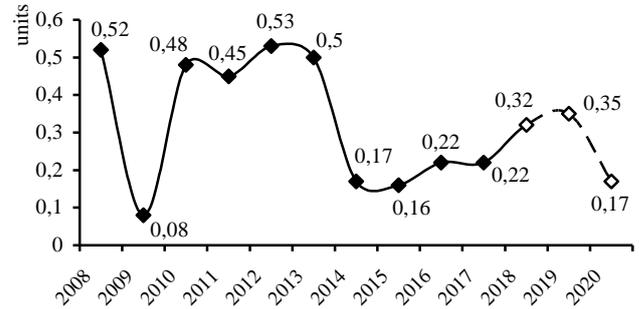


Fig. 7. Forecast of economic development index in Ukraine by 2020 (source: authors on the base of model (1))

Ukrainian economic situation peculiarity is the limited ability to consumption growing. Its reasons are population's poverty, high prices and interest rates. The achieved stability at prices really high level does not allow for consumption expansion. Currently, economic development in Ukraine is limited by consumption. The change of this situation requires to strengthen the investment potential of the economy. It's highly necessary to set up another chain reaction in the Ukrainian economy. It's as follows: investments – jobs – household incomes – solvent demand at own expense. It will automatically make the Ukrainian currency strong. Consequently, innovation in the economy must be the first from monetary regulation.

Catching some growth wave of economic development cycle in Ukraine is possible by revive and support enterprises financial equilibrium. It requires attracting investment by improving legislation. The state investment system and the investment market have to be developed. Without public-private partnership, it's impossible to modernize

technologically the domestic industries, on which the scientific progress depends most. It's necessary to stimulate innovation in agricultural, industrial and construction enterprises by means of a tax mechanism. The tax differentiation can stimulate economic development. It's important to ensure that the social, environmental and economic components of sustainable development are balanced. Cooperating of economic branch should be developed to full, rationally and efficiently using of all resources.

So, building investment-innovative model in Ukraine requires some combining macroeconomic regulators, effective industrial policy, development and modernization of competitive branches, introduction of innovative technologies. The achievement of financial equilibrium by enterprises is possible on the basis of purposeful join forces and actions coordination of the state, owners and producers. It's a way to overcome the consequences of the transformational recession in Ukrainian economy by its development.

VII. CONCLUSIONS

Ensuring solvent consumer demand at the expense of loans is a cause of short cycle in the Ukrainian economy. Increasing the interest rate and restricting access to credit can create a threat of technical defaults before the entire industry. Therefore, the price of money is important, but not only it. The structure of bank lending significantly affects on economic development. Investment demand must be met. It's the reason for genuine economic development. In fact, the cycle of economic development has not begun in Ukraine yet. From time to time, the Ukrainian economy is short sharp decline. It's typical of short cycles due to consumption dynamics. If we talk about long waves in the Ukrainian economy, then we also have a downturn. The transformational decline associated with the transition to market relations goes on up to day. These are not just unresolved contradictions in the changing economic model. We have a distorted structure of the economy. The position of the state was taken by the oligarchs. Ukraine does not have a genuine competitive market. Without changing the economic system, Ukraine is doomed to shocks, whose causes are purely subjective.

Going out of depression is the looking for a new equilibrium. In Ukraine, its search is simply not carried out. The economic development cycle in any state must be planned by its economic policy.

Counter cyclical policy is able to proviad the equilibrium. It means that any economic policy has to be counter cyclical. By that way some possibility of smoothing out cyclical fluctuations and achieving progressive development is opened. In order to achieve this, counter cyclical policies must be systematic and stable. It should not be partial or discrete.

The main objective of counter cyclical economic policy is to create an equilibrium management mechanism. It aims at ensuring the sustainable development of the economic system in some strategic perspective. The cycle of development of an economic system will catch a downward wave if the counter cyclical policy is absent or ineffective.

When economic system gets into any crisis, the need to restore its equilibrium will become the current interest. The crisis overcomes by the recovering of new equilibrium. The crisis signals the need to restore the equilibrium of the economic system in order to preserve and ensure long-term functioning it. Consequently, the main cause of the crisis is inefficient equilibrium management. Achieving equilibrium is not an end in itself. It's some process an orderly way to upgrade. Movement to a qualitatively new equilibrium state is able to provide development of economic system. Such an upgrade is necessary for self-preservation and self-development of the economy. The getting into crisis on this path means that the economic system has crossed the signal line. Since that moment, the time frame for the final selection and implementation one of twice options is accelerated. The first is to upgrade and develop the economic system. The second is its destruction. So, the logic of cyclicity is to create and implement a new something.

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