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INDUSTRIAL POLICY UNDER NEO-SCHUMPETERIAN CONCEPTION OF STRUCTURAL TECHNOLOGICAL DYNAMICS: CASE OF UKRAINE

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Abstract. At a recently time we can observe as the conception of "Industrial Modernization" has become a popular in many countries, especial amongst those that have the innovation development potential weaknesses. In Ukraine also many experts suggest to build a strategy of economic development on a base of supporting the traditional industrial enterprises through their modernization. This point of view has limitation due to that the modern traditional industrial markets become mature very quickly, and their profitability decreasing. That was demonstrated during the current economic crisis. The paper examines the Neo-Schumpeterian conceptual approach according which the economic wealth of the country depends first of all on the development of sectors with technological base belonging to current and next technological paradigms. This approach has created a theoretical basis for a new vision of the basic principles to ensure a countries' economic development and set new requirements to the state economic policy. Central core of this new vision determines crucial importance for economic policy of assessment the national economy structure as a phenomenon occurring from the different waves of technological paradigms. This approach has been used to calculate indicators of the corresponding structural dynamics of Ukrainian industry and separate regions. It is used the elaborated statistical classification in order to estimate different technological levels of each industrial sector. The corresponding policy implications are offered.

Keywords: Neo-Schumpeterian approach; innovation development; industrial structural policy; technological paradigms; economy of Ukraine

JEL Classification: O14, O33, O38, O57

1. Introduction

Majority explanations of current economic and financial crisis demonstrate that a prevailing vision of nature this crisis remains neoclassical. It means that causes of crisis are searched among external shocks: mistakes in finance management on different levels of economy, bad government, negative internal and external politic influences, subjective failures etc. But such kind of shocks could enough easy be understanding and eliminated by the operative politic measures. Why such "learning by doing" did not happen during last hundred years? History has been demonstrating the existence of much more deep reasons for crisises which had appeared suddenly and often caused a

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wars and social revolutions. This paper based on the Schumpeter's conceptual vision of the nature of economic and financial crises (Schumpeter 1934, 1939). It gives us the most satisfactory understanding this problem and led us to importance of Neo-Schumpeterian industrial strategy.

The conceptual distinction of this theoretical approach from neoclassical logic lays in recognition the inner forces of market system, which condition the economic crises of capitalism, and the same forces determine economic growth. These forces are technological innovations. Without last one the national economy inexorably will come to crisis and, in reverse, the progressive technological change can help overcome crisis and cause economic growth. I think the economic failures of the transition economy of Ukraine is largely due to the rigid focus on neoclassical prescriptions of the "Washington consensus", where there is no requirement of innovative technological changes in the economic structure. In general sense we can consider two contradictory approaches to explanation nature of economic growth and business cycles - Neoclassical and Schumpeterian. First of them believes in the efficient of general equilibrium situation with supporting constants of main ratios between output, investments, consumption, and employment; this methodological path do not pay special attention to proportions of technological structure of national economy. The Schumpeterian approach pays main attention to emergence of technological innovations and the structure of sectors with technological change. Josef Schumpeter called these two attitudes as "Statics" and "Dynamics" stages of cyclical economic development. According to Schumpeter the real economic growth can be only on "Dynamics" stage.

The theory of economic development by Schumpeter is a theory of evolutionary development of economics denoting fundamental changes to the current state of affairs, a leap into a new quality (new combination), which is mostly impossible to foresee. Hence, in the theory of economic development by Schumpeter, it is important to particularly focus on the fact that in order to ensure long-term economic growth of the country it is necessary to form the new production structures on the innovation technology base rather than transform traditional production structures. Traditional production structures are important for preservation of existing scopes of national product and support of operations in the mode of economic "Statics", but the dynamics of the economic system are directly related to innovation development.

As numerous empirical studies demonstrate today, the economy which focuses on recovery and development of traditional production patterns (pattern of "Statics"), i.e. on distribution of available resources, cannot significantly increase its wealth and social wellbeing in the long run because the development of traditional competitive markets eventually restricts the formation of new added value. Microeconomic neoclassical theory confirms this conclusion, with regard to certain product markets – marginal profit in such markets should tend toward zero. Therefore, sustainable growth of the national (gross) added value can only ensure innovative development which, actually, shall determine the type of economic development called "Dynamics" by Schumpeter.

A mere increase in scopes of output of traditional productions, even in the mode of increase in labor productivity, shall not provide a strong long-term resource for dynamic development of the country or its regions. It is difficult to percept Schumpeter's ideas mostly due to a belief in neoclassical canon, in which attainment of an equilibrium state of Pareto-efficiency is the ultimate aim and the objective function of a successful economy. However, the format of analysis of economic "Statics", i.e. economic development on the basis of traditional production structure, reflected in empirically found production functions (i.e. functions found according to data of previous periods), still remains a methodologically weak spot of neoclassical theories of economic growth. Such methodology of analysis of economic processes cannot predict (and explain) the state of the economy occurring on the basis of innovative technologies that change the production function itself.

An increase in productivity of the given labor and capital resources (common productivity factor) is the central production factor representing innovation activity in these models. In endogenous theories, such an increase in productivity shall be specified as factors of human capital,

patent activity, financing of research and development etc. However, the growth in productivity of traditional resources shall be determined with regard to comparative products (pre-existing products). Therefore, this refers to economic "Statics" again. That is why modern Neo-Schumpeterian conceptual approaches assume that such an economy shall definitely come to a crisis of relative overproduction and start to degrade, and its rescue and development would be ensured only by the evolutionary innovation leaps in the form of technological revolutions. Innovative technological changes shall alter the production function itself and, therefore, Neo-Schumpeterian theories shall justify the importance of holding innovative restructuring of the economy as a central direction of the country's economic policy. In view of the above, the state management of processes of structural changes related to different types of technologies, particularly, with an emphasis on developing high technologies, is deemed extremely important.

As the events of the last quarter of the XX century demonstrated, Neo-Schumpeterian theories can adequately explain the nature and driving forces of modern post-industrial economic development. In this regard, attention can be paid to the fact that this is paradoxical enough: Schumpeterian conceptual approach is barely studied in university programs, but de-facto it lies at the heart of economic strategies and current policies of developed and developing countries. The economic strategy of the European Union is a vivid example. Ten-year strategies – the Lisbon strategy (2000-2010) and next the "Europe 2020" strategy – actually represent the Schumpeterian and Neo-Schumpeterian concept, where new knowledge and innovations are recognized as the main driving force of economic development (European Commission, 2010; Bazhal, 2013; Carayannis, 2013). These strategies make an emphasis on the fact that along with implementation of traditional goals of macroeconomic policy – attainment of macroeconomic stability, improving the efficiency of available resources and support of employment – today the leading role is assigned to those challenges associated with facilitating an accelerated transition to an innovative knowledge economy.

2. Neo-Schumpeterian concept of economic development

Fundamental theoretical grounds for innovation model of economic growth were laid as far back as the beginning of the XX century. One of its main founders was the world-famous Ukrainian economist M. I. Tugan-Baranovsky (Tugan-Baranowsky, 1901). Besides him, among the luminaries of this theoretical trend we can name his student and the conceptual successor M. Kondratiev (Kondratiev, 1925), a German scientist A. Spiethhoff (Spiethoff, 1903), and main constructor - J. Schumpeter which generalized this theoretical path into a new holistic theory of innovation economic development (Schumpeter, 1911:1934, 1939).

Schumpeter showed the crucial influence of technological revolutions on the economic development. He established a tight connection between technological innovations and long-term cyclical fluctuations of economic development. One of the main categories in this theory is "creative destruction" (Aghion, Howitt, 1990), when basic technological innovations simultaneously ruin old branches of production and create new ones. In this context, it is important to make a clear distinction of "old" and "new" branches in the analysis and during the formation of the economic policy, as well as the problem of "leading sectors" and methods of their state support.

Neo-Schumpeterian approaches have developed these ideas within category of technological paradigm (first article – Dosi, 1982). Such approaches have been elaborating the economic theory of technological dynamics (Dosi G., Freeman C., Nelson R., Silverberg G., Soete L., 1988; Nelson, 1995; Freeman and Louca, 2001; Perez, 2002;; Malerba *at al*., 2003; Elgar Companion to Neo-Schumpeterian Economics, 2007; Dosi, 2012). Technological changes are regarded here as the main material object – the species that dynamically develops by itself and determines the ways of evolution of the modern civilization system. Waviness of this process is described by Kondratyev's

theory of “long waves” (Kondratiev, 1925; Tylecote, 1992; Freeman, Clark, and Soete, 1982; Freeman and Louka, 2001; Rumjantzeva S., 2003). We consider more productive the approach which concentrates less on the fixation of precise time phases of this wave, studying the essence of the process and its reasons. In this sense it is more important to recognize the technological changes which condition structural reconstruction of the economy as a main factor that have been causing the “long wave” of economic development. The cyclical periodicity depends on the frequency of appearance and putting into operation of basic innovations, leading to the creation of branches-locomotives of the general development and their further spreading in the economy (Mensch, 1979). Today among such “locomotives” we see the branches that are connected with information technologies **(**Castells, 1996-1998: 2000-2004; Freeman and Louca, 2001).

The Development of the Neo-Schumpeterian conception created a theoretical basis for a new vision of the basic principles to ensure a countries’ economic development and set new requirements to the state economic policy (European Commission, 2010; Smits, Kuhlmann, Shapira, 2010; Carayannis, 2013). This new vision is connected with perception of the national economy’s structure as a phenomenon occurring from the different waves of technological complexes. But in many cases of policy analyses we can meet domination of more traditional vision under consideration the characteristics of structural change. As a rule it is structure of enterprises according a form of property, dynamics in the context of interrelations of various economic indicators and sectors: commodity or service production, creation of added value, investments, such kinds of activity as the capital flows, final consumption, export, import, etc. Such analysis reveals connections between different parameters of the economic system, establishes certain regularities suitable for international comparisons, etc., but it is limited for the tasks of strategic planning of the state economic policy as it does not give a clear vision of the influence of established structural processes on the future state of the economy. So a more modern instrument of analysis is the vision of structural dynamics of production through regularities of technological systems development.

The concept of technological paradigms singles out the key factor that ensured mass demand for technological changes, and which determined such paradigm. The leaders of the global community master these technologies in advance. The branches that actively use the key factor and adapt its most successfully to the requirements of the corresponding production organization, are the main investors in advanced technologies and form the technological paradigm of the society. In this context, these branches play the role of priority branches. Understanding of the main peculiarities of development and change in technical and economic paradigms and their connection with institutional structure of the society is an important factor of economic policy formation. Specific features of the new technological paradigm, having been determined, show the way of looking for goals and ways of strategic support of its development in the country.

The ‘life cycle” of technological paradigms is in direct connection with duration of Kondratiev’s "long waves". That’s why their numeration depends on the numeration of this "long waves". Six paradigms of this kind was singled out (five realized ones (Perez, 2002) and the sixth one is still ahead). The key factors for these paradigms are following (the year of the beginning or the end means the point of reference of the time period): for the first long wave (1790-1850) – substitution of machinery for handwork in weaving; for the second long wave (1851-1895) – coal mining and the steam engine; for the third long wave (1896-1946) – iron industry; for the fourth long wave (1947-1989) - energy (oil and organic chemistry products); for the fifth long wave (1990-2040) - microelectronics; for the sixth long wave (2041- ?) – nanotechnology, biotechnology. It should be noted that the key factor of a certain paradigm is also effective for the technologies that appeared in previous paradigms though it changes their technical quality. Whether modern economic development has confirmed viability of Neo-Schumpeterian approaches?

3. What is the main factor of economic growth?

A post-industrial economy is a Schumpeterian economy. The denotation "post-industrial" means that we tell about new goods, not goods that existed in previous times. In relation to industrial products they are innovations. Moreover, a characteristic feature of post-industrial development is the economy requires constant appearance of innovation that has caused the formation of knowledge economy. It is why the methods for extrapolating the quantitative parameters of the trends that have been established over quite a long period of time ("Statics"), usually mostly do not provide quantitative parameters for determining a development prospective ("Dynamics"). Moreover, innovation processes at the time of their emergence and quite a short "life" occur against the background of existing interdependencies between economic characteristics, which have been formed during previous years, therefore innovation processes are not presented into the existing statistical time-series correlations and, respectively, they cannot be adequately reflected by traditional methods of macroeconomic analysis.

In our opinion, the failures of neoclassical macroeconomic tools in explanation the role of innovation in economic growth have caused the dissemination of multicriterion ranking methods in comparison of the levels of economic development different countries, regions, companies etc. An especially big number of such ratings appeared with regard to assessing the competitiveness of national economies and innovation activity. Actually, such methods represent a completely different analytical approach than in neoclassical methods of strategic forecast. It is not a search of functional dependency between certain economic indicators in order to have a possibility of extrapolation of variables of certain statistical function for future periods, but the search and assessment of such characteristics of a social and economic system that will provide an advantage for one country (region) over the others in the future.

The ranking approach is similar to the methodology of assessment of economic efficiency of investment projects, when we do estimates of comparative efficiency of implementation of certain projects. In this case there exist only relative advantages of one option over the other. The same occurred earlier during the "marginal revolution" with regard to the pricing theory – denial of existence of one "right" price for the goods. Therefore, today the substantiation of peculiarities of postindustrial development takes place mostly (if not to take into account expert subjective forecasting methods) through determination of potential of relative competitiveness of a country or region.

Nevertheless this method has a weak point associated with multiplicative expansion of the list of characteristics used to assess competitiveness. This stipulated the necessity to form an integral index of many parameters in order to return a clear conclusion about competitiveness. But the integral index turned out to be unsuitable for the purpose of improvement of economic policy. Such characteristic does not help to elaborate needed measures of certain economic policy to improve competitiveness. If we will take as goalposts the rating of hundred indicators, it becomes impossible to form right policy because a budget constraint existence. This actually means a return to the beginning of analysis and setting of tasks to develop every aspect of the social and economic system that, actually, disallows questions on priorities and key areas. But, in our opinion, there are empirical searches with some positive achievements in addressing this issue.

In the scientific community, the results of studies, published in the annual Global Competitiveness Report of the World Economic Forum (Davos, Switzerland) in 2002, somehow went unnoticed. Multi-criteria researches of economies of different countries were held for the purpose of determining the roles of different factors, influencing their competitiveness (over 100 indicators), on which basis an interesting conclusion was made: the overall global level of competitiveness of the country can principally be reflected as aggregate in one indicator – the number of utility patents (i.e., patents for invention) granted by The United States Patent and Trademark Office per million population. The summary analysis of positions of competitiveness of

the countries by dozens of parameters demonstrated basically the same result of assessment as the result by the mentioned single parameter which characterizes directly the innovation processes in the country related to the post-industrial development. Having this in mind, the mentioned report proposed of classification taxon – "key technologically innovative countries", to which were reckoned among countries according to the criterion to have 15 and more such patents per million populations (Cornelius, Blanke, Paua, 2002). In 2001 there were 24 such innovative countries. They turned out far ahead of other countries by mentioned indicator.

In subsequent Global Competitiveness Reports, this indicator was used only as one of the sub-indices of "innovative factors" and was not considered as the synthetic characteristic of country's competitiveness in post-industrial economy. That is why we have performed a testing of the viability of the conclusions made in 2002 using the recent data (The Global Competitiveness Report 2011–2012).

For such analysis two parameters for 76 countries were compared in 2010: the number of used patents issued by the US patent office per million population and relevant GDP per capita as calculated at the current exchange rate. In 2010 the same 24 countries as in 2001 reached the criterion of 15 patents per million population, and the gap with the nearest country in the rank list had remained essential. The last of the key innovation countries was Italy with a figure of 29.9 followed by Slovenia with 12.0. To compare, in Ukraine this characteristic makes only 0.3.

The next step of analysis was the search of statistical dependency between these two series of parameters. No representative correlation dependency was found, but we obtained a very informative, in our opinion, diagram of the paired comparison of values represented, which is actually a matrix of McKincey-General Electric, where an analytical comparison of the competitive position of the company and attractiveness of its activity is given. In our case, the competitive position of the country is represented with an indicator of US patents utilized per million populations, and the attractiveness of economic activity is represented with the country's wealth parameter: GDP per capita (Figure 1).

The diagram clearly demonstrates the lack of correlation dependency between these two parameters, but two areas can be traced which allows to make analytical conclusions. If we separate those areas where GDP per capita exceeds USD 30 000 and the rate of patents per million population exceeds 20, we will get an indicative material for analytical conclusions

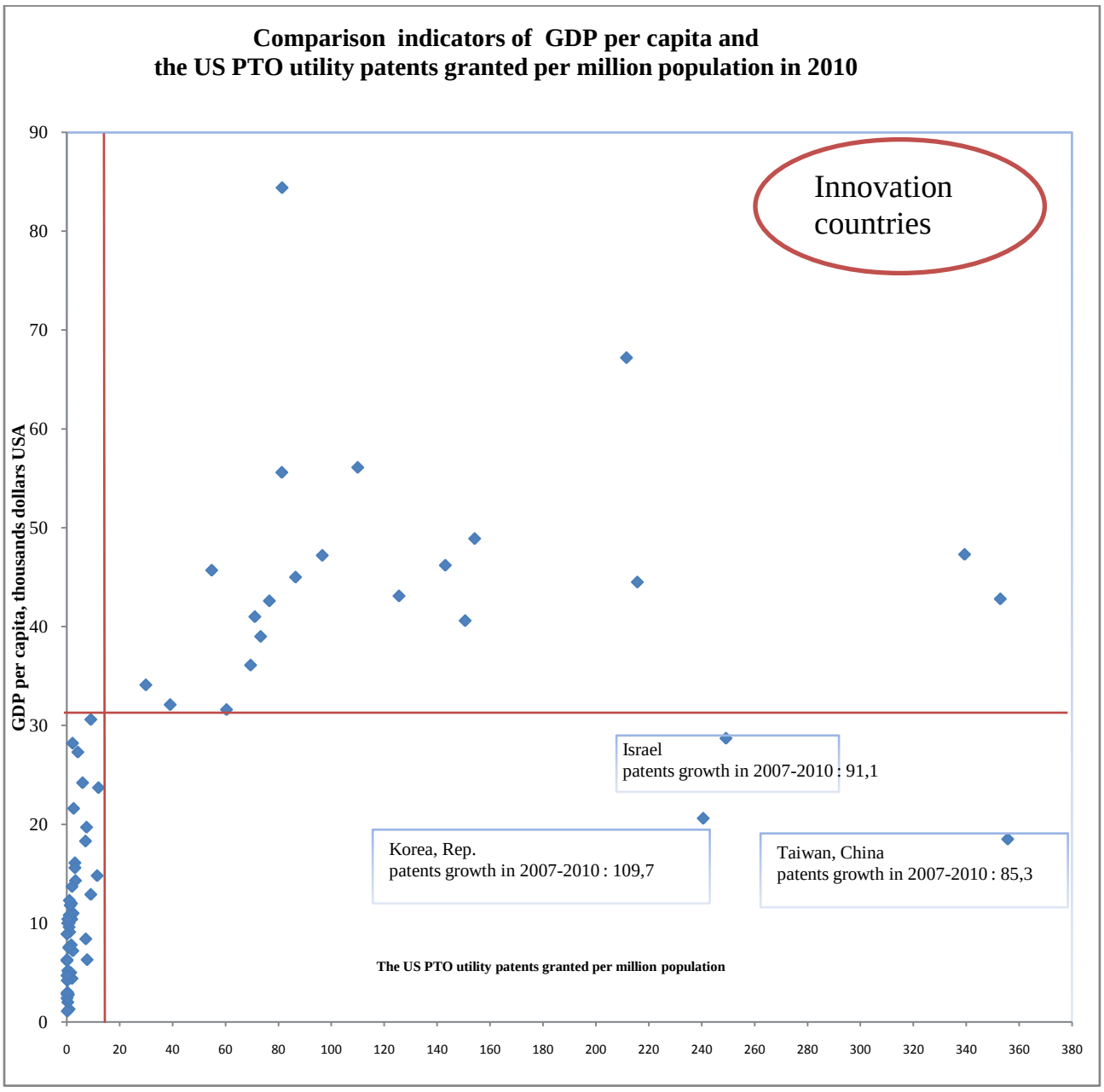
First of all, it gives proof of the credibility to Schumpeterian hypothesis about of innovative nature of economic development. The rich countries with a GDP per capita over USD 30 000, all provide active innovation performance. Some "innovation-oriented countries" such as Taiwan, South Korea and Israel are behind developed countries according to indicator of GDP per capita, but it can be noted that these countries have got the highest growth rates of innovative activity in the area of transfer of new technologies through the applying of technological patents (our patent indicator have increased in these countries respectively by 85.3, 109.7, 91.1 for the last three years, at norm of 15) allowing these countries rapidly were growing and to decrease of GDP gap with the rich countries.

As we can see from Table 1, in order to ensure a dynamic catch-up development mentioned successful countries, that twenty years ago belonged to the group of underdeveloped countries, demonstrate their strong activity in the area of implementation of advanced technologies through the patenting system.

If we take Italy, which closes the list of key innovative countries, as a basis for comparison with dynamic developing countries shown in Table 1, we can see impressive picture of main factor of their successful growth. All this countries excel Italy in the increasing of parameter analyzed, and such countries as South Korea, Taiwan and China went ahead of Italy in the growth of the number of patents over the last 15 years 14 times, 8.8 times and 4.1 times respectively.

An even greater contrast is demonstrated when comparing the successful paths of these countries in technological innovations with the post-Soviet states, including Ukraine. It should be noted that statistical tables in the last issue of 'Science and Engineering Indicators' do not contain any appropriate data for these countries. Nevertheless, there are such data for the pre-crisis year of 2008 (Table 2).

Figure. 1. Comparison of indicators of GDP per capita and the number of the US PTO utility patents granted per million population in 2010 for 75 countries.



Source: drafted by the author from The Global Competitiveness Report 2011–2012.

Table 1 Number of invention patents granted by the US PTO to the citizens of the states which demonstrated dynamic development for 1995-2010

Country	1995	2000	2005	2010	Growth for 1995-2010
South Korea	1 166	3 331	4 364	11 655	10 489
Taiwan	1 624	4 704	5 114	8 233	6 609
China	168	326	744	3 213	3 045
Italy	1 092	1 702	1 315	1 840	748
Israel	392	789	934	1 839	1 447
India	40	141	401	1 143	1 103

Source: National Science Board, 2012

Table 2. Number of invention patents granted by the US PTO to the citizens of certain post-Soviet states for 2000-2008

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Russia	184	234	201	203	169	148	172	188	176
Hungary	36	60	48	72	48	46	49	47	66
Czech Rpb.	32	23	31	41	31	25	34	37	48
Poland	13	16	11	17	16	23	29	32	54
Ukraine	17	21	27	14	21	18	24	12	21

Source: National Science Board, 2010.

The data given above shows that the keys to solving development problems are in the area of implementation of innovative technologies, which, as analyses show, mainly are belong to the latest technological paradigms.

Phenomena and examples given reflect the display of major qualitative differences of the post-industrial type of economy (an economy of the Schumpeter's type) from industrial type (an economy described in the neoclassical theory). The fundamental neoclassical axiom about restricted resources starts becoming not realistic in terms of knowledge resources of innovation development. Firstly, they become unrestricted in case of their permanent generation; secondly, it is difficult to maintain a long-term monopoly of relevant ownership; thirdly, the resource is constantly replaced with another knowledge resource, which may be new emerging by another owner. Under such circumstances, the economy approaches to non equilibrium state. Named features of post-industrial economy can be also generalized in theoretical terms as the following representations: neoclassical attitudes describe the economic processes and policy regarding to pre-existing markets and phenomena, while the post-industrial Neo-Schumpeterian theory of innovation development tries to develop visions and tools to manage processes and phenomena which do not exist today, but will emerge tomorrow and will determine the future economic development at both macro and micro levels. Thus today it is very important provide policy in which main priorities of the strategy of

economic development concern to formation and effective using the knowledge resources for producing innovations.

4. Measurement the economic structure Ukrainian industry under Neo-Schumpeterian concept of technology paradigm

The main approach to structuring the industrial sectors by separate technological clusters is the product principle, that is, unification sectors according to different taxons of technologies using type of produced goods and services. However, this or that technological taxon is not always oriented to finished products. Transition to each subsequent technological level of the classification of finished products manufacturing makes it difficult to present them in different technological groups. For example, the branch "Aircraft construction" (production, assembly, reconstruction and repair of aircraft, gliders and parts and elements for aircraft), under the technological classification of OECD, belongs to the cluster of medium technologies production, but production of electrical devices for air navigation and measurement instruments for aircraft belongs to the groups which already belong to high-tech productions. This fact makes it more difficult to compare them with the data of the State Statistics Office of Ukraine, but in general it does not eliminate the possibility to get a notion of the structure of Ukrainian industry both in the level of technologies (using OECD methods) as by technological paradigms classification. Using this approach, we grouped the positions of the kinds of economic activities presented in statistic bulletins of the State Statistics of Ukraine, in the context of technological paradigms representation (*numbers* – groups by the level of technologies, 1 - highest) in the following way:

- *Fifth technological paradigm*: production of electric, electronic and optic equipment (1).
- *Fourth technological paradigm*: production of charred coal and oil products (3); chemical production (2); production of rubber and plastic products (3); production of other non-metal mineral products (3); metallurgic production and production of ready-made metal products (3); production of machines and equipment (2); production of vehicles and equipment (2).
- *Third technological paradigm*: raw materials industry (4); production of food, drinks and tobacco products (4); textile industry (4); production of clothes, fur and fur products (4); production of leather, products made of leather and other materials (4); processing of wood and manufacturing products of wood, apart from furniture (4); paper and pulp industry (4); printing industry (4); production of electrical energy, gas and water (4).

We used the above classification of the groups of industrial sectors by the type of technology level to calculate the corresponding structural dynamics of Ukrainian industry in 2001-2008. This data is given in Table 3. From this we can also go to the analysis of structural dynamics by technological paradigms as stated above.

It is clear from Table 3 that the structure of Ukrainian industry evaluated by the level of technologies does not correspond to the requirements of time. In 2008 high-tech branches amounted only to 2,8%. It is 4-5 times less than in developed economies. We also have a considerable retardation of industrial structure regarding the group of medium-high-tech branches. Of 22,0% of the group of medium-low-technological branches belong to metallurgic production and production of ready-made metal products. In the group of low-technology branches, we can single out the production of food, drinks and tobacco products. But the most important thing is the picture of structural dynamics which shows the trends of future economic development of the country. The eight years analyzed were the years of fast economic development of Ukraine. Among the sectors which considerably changed their position in the structure of industry during this period were: production of vehicles and equipment and production of charred coal and oil products, and production and distribution of electrical energy, gas and water. As we see, it is difficult to talk about

progressive structural change in Ukraine. From the point of view of the theory of technological paradigm, this is the biggest threat for the present-day economy of Ukraine.

Table 3. Structural dynamics of the industry of Ukraine by levels of technologies in 2001-2008 *(% to the all industry; in current prices)*

Branches of industry	Group of sectors by level of technologies	2001	2003	2005	2007	2008
High-tech						
Production of electric, electronic and optic equipment	1	2,7	2,9	2,9	3,0	2,8
Medium-high-tech						
Chemical production	2	4,7	5,0	4,7	4,3	4,4
Production of machines and equipment	2	4,8	4,5	4,4	4,2	4,1
Production of vehicles and equipment	2	2,7	4,8	5,4	6,5	6,4
Medium-low-tech						
Production of charred coal and oil products	3	4,9	7,4	9,4	7,3	7,2
Production of rubber and plastic products	3	1,3	1,4	1,7	1,8	1,7
Production of other non-metal mineral products	3	2,7	2,6	2,9	3,8	3,8
Metallurgy & ready-made metal products	3	18,0	20,0	22,1	22,0	22,0
Low-tech						
Raw materials industry	4	9,7	7,7	8,3	7,9	9,3
Production of food, drinks and tobacco products	4	16,6	17	16,3	15,3	15,2
Light industry	4	1,4	1,3	1,1	1,0	0,9
Textile industry; production of clothes	4	1,0	0,9	0,8	0,7	0,6
Production of leather, and other materials	4	0,4	0,4	0,3	0,3	0,3
Processing of wood and its manufacturing	4	0,7	0,8	0,8	0,8	0,7
Paper and pulp industry; printing industry	4	2,4	2,5	2,5	2,4	2,2
Production of electrical energy, gas and water	4	24,8	20,4	15,9	18,2	17,8

Source: State Statistics of Ukraine.

We see an even worse situation in the analysis of the structure by technological paradigms. If we perform the above grouping of branches by three paradigms, we will get the results presented in Table 4.

Table 4. Structural dynamics of Ukrainian industry by technological paradigms in 2001-2008 ***(in % to the all industry; in current prices)***

Paradigms	2001	2003	2005	2007	2008
5th technological paradigm	2,7	2,9	2,9	3,0	2,8
4th technological paradigm	12,2	14,3	14,5	15,0	14,9
3rd technological paradigm	88,6	87,4	86,8	85,8	86,1

Source: State Statistics of Ukraine

Today, the dynamics and quality of economic growth in developed countries are determined by branches of the 5th technological paradigm. In the industry of Ukraine, its part in the XXI century did not exceed three percent. This figure is very small. As we see from Table 4, these years saw the strengthening of positions of the 4th technological paradigm, which corresponds to the philosophy and actual priorities of the current economic policy of Ukraine.

We will see the same picture as far as external economic relations are concerned. As it is known, the indicator of the share of export of high-tech branches is one of the most important evaluation criteria of the level of the country's competitive strength. In Table 5 we see the data concerning the structure of Ukrainian export based on the evaluation of groups of production by level of technologies determined with the help of methods used above. We see again a very small share of the products of high-tech sectors – only 4,6%. The advanced developed countries have the indicator of 30%. The medium-low technological branches dominate in Ukrainian export – 56,1%. It means that the country is oriented to the production of traditional industrial commodities realized at competitive saturated markets. The drawback of this external economic position consists in the fact that such markets have no special prospects of development, which raises doubts as to the possibility of supporting the long-term dynamics of economic growth of the countries oriented to such markets. That's why developed countries constantly try to make expansion to new innovational markets that can ensure their stable strategic development.

Table 5. Structure of Ukrainian industrial export in 2008 by type of branches on the basis of the different technological paradigms

Paradigms	Export of industrial products		Trade balance (export – import) by groups of tech paradigms, billions $
	Billions $	Structure, %	
5th tech paradigm	3,46	5,2%	-4,08
4th tech paradigm	11,15	16,7%	-16,95
3rd tech paradigm	52,34	78,2%	2,54
Total	66,95	100,0%	-18,49

Source: COMTRADE statistics

Looking into the future, the advanced countries are already deploying prerequisites for the expansion of productions of the 6th paradigm, where biotechnologies are predicted to be the key factor. In Ukraine, the share of such enterprises is not only meager, it is also impossible to trace the priority of investment flows for this group. Meanwhile, advanced mastering of future technologies

of the sixth techno-economic paradigm may give Ukraine a chance to catch up with the "peloton" of the developed countries in XXI century. As we see, the actual priority today is given to 3rd and 4th paradigms. It may be reflected by simple reproduction of the state of technological basis formed in the past. It is clear that such policy cannot ensure long-term economic growth of the country.

The information in Table 5 shows one more worrying tendency of Ukrainian economy: huge negative trade balance in the groups of high and medium-high technologies. These figures testify to very low innovation potential of the country. Using high-tech products, the country does not create its own production base for adequate increase in the competitive production. This situation cannot be satisfactory in the context of the task (necessity) to create resources for future economic growth of Ukrainian economy.

5. Conclusions

A distinctive feature of a post-industrial innovation economy is the production of new products and services that had not been produced in the industrial age. The theory of economic development by Schumpeter, Neo-Schumpeterian concepts as well as actual economic practice of the last decades proves that a dynamic economic development of the country is possible only in an innovation model of economic growth. Preservation and conservation of traditional production structure, i.e. reproduction and development only of pre-existing companies, even of the very successful ones, may have only a short-term positive effect. In the long run, such policy shall lead to economic crisis and stagnation.

The Neo-Schumpeterian conception of technology paradigms is fully proved by practice. All developed and dynamic countries have proved the correctness of the conclusions of this theory by criterion of efficiency of their economic policy which is built up on these principles. In Ukrainian circumstances it is hard to recognize of objective character of this theory but today it is obvious the all successful and rich countries have effective national innovation system (UNESCO, 2010). The advantages of the modern innovations that belong to the current techno-economic paradigm cause the existing economic and technological gap between rich and poor countries. But those advantages may and must be used to the overcoming of such gap.

The progress of the advanced countries is primarily caused by development of innovative production structures. In a broader sense, the history of human civilization shows that those countries which tried to maintain their competitiveness only due to expansion and improvement of the existing production structures, even if they were highly competitive at a particular time, became outsiders of the world economic system. In contrast to this, the focusing policy actions on generating and mastering of innovation technologies, which create condition for production of new products and services, allowed ensure the dynamic economic development.

The development of post-industrial production structures requires the growth of potential of new knowledge generation and effective institutions for knowledge commercialization and its transformation into innovative technologies and products that are to belong to current and future technological paradigms. Thus, today the main emphasis in economic policy of the ambitious country, including Ukraine, must be to develop sectors of post-industrial economy, building the resource base of creative innovation activity and institutions of commercialization of new knowledge. This policy primarily develops local universities, advanced organizational forms of their interrelations with business, creating infrastructure for transfer of innovative technologies as well as a network of cross-industry systems (clusters).

It is necessary to strengthen the development strategy for new industries of economy and production structures belonging to the post-industrial economy. Major attention in this strategy shall be paid to the formation of resource potential for generation of innovations that cause the formation of new companies, create new jobs in the regions and new markets in the international context,

rather than to recover traditional production structures. For this purpose the first role shall be assigned to measures aimed at developing innovation potential, strengthening of education and science, formation of infrastructure for transferring innovative technologies, support of innovative activity in all the areas as well as its wide international integration in education, research and innovative areas.

Innovative post-industrial model of economic growth provides a completely new model as compared to the industrial one. Fundamental difference is that innovation development can be successful without critical dependency of acquired earlier and natural resources of the territory. The main resource of post-industrial development is innovative knowledge – it may be developed quickly enough not only in those regions where such a resource has been historically formed, but also in those regions that fall behind. On this way there appears a number of new dynamic regions, which quickly found their innovative way up to prosperity, having started from weak competitive positions.

The above processes may be effective if supported by the state through the formation of relevant institutions. New innovation business cluster turned out to be the most successful institutions, where the process of technology transfer is carried out in new post-industrial organizational forms. The transition from linear hierarchical management systems which serviced vertical and horizontal production cooperation, to the systems based on implementation of principle of self-realization of individual small innovation companies and non-linear management relations.

The efficiency of cluster production structures mostly begins to depend upon the state innovation policy which shall create a favorable institutional environment for the growing number of cooperative relationships between companies, universities and research institutions of the region, country and the world. In this process the role of incentive instruments, which may be offered by the state, increases by far. Tax benefits must create incentives for not a mere company, but a whole production system, which may make a significant impact upon economic development of both the region and the country.

In innovation policy, it is important to analyze the peculiarities of the post-industrial economy in light of the perspective to apply practically theory of technological paradigm which considers post-industrial production structures as those which may not be associated with the using of those traditional resources which at the certain historical moment were as the competitive advantages of a country or region. Mastering the achievements of a new technological paradigm mainly occurs through the formation of new creative enterprises, which ensure progressive structural changes in the country and to create new competitive advantages.

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