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THE WAYS OF SECURING CRISIS-FREE ECOLOGICALLY FOCUSED DEVELOPMENT OF UKRAINIAN INDUSTRY

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ABSTRACT. The paper argues that Ukraine should change conventional concept of economic development, based on extensive consumption of natural resources and a large impact on the environment. The authors present how the concept of sustainable development might function to secure ecologically focused (continuous, crisis-free) industrial development. The main prerequisites to sustainable development are innovations, as well as ecologically loyal institutional rules of business. But these innovations have to be ecologically focused on nature and for mitigating eco-destructive impact. The authors pay attention to the analysis of ecological problems in development of Ukrainian industrial production during the recession period and propose methodological basis for a concept of ecologically focused anti-recessionary management of industrial production development.

JEL Classification: B31, L60, O11

Keywords: ecological innovations, industrial production, sustainable development, crisis, Ukraine.

Introduction

Economic growth and development are among key issues addressed by macroeconomic studies of foreign and domestic researchers. This is associated primarily with growing human needs and corresponding tasks of maximal output of products and services, which are set to satisfy current demand in the best way. In the context of limited material and financial resources the potential for expanding the manufacturing scale of products are fixed and therefore do not allow meeting the ever growing needs to the full extent. Consequently the issues related to raising living standards of population, securing high income and consumption levels, which are derivatives of economic growth, are priorities in implementing the economic policy.

The key element of economy is production; hence, securing a continuous industrial growth is among major issues addressed by economic science. The growth continuity process is very complicated due to the market economy cyclicality. This characteristic brings about deceleration and relapse of many economic processes. Overcoming the cyclicality will allow securing not only continuous growth but also well-being of population on the whole.

At the same time economic growth is related to a growing impact on the environment. With this in view, it is significant to identify key factors of economic growth and the harmony which exists between the economic and ecological systems (Plachciak, 2009). The ecological situation in numerous emerging countries is complex: a high pollution level of all natural resources and deteriorating quality of ecological services reflect the exacerbation of a crisis in the interaction of society and environment; subordination of environmental interests is allowed in order to gain economic benefits. Excessive consumption of natural resources keeps growing, gradually resulting in destruction of ecosystems, waste accumulation, contamination of all nature components and climatic changes (UNEP Report). Existent negative processes threaten health and life of population.

The ecological situation is particularly complex in Ukraine. National environmental impact assessments demonstrate numerous ecological problems in water resource, air and waste management. Deterioration of environment (quality of air, water, soil fertility) caused the losses for society because of health impairment and reducing quality of life. Ukraine ranked 147th out of 225 countries in life expectancy (the average life expectancy – 66,5 years). So the optimal use of natural resources and mitigation of negative environmental impacts are important for Ukraine.

Among the lessons the country may draw from the current situation is recognition of the fact that throughout its years of independence the economy of Ukraine had underwent virtually no quality changes in the field of innovations and fundamental restructuring which would afford ground for adequate competitiveness and economic efficiency, reduce environmental capacity of production and secure a realistic transition of the national economy to a sustainable development model. The necessity to ensure further industrial development of Ukraine with allowance for the ecological imperative makes it topical to look for rational ways and decisions supporting sustainable industrial development.

It is assumed that the transition of an economy to an innovative path of development is a challenge typical of relatively successful periods and is effected on the basis of the laissez-faire principle and also at the expense of recessionary phenomena and self-reformatting of the economy. The paper hypothesizes that effective state regulation of economic processes with account of ecological specificity of individual countries allows to strategically resolve the issue of continuous economic growth and development. This demands the creation of appropriate conditions from the state, which can motivate the private sector to get effectively engaged in the unprofitable ecological field. Instrumentally, innovations are to become one of state regulation subjects within this concept, which will allow bringing the system under regulation into a new development phase. These innovations have to be ecologically focused on nature and for mitigating eco-destructive impact, while promoting energy-saving technologies. This paper offers some approaches which allow testing the above hypothesis and examining the ways of securing continuous crisis-free ecologically focused development by the example of Ukraine.

The first part of the paper examines ecological problems in development of Ukrainian industrial production during the recession period, which concluded on the necessity of changing the economic model of development, based on extensive consumption of natural resources and great imprint on the environment. The second part of the paper demonstrates that economic development in the long run requires timely introduction of innovative technologies whereas sustainable development necessitates ecological innovations. The third part offers a concept of ecologically focused anti-recessionary management of industrial production development of Ukraine.

Analysis of ecological problems in development of Ukrainian industrial production

To date Ukraine follows an export-oriented industrial development model which is characterized by domination of poorly diversified low-technology production. The process of Ukraine's entry into the world processing chains fails to meet structural requirements – raw materials account for nearly 65% of the national sales volume whereas the share of raw materials and semi-finished products in the global export structure is only 12.5%. Its industrial production grew excessively oriented on energy feedstock in the process of market adaptation of industrial enterprises under the critical influence of the external factor − a favorable global business environment for basic low-technology raw material categories of commodity exports of Ukraine. The above, together with the use of underutilized production capacities, availability of a relatively cheap resource base and low-cost labor served the main driver of economic growth.

The effectiveness of the current industrial development model is overmuch dependent on global market conditions and has no mechanisms for counteracting external factors, especially during recession. As a result, when affected by the global economic crisis in 2009, the industrial outputs of Ukraine greatly dropped by as many as 15%.

Another negative development trend of Ukrainian industry is slow rates of production upgrading. While the leading countries of the world extensively use the potential of innovative economic development, Ukrainian industry is mainly based on traditional technologies introduced yet at the early stages of industrialization. Negative structural changes entail not only a low economic benefit but also environmental degradation and depletion of natural resource reserves. In spite of the reduced rate of environmental pollutant emissions in physical terms directly during the economic crisis, the yield of emissions per unit in specific terms is growing (see *Figure 1*).

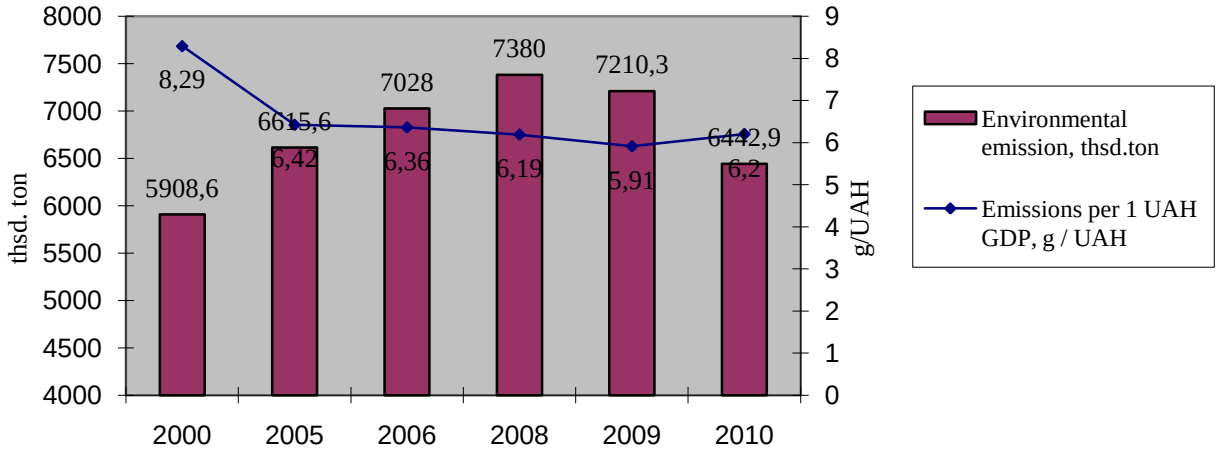

Figure 1. Dynamics of environmental emissions in Ukraine
Source: own calculations based on Boreyko (2012).

As seen in *Figure 1*, specific air pollution indices in Ukraine decreased over 2000-2008 from 8.29 to 5.91 g/UAH. In the next year, the year of recession, the above index however grew up to 6.20 g/UAH. Due to the lack of financial and technological capabilities, an increase in production capacities in the future will aggravate the environmental pollution situation.

The effect of economic depression is now accompanied with a longer and acuter ecological crisis. The drop in financial reserves of companies due to economic stagnation results in cost reduction of both current financing of environmental activities and investment

in development and introduction of ecological innovations. Social problems (unemployment) and maintenance of competitiveness of domestic producers are priorities. Environmental actions and ecologically focused developments are generally financed on the residual principle (especially in developing countries). This leads to conservation of obsolete technologies (resource-intensive and faulty) and total wear of fixed assets, including those that are environmentally targeted, and to the degradation of the technological base.

The depreciation extent of the physical assets of Ukraine has been incessantly growing and reached 74.9% in 2012. Operation of the outdated assets necessitates appropriation of a significant part of capital investment for support of the current technological level of enterprises rather than introduction of new, more sophisticated, processes. The lack of efficient incentives for investment in technical upgrading of production resulted in the critical state of the assets in some branches of the real sector, specifically the extent of depreciation came to 94.4% in the transport industry and communications, 66.8% in the processing industry and 60.7% in production and distribution of electric power, gas and water. The state of the physical infrastructure in some segments of industry is rapidly getting worse. The most critical situation is faced by mechanical engineering companies where the assets depreciation extent is 83.4% and by the chemical and petrochemical industries as well as coke and petroleum derivative producers, where this indicator approaches 70%. This being said, the metallurgical production and the chemical industry account for the largest share in the export structure.

Continued use of traditional technologies merely speeds up the ecological crisis because economic development of Ukrainian industry is accompanied with unbalanced exploitation of natural resources. Today the national industrial production accounts for about 58% of air pollution. Industry consumes 61% of electric energy in the country (35% on the average in the world) and produces more than a quarter of primary resources. Ukrainian economy is still among the most natural resource-intensive in the world. This results not only in low economic efficiency but also environmental degradation and depletion of natural resource reserves.

One of the acutest ecological and social problems faced by Ukraine is atmospheric air pollution from anthropogenic sources: industry, transport, heating systems, waste and toxic chemicals used in agriculture. Metallurgical as well as electric energy, gas and water distribution enterprises annually discharge into the atmosphere up to 66% of the total emissions from stationary sources which are the main air pollutants of Ukraine. The density of emissions from stationary pollution sources in Ukraine on a per square kilometer basis is 11.4 t, whereas maximal concentrations of some heavy metals are 12.6 times higher than maximal allowable values.

An analysis of a relationship between air emission rates and the infection rate of the Ukrainian population in 2002-2012 indicates that the number of cancer patients grows by 209 people, with ecologically noxious emissions increased by 1 thousand tons, whereas an increase of SO_2 concentration per 0.01 mg/m^3 (20% of the maximal allowable concentration) contributes to an increase of the general morbidity rate by 1.4 times and an increase of the NO_2 concentration also per 0.01 mg/m^3 (25% of the maximal allowable concentration) makes the morbidity 1.1 times higher. Atmospheric air pollution in Ukraine has therefore reached a level which is dangerous to health and life of its inhabitants and the continued use of the brown model of industrial development of Ukraine will produce an ecological crisis. In these circumstances the priority task for the country is the transition to a sustainable development concept which has to replace the conventional meaning of economic development, based on extensive consumption of natural resources and a large impact on the environment.

Opportunities for overcoming recession phenomena owing to introduction of innovations

An increased number of strategic studies aim to overcome aggravating problems associated with the ecological confines of economic growth and promote a sustainable development concept to: increase production efficiency, change the consumption pattern towards optimized use of resources, and depart from material-intensive economic growth and maximal reduction of waste accumulation (Agenda 21, 1992). In other words, the basis of sustainable development is greening of the economy and the creation and development of the so-called 'green' markets.

The main prerequisites to sustainable development are resource-saving and ecologically clean technological innovations, as well as ecologically loyal institutional rules of business. Sustainable development is defined as continuous long-term crisis-free development, and timely introduction of innovations with an allowance for an ecologically focused management vector. Ecologically focused innovativeness, initiative and loyalty of entrepreneurship are a decisive force in the formation of a socio-economic structure that meets dominating ideas of sustainability to optimize balance of economy and nature. This conclusion brings us back to the concept of an initiative innovative entrepreneur, developed by J. Schumpeter (1982) and the investment theory of economic cyclicality by P. Samuelson (1944) and J. Hicks (1946) i.e., to the issue of inevitable exhaustion of loan capital stock and accordingly to cyclical development.

Cyclic trends of global economic development necessitate diagnostics of market fluctuations, and the timely response by governments to potential threats of macroeconomic balance disturbance. The economic policy of the state is unable to completely eliminate cyclical fluctuations in the rate of economic growth because it is impossible to concurrently balance all parameters of public production. Yet one of the critical tasks of public regulation is to steady violent fluctuations in the rates of growth to the maximum while pursuing the aim of mitigating or preventing a considerable drop in production during the recession. Thus, to secure sustainable (continuous, crisis-free) economic development, the following tasks have to be addressed:

- reduction or elimination, if possible, of the economic slack: time compression ($A \rightarrow B$), contraction of peak-to-peak fluctuations ($C \rightarrow B$) (see *Figure 2*);
- focus on the process of innovative changes to technological patterns on development of ecological (green) economy.

Both tasks require a highly professional coordination of actions, concentration and effective management of investment and intellectual resources at the macro level of the national industrial complex and at the micro level of individual companies.

According to the logistic curve representing the dynamics of evolutionary processes in the biosphere and technosphere, timely introduction of innovations secures continuous sustainable development of any economic entity in the longer term (Bir, 2005). Introduction of innovations at the growing phase of the economic cycle increases its duration and reduced the recession (or crisis) period. Waves of similar frequency (length) and coinciding phases create a resultant wave with the same frequency but multiplied amplitude (Mandelbrot, 2002; Khajinov, 2012). The result of superposed waves with different frequencies depends on the degree of discordance between the cycle phases. The greater the phase difference, the smaller the resultant shift and the closer the phases the larger the shift (Khajinov, 2012).

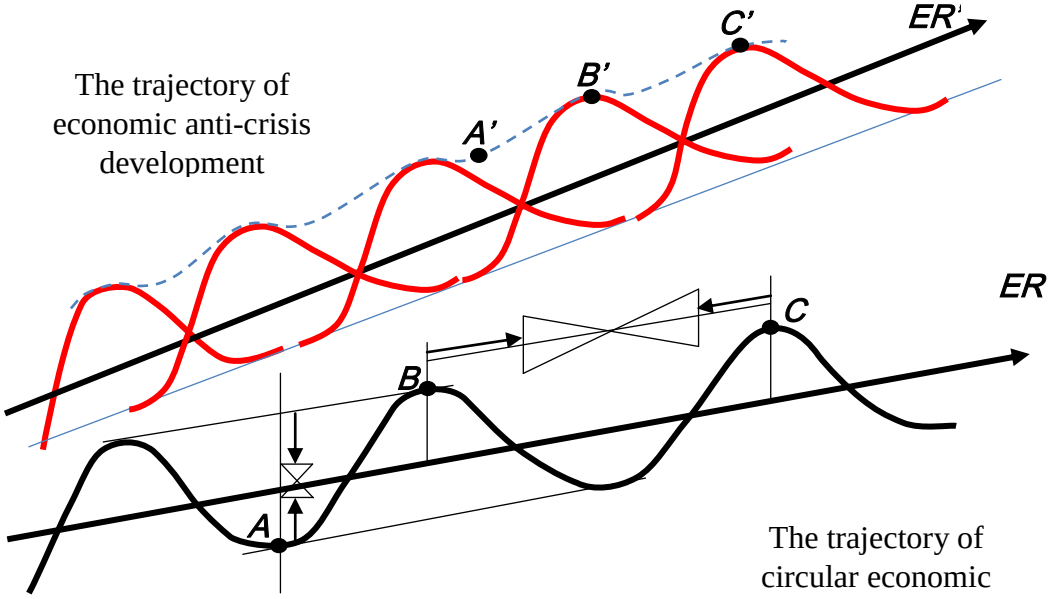

Figure 2. Schematic drawing of the inclination of the trajectory, amplitude of waves and duration of changes of economic development phases (actual and crisis-free) *developed by the authors*

As follows from *Figure 3*, the *ER* enveloping curve of economic development consists of the combined successive curves of production based on the *A-D* technologies, which start their own life cycle from the innovation phase to that of tradition.

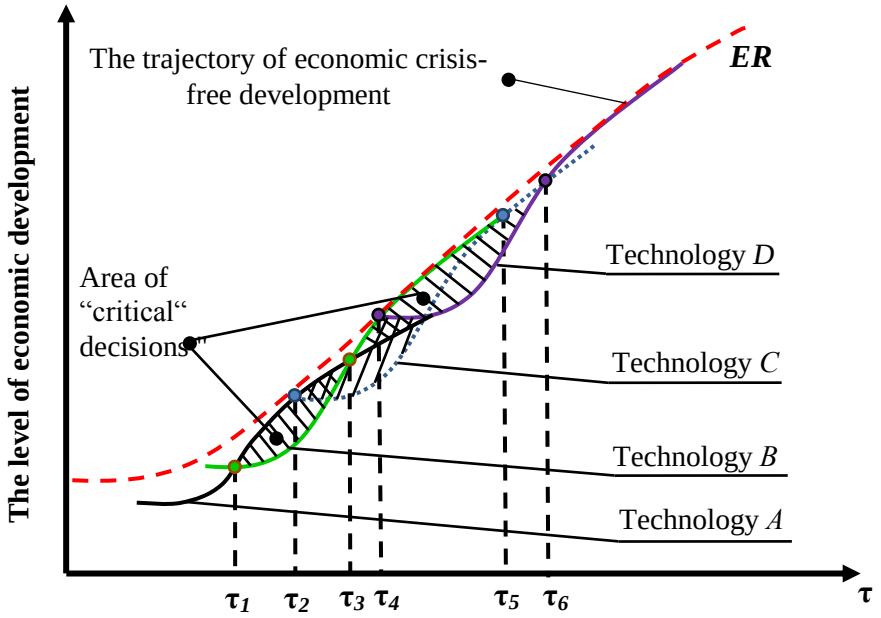

Figure 3. Interaction of the life cycle of technologies, *developed by the authors based on (Bir, 2005; Polovyan, 2012)*

Thus, during the time period $\tau_1 - \tau_4$ the *A* technology is traditional for a certain type of economic activities whereas the *B* and *C* technologies are innovative. This means that the time points τ_1 and τ_2 refer to the economic development stage when the traditional *A* technology remains profitable and creates certain stand-by funds which can be applied to

invest in development and testing of the technology *B* (τ_1) and technology *C* (τ_2), respectively. The time point τ_3 corresponds to the production stage at which the innovative technology *B* starts dominating over the technology *A* and secures the main share of profits.

The time period between τ_1 and τ_3 refers to implementation of a strategy of mixed capital investment in traditional and both innovative technologies. Continuous profit-making and maximal return on the capital invested in the *A* technology necessitates continued investment in the latter throughout the above interval. It is also the time to start investing in the *B* and *C* technologies so as to ensure a smooth transition to their use once the *A* technology works itself out. Consistent and timely introduction of innovations promotes continuous sustainable development of an economic system in the longer run.

As follows from Figure 3, the innovative technology *C* makes virtually no contribution to supporting the growing trajectory of economic development: it dominates as the leading production technology over the shortest time interval $\tau_5 - \tau_6$, replacing the *B* technology, and the *D* technology is nearly immediately substituted for it. One can therefore deduce that its use was inefficient, hence the investment in its development and implementation was not economically justifiable and feasible.

Thus, there is a problem of optimal in seeking to improve the manageability of the economic development trajectory it is necessary to allow for the priority of the ecological vector of changing the current technological platform as a prerequisite to transition to the sustainable development model.

Concept of ecologically focused anti-recessionary management of industrial production development

Adoption of the concept of an endogenous and cyclic nature of crises in the economic theory promoted the emergence and development of a specialized direction of research, namely design of an anti-recessionary policy. Developments in this field primarily aim to prevent (where possible) or mitigate such destructive consequences of crises as inflation, unemployment and bankruptcy of companies. The variety of available anti-recessionary programs and actions aimed at smoothing economic system departures from equilibrium can be combined within two main approaches – Keynesian and neoliberal, which are opposed by the free competition mechanism for balancing the economic system, and expedite state regulation of economy through fiscal policy.

As experience by many developed countries (Japan, South Korea and France) suggests, state regulation is the most effective method. Public policy must focus on the efficient use of innovation for economic development, support better financing of the research sector to successfully overcome the financial crisis because as demonstrated above, timely introduction of innovative technologies enables reducing the economic slump phase. Allowance for the ecological imperative in the management of the national economy has to be a distinctive feature of the process. It can be achieved through development and implementation of a comprehensive concept of ecologically focused anti-recessionary management of industrial production development.

Ecologically focused crisis management of industrial production development is the transition of a national economy to a sustainable development model that can be achieved through the design of an effective anti-recessionary state policy that secures operational stability of industrial production from a continuous ecologically focused technological progress or green innovations. The main managerial tasks at the macro level have to be as follows (see *Figure 4*):

- creation of a favourable institutional environment for ecologically focused investment and innovation activities in the industrial sector of economy and development of green market of commodities and services;
- control over observance of 'ecological norms of special nature management' (i.e. in commercial quantity) as a compulsory minimum established at a legislative level by all actors of the commodity-money relations as well as over adequate operation of relevant economic and social institutes in the field of environmental management;
- regulation of the economic and ecological system with the help of 'built-in stabilizers', 'fine tuning' and 'indicative planning' during recession phenomena in order to mitigate their negative impacts.

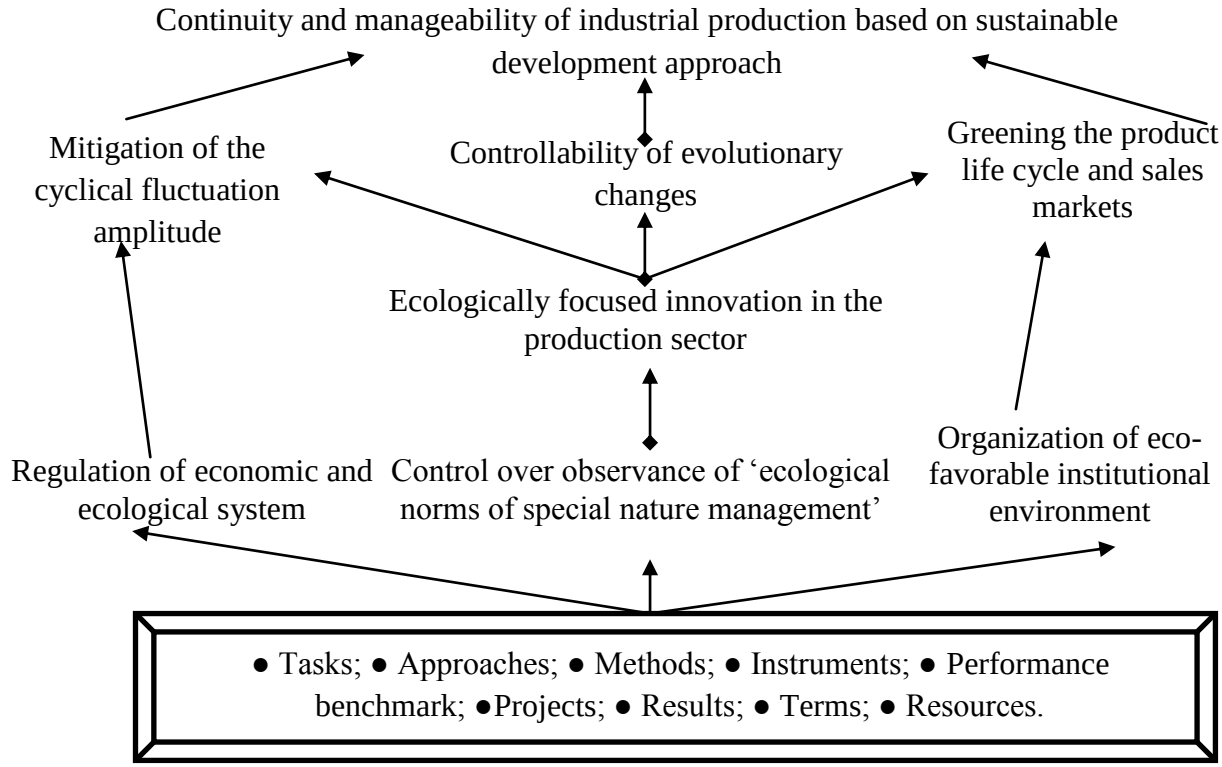

Figure 4. Concept of ecologically focused anti-recessionary management of industrial production development *(developed by authors)*

Many years' practice of economic development in the leading countries shows that application of only economic mechanisms cannot yield the required result. No effective socially focused market system can be developed without an efficient regulating role of the state. There is therefore no country with a highly developed economy, where the state avoids regulation and encouragement of key socio-economic processes, including innovations. It is important then to find a balance in the interaction of business initiative and public activity, which are complementary rather than interchangeable phenomena. They are linked by the institutional environment which is also developed owing to appropriate actions of the state and primarily requires relevant regulatory documents to be drawn up.

Ukraine has adopted about 80 regulatory legal acts and ratified a number of international documents covering sustainable development (Chmir, 2013). The ecological policy instruments currently in use have however a narrow focus and relate mainly to ecological management and collection of charges for pollution of water, air, environment and

waste utilization, i.e. they are focused on mitigation of effects of pollution. Sustainable development is inadequately supported with economic instruments which have to secure the influence of state regulation on the size and structure of consumption and manufacture of products, organization of business projects and application of resource saving innovative technologies. It is only today that a Concept of green economy of Ukraine is under development, which is to specify the main provisions of the national state policy of green economy development, target values of green development and respective costs for its implementation. A crucial task of the Concept is identification of green growth points – the key sectors of the national economy, which are to secure its priority ecologically focused growth.

No less important for development of an adequate institutional environment is the use of built-instabilizer (Galushkina, 2000). The state influence instruments of this type include any economic measures which promote demand and supply when the manufacturing output declines and production is curbed during the economic overheating, with no direct prompt state regulation needed, and which are taken in free market economies to limit price fluctuations, production volumes, employment etc. (Bir, 2005; Polovyan, 2012). Their primary purpose is therefore to smooth the amplitude of economic activity cycles on the basis of self-regulation.

As seen from *Figure 4*, ecologically focused innovations are a driver which initiates required quality transformations. Introduction of ecologically innovations results in fulfilment of a number of basic tasks:

- mitigation of the cyclical fluctuation amplitude in operation of the industrial complex through balancing of demand and supply;
- management of the targeting of the technological evolution process towards becoming green;
- development of the national market of green commodities and services.

Development of a market of green goods and services together with a focus on ecological ethics in social life meet major requirements of transition of a socio-economic system to the sustainable anti-recessionary development model. The market of green goods and services is among the fastest-growing markets in the world. According to research results of Roland Berger Strategy Consultants, the annual volume of the global green market in 2007 came to Euro 1,400 bln, including energy saving accounting for Euro 538 bln, sustainable water management – Euro 361 bln, constant mobility – Euro 94 bln, ecologically clean energy – Euro 155 bln and sound management of materials – Euro 200 bln. On the average, from 2007 the growth of the global market of green technologies has been 11.8% per year, reaching today Euro 2.0 trillion, and it will more than double by 2025, approaching Euro 4.4 trillion (Greentech Atlas, 2012).

Ukrainian markets of green technologies also have a great potential for development. Current investigations indicate that in 2006 the size of the market of ecological commodities and services in Ukraine was UAH 112.6 bln (Euro 22.6 bln), having grown more than 6 times versus 2005 when it made only UAH 18 bln. Obsolete technologies, an acute need to decrease energy and resource dependence of the main industries of the country allow estimating the potential of Ukrainian market of green commodities and services at Euro 120 bln (Green business support strategy for Ukrainian private business organizations focusing on metal and mining industry). Energy saving / climate protection account for its greatest share – Euro 118 bln. To implement this potential, it is necessary to develop and implement an adequate state policy aimed at promotion of green investment.

The use of the proposed concept will allow attaining continuous managed development of industrial production on the principles of a ‘balance of economic and ecological goals’ of environmental management. Introduction of the proposed instruments of

ecologically focused industrial production management and implementation of a consistent state policy will offer an opportunity to create a favorable institutional environment and initiate a multiplier effect of emerging and expanding innovations among micro level economic agents . This, in turn, will contribute to renewal of the natural environment and secure high living standards for the population.

Conclusion

The development dynamics of Ukrainian industry features a number of system problems which necessitate prompt solution and involve risks for further economic growth. Primarily these are a significant export focus of production, its high resource and energy intensity, a critical state of the fixed assets, a low technological level and an inadequate innovation capacity of the economy. It is the above limitations which during the recession period demonstrated the necessity to reform the industrial sector by developing high-tech production on the basis of a sustainable development strategy capable of securing continuous growth that is underpinned by the harmony of economic, social and ecological goals of development.

According to the sustainable development strategy, the build-up of an up-to-date industrial complex in the integration and globalization context, which is integrated in global production, will be able to address key tasks of socio-economic development, secure ecologically safe living of society and tackle ecological problems including reduction and limitation of hazardous environmental emissions. It can be achieved through development and implementation of a comprehensive concept of ecologically focused anti-recessionary management of industrial production development.

It is proposed to handle the issue of continuous economic growth and development within the framework of this concept that implies effective state regulation of economic processes with account of ecological specificity of individual countries. According to the concept, innovations have to become one of the subjects of regulation. They will allow to greatly shorten the duration of the economics lump phase, on the one hand, and bring the system under regulation to a new development turn, on the other hand. It is assumed here that innovations have to be ecologically focused and aim to mitigate the eco-destructive environmental impact.

Development of state regulation instruments and practical implementation of an efficient state policy, which aim to level the destructive effect on economy, are of great and crucial importance in counteracting negative impacts of the economic cycle. It is understood that an efficient state policy is implemented at the slump and recession stage where a large-scale liberalization is effected during recovery and stabilization.

An effective solution of this task implies introduction of instruments for development of eco-innovative culture into conventional state regulation methods. Long-term rules of conduct of economic agents for emerging economies (including Ukraine) have to be laid down in the direction "replication – innovation", which means establishing the rules for replication of the best ecologically focused technologies at the first stage, followed by development of respective national technologies.

References

Boreyko, V.I. (2012), *Tendentsiï ta prychyny zminy technogennogo navantazhennya na dovkillja in Ukraïni* / В.І. Борейко Тенденції та причини зміни техногенного навантаження на довкілля в Україні Збірник наукових праць «Проблеми

раціонального використання соціально-економічного та природно-ресурсного потенціалу регіону: фінансова політика та інвестиції». – 2012. – Т.3. – С. 272-281.

Bir, S. (2005), *Mozg firmy*. – M.: Izdatelstvo «Editorial URSS»/ Бир Стэффорд «Мозг фирмы»/ Стэффорд Бир; пер. с англ. проф. М.М. Лопухина. – М.: Издательство «Едиториал УРСС», 2005. – 416 с.

Hicks, J.R. (1946), *Value and Capital*, Oxford: Clarendon Press.

Galushkina, T. (2000), *Economic instruments of ecological management (theory and practice)*, Odessa.

Greentech Atlas 3.0, Sep 2012. Roland Berger Strategy Consultants. http://www.rolandberger.com/media/press_releases/ 512press_ archive2012_sc_content /Green_tech_atlas_3_0.html.

Green business support strategy for Ukrainian private business organizations focusing on metal and mining industry. Union of Black sea and Caspian confederation of enterprises (UBCCE). – Retrieved from: www.ubcce.org/docs/GIZ_Ukraine_Strategy.pdf.

Chmir, O.S. (2103), *Sutnist ta znachenny suspilnogo progresy "zelenoї" ekonomiki* / Чмир О.С. Сутність та значення для суспільного прогресу «зеленої» економіки. – «Зелена» Економіка – шлях до сталого розвитку: зб. матеріалів. – К.: НДЕІ Міністерства економічного розвитку і торгівлі України, 2013. – С. 10-16.

Khajinov, I.V. (2012), *The international competitiveness of regional economic complexes in the context of globalization*, Donetsk: Donetsk National University.

Mandelbrot, B. (2002), *Fractal Geometry of Nature*, Moscow: IKI.

Plachciak, A. (2009), Sustainable development as the principle of civil Society, *Economic&Socilogy*, Vol. 2, N 2, pp.85-90.

Polovyan, O. (2012), *Zbalansovaniy rozvitok ekonomichnih ta ekologichnih sistem* (ko-evolyutsiyniy pidhid): monogr. NAN Ukrayini, In-t ekonomikipromsti. Donetsk.480 p./ Половян О.В. Збалансований розвиток економічних та екологічних систем (ко-еволюційний підхід): моногр. / О.В. Половян; НАН України, Ін-т економіки пром-сті. – Донецьк, 2012. – 480 с.

Report of the united nations conference on environment and development "Agenda 21" (1992), http://sedac.ciesin.columbia.edu/entri/texts/a21/a21-contents.html

Samuelson, P. (1944), The relation between Hicksian stability and true dynamic stability, *Econometrica*, Vol. 12, № 3, pp. 256-257.

Schumpeter, J.A. (1982), *The Theory of Economic Development*, Moscow: Publishing House "Progres".

Statistical information on main indicators of socio-economic, demographic development of Ukraine [Internet resource] / Статистична інформація щодо основних показників соціально-економічного, демографічного розвитку України [Електронний ресурс]. – Режим доступу: http://www.ukrstat.gov.ua.

UNEP Report "Towards a green economy: pathways to sustainable and poverty eradication", http.unep.org/greeneconomy/publications.