ІННОВАЦІЙНО–ІНВЕСТИЦІЙНА ПОЛІТИКА

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Парадигмальний дискурс про майбутнє інновацій в Україні

Предметом дослідження *є політичні та економічні стратегії інноваційних процесів у розвинених країнах.*

Мета статті *розкрити авторське бачення переваг впровадження інноваційних світових стратегій і систем в економічну практику України для вирішення завдань сталого економічного зростання.*

Методологія роботи *– макроекономіка, міжнародна торгівля, теорії економічного зростання та сталого розвитку, системний підхід до аналізу інноваційних факторів, що впливають на стійкий випуск економіки знань. Використовуючи методи експертного аналізу, визначаються основні напрямки інноваційної системи та стратегії. Структура та методи синтезу виявляють сильні та слабкі сторони міжнародного співробітництва у сфері інновацій.*

Результати роботи *– У статті наведено аналіз фактора національних особливостей інноваційного процесу. Країни відрізняються своїми традиціями, ідеологіями та переконаннями щодо відповідних ролей уряду, і вони будуть стежити за відмінностями, які вони вважають важливими. Національна інноваційна система також охоплює безліч інноваційних «трубопроводів», які є стратегіями просування інновацій до промислового виробництва. Ці трубопроводи спрямовані на створення здорової інноваційної екосистеми через функціональну політику, яка спрямовує первинних суб'єктів на сприяння інноваціям. Національні уряди можуть мати низку мотивів для впровадження інновацій. Головним з них є економічний розвиток для збільшення національного багатства і процвітання через створення нових продуктів і послуг і, у свою чергу, високооплачуваних робочих місць. У економічній реальності пострадянських країн на сьогоднішній день існує ряд складових, без яких неможливо уявити ефективно функціонуючий національний економічний інноваційний комплекс. Багаторівнева перспектива – пропозиція уряду щодо «управління перехідними процесами» та «стратегічного управління нішами» з метою сприяння й захисту розвитку та використання новітніх технологій.*

Висновки *– Система інноваційного підходу сумісна з уявою про те, що інноваційні процеси значною мірою характеризуються інтерактивним навчанням. Можна стверджувати, що певна система інноваційного підходу притаманна будь–якій перспективі, яка розглядає процес інновації як інтерактивний: а інтерактивність відкриває шлях до системного підходу. Нинішні інноваційні структури НСІ є, таким чином, результатом історичної еволюції, викликаної послідовністю техно–економічних парадигм. Отже, доречно посилатися на підсистему політики, що залучає урядових бю–*

рократів, зацікавлені сторони, академічних та інших експертів. На нашу думку, краще вважати цю підсистему такою, що складається з набору інституцій, можливостей і стимулів.

Ключові слова: *інновації, інноваційні структури НСІ, інноваційний процес, національна іннова–ційна система, інноваційні суб'єкти та стимули.*

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Парадигмальный дискурс о будущем инноваций в Украине

Предметом исследования *являются политические и экономические стратегии инновационных процессов в развитых странах.*

Цель статьи *раскрыть авторское видение преимуществ внедрения мировых инновационных стратегий и систем в украинскую экономическую практику для решения задач устойчивого экономического роста.*

Методология работы *– макроэкономика, международная торговля, теории экономического роста и устойчивого развития, системный анализ инновационных факторов, влияющих на устойчивый выпуск экономики знаний. Используя методы экспертного анализа, определены основные направления инновационной системы и стратегии. Структура и методы синтеза раскрывают сильные и слабые стороны международного сотрудничества в сфере инноваций.*

Результаты работы. *В статье дан анализ фактора национальных особенностей инновационного процесса. Страны различаются по своим традициям, идеологиям и убеждениям относительно под–ходящих ролей для правительства, и они будут наблюдать различия, которые они считают важными. Национальная инновационная система также включает в себя множество инновационных «трубо–проводов», которые являются стратегиями продвижения инноваций к промышленному производ–ству. Эти конвейеры нацелены на создание здоровой инновационной экосистемы посредством функциональной политики, которая направляет основных участников на стимулирование иннова–ций. Национальные правительства могут иметь ряд мотивов для поиска инноваций. Главным сре–ди них является экономическое развитие для увеличения национального богатства и процветания посредством создания новых продуктов и услуг и, в свою очередь, высокооплачиваемых рабочих мест. В экономической реальности постсоветских стран на сегодняшний день существует ряд со–ставляющих, без которых невозможно представить эффективно функционирующий национальный экономический инновационный комплекс. Многоуровневая перспектива – предложение прави–тельства об «управлении переходными процессами» и «стратегическом управлении нишами» в це–лях поощрения и защиты разработки и использования перспективных технологий.*

Выводы. *Система инновационного подхода совместима с представлением о том, что инновационные процессы в значительной степени характеризуются интерактивным обуче–нием. Можно утверждать, что определенная система инновационного подхода присуща любой перспективе, которая рассматривает процесс инноваций как интерактивный: а интерактив–ность прокладывает путь к системному подходу. Таким образом, современные инновационные структуры НСИ являются результатом исторического развития, вызванного чередой технико–экономических парадигм. Поэтому целесообразно обратиться к подсистеме политики, в которой участвуют правительственные чиновники, заинтересованные стороны, а также академические и другие эксперты. По нашему мнению, лучше всего рассматривать эту подсистему как совокуп–ность институтов, возможностей и стимулов.*

Ключевые слова: *инновации, инновационные структуры НСИ, инновационный процесс, на–циональная инновационная система, инновационные субъекты и стимулы.*

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Paradigmatic discourse on the future of innovation in Ukraine

The subject of the study *is political and economic strategies for innovative processes in developed countries.*

The purpose of the article *reveals public author's vision of the benefits of introducing world's innovative strategies and systems in the Ukrainian economic practice for solving the tasks of sustainable economic growth.*

Methodology of the work *is macroeconomics, international trade, theories of economic growth and sustainable development, systematic approach to the analysis of innovation factors influencing the sustainable output of the economy of knowledge. Using the methods of expert analysis, the main directions of the innovative system and strategy are determined. Structure and synthesis methods reveal the strengths and weaknesses of international cooperation in the sphere of innovation.*

The results of the work *– In the article are given analysis of the factor of national peculiarities to innovative process. Countries differ in their traditions, ideologies, and beliefs about appropriate roles for government, and they will guard the differences they think matter. A national innovation system also encompasses many innovation «pipelines,» which are strategies for advancing innovation to industrial output. These pipelines aim to create a healthy innovation ecosystem through functional policies that guide primary actors to foster innovation. National governments may have a range of motives for pursuing innovation. Chief among them is economic development to increase national wealth and prosperity via the creation of new products and services and, in turn, high–paying jobs. In the economic reality of the post–Soviet countries, to date, there are a number of components without which it is impossible to imagine an efficiently functioning national economic innovation complex. The multiple–level perspective has emerged the proposal for «transitions management» and «strategic niche management» by governments in order to promote and protect the development and use of promising technologies.*

Conclusions *– The system of innovation approach is compatible with the notion that processes of innovation are, to a large extent, characterized by interactive learning. It could be argued that some kind of systems of innovation approach is inherent to any perspective that sees the process of innovation as interactive: interactivity paves the way for a systemic approach. Current NSI innovation structures are, therefore, the result of a historical evolution induced by a succession of techno–economic paradigms. Therefore, it is appropriate to refer to a policy subsystem involving government bureaucrats, stakeholders, and academic and other experts. It is best in our opinion to consider this subsystem as consisting of a set of institutions, capabilities, and incentives.*

Key words: *innovation, NSI innovation structures, innovative process, national innovation system, innovation actors and incentives.*

Formulation of the problem. It should be first of all noted that in the world there are more than 20 countries that are considered OECD as innovative and practice such policy. These are the states with the following features:

1) The country has organized the production of new knowledge and their transformation into innovations and new technologies;

2) An information infrastructure is created that allows the storage and dissemination of knowledge and innovation;

3) An organized demand process from the part of production for innovation in order to increase competitiveness;

4) The social structure of society leads to the spread of innovations in all spheres of life.

So we need to conceptualize that, despite the recent slowdown in global growth, innovations continues to be a critical driver of the economy in developed and developing countries. It is the main source of investment in research, development and innovation (R&D&I), with manufacturing companies responsible for more than 85% of the R&D carried out by the private sector in Germany, Japan and South Korea. Technology and innovation have been and will remain central to how production evolves and is transformed. Over the past 20 years, worker productivity across industries in the United States increased by 47%, driven primarily by technology adoption and innovation. Society is at the juncture of the increasing convergence of production and consumption, which is mainly driven by new business models enabled by transformations in technology. In the context of the Fourth Industrial Revolution, production is at the cusp of a paradigm shift driven by three technological megatrends that have reached unprecedented pace and breadth, even as their full–scale adoption and benefits in production is yet to be realized [60].

The aim of the study: to relieve author's vision of the benefits of introducing world's innovative

strategies and systems in the Ukrainian economic practice for solving the tasks of sustainable economic growth.

Analysis of the research. We need to recognize concept of analysts: Richard R. Nelson that a national innovation system emerges from the belief that a nation's technological capabilities are its primary source of competitive performance and that these capabilities can be built through national action [45–46]; Philip E. Auerswald and Lewis M. Branscomb about that a nation's innovation system is shaped by how the nation leverages its endowments–natural resources, culture, history, geography, and demographics – through policies that create a thriving market–oriented (firm–centric) economy and accelerate the transition of new technologies, processes, and services to the market. The core of a nation's innovation system, then, is its endowments and how government and industry leverage these endowments – the nation's government through policy investments, incentives, and, regulations and industrial firms through strategies, investments, and training [11]. It is necessary, when comparing, to consider the uncertainty factor highlighted by Richard R. Nelson that in spite of the fact that the core of the innovation economy, which is the national innovation system, was created in many developed countries of the world as early as the end of the 20th century, the theoretical construct of innovative economics has hitherto been used by many researchers as insufficiently defined concepts. There is, first of all, the concept to a national innovation system itself. Each of the terms can be interpreted in a variety of ways, and there is the question of whether, in a world where technology and business are increasingly transnational, the concept as a whole makes much sense. Consider the term 'innovation', the participants, interpret the term rather broadly, to encompass the processes by which firms master and get into practice product designs and manufacturing processes that are new to them, whether or not they are new to the universe, or the nation. Richard R. Nelson does that for several reasons:

1) The activities, and investments associated with becoming the leader in the introduction of a new product or process, and those associated with staying near the head of the pack, o r catching up, are much less sharply distinguishable than commonly is presumed;

2) Much of the interest in innovative capability is tied to concern about economic performance, and here it is certainly the broader concept rather than the narrower one that matters.

This means that our orientation is not limited to the behaviour of firms at the world's technology forefront, or to institutions doing the most advanced scientific research, although in some countries the focus is here, but is more broadly on the factors influencing national technological capabilities. Then there is the term system. While to some the word connotes something that is consciously designed and built. Rather the concept here is of a set of institutions whose interactions determine the innovative performance, in the sense above, of national firms. There is no presumption that the system was, in some sense, consciously designed, or even that the set of institutions involved works together smoothly and coherently. Rather, the 'systems' concept is that of a set of institutional actors that, together, play the major role in influencing innovative performance. The broad concept of innovation that we have adopted has forced us to consider much more than simply the actors doing research and development. Indeed, a problem with the broader definition of innovation is that it provides no sharp guide to just what should be included in the innovation system, and what can be left out [45–46].

So it is necessary to take into account the factor of national peculiarities. Countries differ in their traditions, ideologies, and beliefs about appropriate roles for government, and they will guard the differences they think matter. A national innovation system also encompasses many innovation «pipelines,» which are strategies for advancing innovation to industrial output. Such strategies are not necessarily linear. These pipelines aim to create a healthy innovation ecosystem through functional policies that guide primary actors to foster innovation. National governments may have a range of motives for pursuing innovation. Chief among them is economic development to increase national wealth and prosperity via the creation of new products and services and, in turn, high–paying jobs. For high–wage countries like South Korea, this may mean having more attractive products or better production processes than firms in low–wage countries. In the economic reality of the post–Soviet countries, to date, there is a number of components without which it is impossible to

imagine an efficiently functioning national economic innovation complex (such a complex, for example, already established and operating in the USA): 1) in the opinion of the Belarusian economist, L .M Kryukov, «Today, none of the CEE and CIS countries have a scientific innovation system. But there is an active search for the most effective approaches to its creation. In Russia this problem has being intensively developed» [3, p. 71]. According to Russian researchers B.N. Kuzyk and Yu.V. Yakovtsa «there is no reason to say that national innovative system in Russia has already been established, it remains to be completed. They are only at the beginning of the path» [4, p. 440]. For its creation in the «Basic directions of the policy of the Russian Federation in the field of development of the innovation system for the period up to 2010» included the relevant activities, which are planned to be implemented within the next five years. However, the Russian researcher E. Semenov expresses reasonable doubt as to the specified time, fairly assuming that «to form a modern innovation system for this period of time, apparently, is unlikely» [4, p. 26]. For comparison, in the United States, such an innovative system was created over 50 years [1].

In view of the absence in the modern economic practice of the post–Soviet countries of the above–mentioned components, of which, in many respects, the innovative economy as a national economic system develops, many researchers in their works prefer to call the last «innovative sector of the economy» [6], which corresponds more to domestic economic realities. From other sectors of the domestic multi–layered, «multi–layered, multifunctional economy» [5, p. 27] innovation sector is characterized by the fact that innovation is used as the main economic resource, while in the high–tech sector it is high technologies, in the financial sector, finance, etc. The conceptual block of questions associated with the development of an innovative economy is considerably better developed in the post–Soviet countries, the content of which allows us to consider it as a frontier scientific discipline, formed at the junction of economic science, innovation and science. n addition, a number of innovative models, which are abstract constructs that simplify the main features of the economic system of this type, have been created by specialists in innovative economics, innovation and science. Finally, the authors of the monograph «Innovative Economic Development: Model, Management System, State Policy» (K., 2005), not only describe different models of innovative economic development, but also distinguish several types of innovative economy [2, p. 31–32.]. The analysis of the typological features of the domestic innovation economy allows Shcherbin V.K. to give it the following definition, it is:

1) The emerging industrial relations of innovation character;

2) The national economy sector, which provides GDP growth through the commercialization of research and development;

3) Border scientific discipline, formed at the junction of economic science, innovation and science [7].

A review of the literature on innovation and diffusion reveals several paradigms as to just what an innovation is:

1) The problem of technological innovations has not been considered a priority by the classic theorists. Due to the fact, no special importance is ascribed to the innovation development theory, in spite of the fact that Smith, Ricardo, Marks, Marshall, Keynes and Solow are almost unanimous, stating that long–term efficiency growth is inextricably related with introduction and diffusion of technological and organisational innovations;

2) One of the paradigms was developed by Everett Rogers. He defines innovation as «an idea, practice, or object that is perceived as new by an individual or other unit of adoption» [51, p.11]. For E. Rogers, innovations are singular inventions that are adopted via a process of protagonist «marketing». At issue is the potential adopters behaviour («i.e.» attitudes and personality) – rather than their ability to adopt, and the ability of the agent promoting the innovation to persuade the potential adopter;

3) In contrast to the Rogers's concept, H. Barnett [12], B. Agarwal and others have argued that innovation and diffusion are not separate processes – that innovation is essentially the first step in the diffusion process – and those potential adopters decisions concerning adoption is based on rationality rather than persuasion [12]. In this paradigm, innovations are ideas or technologies which are continually adapted as they are adopted, and represent sequential sociocultural change. J. Schumpeter's simple definition, that innovations are «the carrying out of new combinations» also fits this contrasting school of thought [54];

4) So called Economists have focused on the economic factors «inducing» innovation, and have taken a market rather than personal perspective. Ruttan and Hayami utilize a functionalist, neo–classical argument that innovation results from the endogenous scarcity of some component of production [52]. Economist Alainde Janvry criticized the neo–classical school and emphasized the importance of exogenous, structural factors (history, international markets, politics and institutions) in «inducing» innovation [10];

4) So called Anthropologists are divided largely between those who consider humans to be pragmatists with innovations a function of their rational objectives and characterized by the materials at hand, and those who consider humans meaning– and symbol–making beings with innovations a function of their subjectively defined beliefs. Two anthropologists, H. Barnett and S. Gudeman, offer arguments that bridge this gap between the «induced» argument of the economists and the «culturalist» arguments of some anthropologists. At the personal level, the «induced» innovation model of Ruttan and Hayami would fit within Barnett's model [52]. Accepting the Barnett's and Schumpeter's definition of innovation – as that of making new combinations of familiar things – S. Gudeman proposes that people create new things for use, and simultaneously create culture [35]. A discarded food bowl used for a chimney cap is thus both an innovation with practical use value and a cultural creation. This proposal is both a refinement and extension of the Barnett model.

Using the idea of a hierarchy of levels of innovation and working within the evolutionary approach, F. Geels put forward a multi–level perspective of how transitions to radically new technological systems could occur and how policy support (i.e. transition management) might facilitate this. This multi–level perspective is important for an understanding that breakthroughs of innovations are dependent on multiple processes in the wider contexts of regimes and landscapes. According to Geels, transitions do not only involve changes in technology, but also changes in user practices, regulation, industrial networks (supply, production, and distribution), infrastructure, and symbolic meaning or culture. Geels uses three explanatory levels: technological niches at the «micro» level, sociotechnical regimes at the «meso» level, and landscapes at the «macro» level [33]. Winskel and Moran think that socio–technical regime reflects the interaction between the actors and institutions, and the resultant routines and practices, involved in creating and reinforcing a particular technological system [59]. These practices include: «engineering practices; production process technologies; product characteristics, skills and procedures embedded in institutions and infrastructures [26]. Thus, in so far as firms differ in their organisational and cognitive routines, then there is variety in the technological search directions of engineers. In so far as different firms share similar routines, these forms a regime. Technological regimes produce technological trajectories, because the community of engineers searches in the same direction. Technological regimes thus create stability in the direction of technical development [33]. This is closely related to the concepts of path dependency and lock–in.

Alongside the multiple–level perspective has emerged the proposal for «transitions management» and «strategic niche management» by governments in order to promote and protect the development and use of promising technologies [25]. Strategic niche management differs from simple «technology push» policies, particularly in the role that states undertake [43]. Echoing the multiple–level perspective, there is recognition that government and firms, as well as other stakeholders, have a central role to play in a system change and, for example, in the diffusion of low carbon technologies and that there is a need for policy–makers to manage the dynamics of possible transitions in order to avoid early lock–ins. According to Rennings, transition management is not so much about the use of specific economic instruments but more about different ways of interaction between entities, the mode of governance, and goal seeking. If innovation and learning are the aims of transition management then this requires a greater orientation towards outsiders, a commitment to change and clear stakes for regime actors [49–50].

Foxon did research under the transitions approach in order to develop «socio–technical scenarios». Such a scenario describes a potential transition not only in terms of developing technologies but also by exploring potential links between various options and by analysing how these developments affect and are affected by the strategies (including policies) and behaviour of various stakehold–

ers. Elaborating on the socio–technical scenarios method, Foxon offers a theoretical approach to developing transition pathways. Three main steps to specifying transition pathways are identified: Characterise key elements of existing regime (socio–technical, actors, and landscape) [26]. Identify key processes that influence dynamics and stability, especially at the niche level. Specify interactions giving rise to or strongly influencing transition path [17].

One of the most persistent themes in modern innovation studies is the idea that innovation by firms cannot be understood purely in terms of independent decision–making at the level of the firm. Rather, innovation involves complex interactions between a firm and its environment, with the environment being seen on two different levels [38–40]. On one level, there are interactions between firms – between a firm and its network of customers and suppliers. The second level is wider, involving broader factors shaping the behaviour of firms: the social and cultural context, the institutional and organizational framework, infrastructures, the processes which create and distribute scientific knowledge.

Thus, more recent perspectives on innovation structures and processes emphasise the systemic character of technological innovation. This helps to explain why technological change is often a very slow process and why it is difficult to influence [36]. The rate and direction of change is not so much determined by the simple competition between different technologies, but also by the competition between various existing innovation systems, both fully developed and emerging ones. The inertia of technology–innovation system combinations is quite large, which can lead to a lock–in those results in relatively rigid technological trajectories.

Energy systems may exhibit a particularly acute form of lock–in [58]. As Gross emphasises, currently we are locked into a carbon intensive energy system and largely carbon intensive technologies. Assets are long lived and capital intensive, incumbent technologies have benefited from decades of development, and the system has co–evolved into compatible networks of fuels, end use devices, vehicles, delivery infrastructure and institutions. It is also argued that the locked–in system emerged before the carbon problem was recognised and/or low carbon alternatives could be promulgated [34].

Advances in innovation theory have afforded insights into the structures and processes of energy systems and have proposed theoretical approaches with which to further eco–innovation and the radical transition to more sustainable energy systems. By contrast, the relative paucity of literature addressing remediation/adaptation from the perspective of innovation theory suggests that more research in these areas could be equally valuable.

Steen Heyrup, Kirsten Meller proposed methodological approach to involve employees in development is seen as an advantageous way to be more innovative. Employee–driven innovation (EDI) could be such a methodology to implicate the spoken and tacit knowledge of the employees that would strengthen the innovative capabilities of the project organization [37]. They used de Sousa's concept. Innovation is no longer only a task for specialists and R&D departments. According to de Sousa et al more than 80 percentages of every innovation produced today are generated from smaller incremental innovations [55]. Hence the main potential lies in the smaller innovative steps that often are driven by the creativity of the workforce, when existing products, processes or services are optimised or reinvented [13]. Involvement of employees has been a research topic for some years, but it has never been formalised in terms of a theoretical or practical framework [13]. Innovation depends on a system that can process the initial idea from individual creativity through a group level which will handle the variety of obstacles in adoption to dissemination and implementation of the idea [55]. In project lead organisations within the build environment the product and process knowledge are closely related to individual employees. Earlier studies on innovative behaviour have focused on incremental, process–related innovation at the shop–floor level of organisations. Innovative work behaviour has, therefore, merely been considered as extra–role behaviour that is not usually recognised by the formal reward systems of an organisation [57]. In research literature it is well documented that ideas are considered the raw material for innovation, hence the importance of generating an adequate number of ideas are significant [8–9]. Innovation management abilities are related to project management. Managing innovation requires persons who commit themselves to a project or an idea, they have to be enthusiastic and motivated to support and promote. According to Mansfeld innovation managers must possess the

skills of the two roles champion and promoter. The champion support innovation through enthusiasm, confidence, persistence, and the managerial skills to assemble the right team. The promoter either; possess the technical knowledge to advance or further develop the ideas, possess the necessary hieratical power to drive the project or apply the needed resources, or has the organisational network and influence to support the idea. Mansfeld define these skills and different roles in the general management role as an innovator, the person or character that can push the innovation to succeed [42]. When managing innovative employees, Kleysen and Street have identified five dimensions of innovative behaviour that innovation management should support and encourage:

1) Opportunity exploration;
2) Generatively;
3) Formative investigations;
4) Championing;
5) Application.

They all play an important part in making innovation a part of business as usual, representing the activities as implementing, modifying and reutilizing. A challenge in relation to encourage the employees to be creative is that the management must carefully distinguish between expected, encouraged and non–expected behaviours according to role and employment [41]. According to Tuominen and Toivonen if the management is aware of the variety of innovative behaviour, the innovative processes would be more effective [57]. Onarheim and Christensen think that in high–risk design projects stage–gate models are often used as a management tool to control the development of the projects [47]. Adams has elaborated a framework containing seven categories with different areas of innovation measurement. The areas are:

1. Input measured by people, physical and financial resources, and tools;
2. Knowledge management measured by ideation, knowledge repository, and information flows;
3. Innovation strategy measured by strategic orientation, and strategic leadership.
4. Organisation and culture measured by culture, and structure;
5. Portfolio management measured by risk/return balance, and use of optimisation tools [8–9].

According to the typology, the following types of innovation policy are distinguished: countries aimed at realizing the goals of sovereignty, countries aimed at diffusing technologies or spreading technologies in the industrial sector, and countries that catch up with the leaders of innovative development. It should be noted that individual programs and projects of each country at different periods of development and priorities of innovation policy may be related to a different type of policy. For example, in Germany, which belongs to the group of countries focused on the diffusion of technology, there are projects corresponding to the group of countries – «mission carriers» and aimed at goals of national importance. Separately, Japan should be singled out, which from the group of catching–up countries «broke free» into a complex of orientation towards diffusion of technologies and orientation towards goals of national importance.

Galli Riccardo said that in the past, structural changes in the organization of science and technology (S&T) have been associated with paradigmatic transitions in order to best fit the features of new emerging and dominating technologies. Freeman describes the evolution and progressive appearance of new kinds of institutions and mechanisms for technological development and professional education within NSI's pari passu with successive technological revolutions and associated techno–economic paradigms. Early institutions such as universities, scientific academies, and professional associations were followed by industrial R&D centres and eventually mission–oriented public research centres. Important mechanisms developed gradually: in the second half of the nineteenth century we observe the emergence of national and international patent protection systems, and later on, interfirm technology transfer mechanisms, interfirm technical cooperation, and industry–university relations [32].

Christopher Freeman wrote a lot about technological innovation [27–31]. According to C. Freeman, the first person to use the expression 'national system of innovation' was Bengt–Ake Lundvall [29, P. 5]. However, in published form, the expression was first used by C. Freeman himself in his book on technology policy and economic performance in Japan [28]. In the early 1990s two major books on national systems of innovation were published. These were edited by Bengt–Ake Lundvall [44] and Richard Nelson [45–46]. A perspective that is similar in important respects has been developed within a research program led by

Bo Carlsson [15–17]. Carlsson and his colleagues talk about «technological systems». They argue that these are specific for various technology fields, and hence their approach is sectoral rather than national. It may sometimes also be useful to talk about regional (or local) systems of innovation. Despite their different emphases, the various perspectives also hold important similarities which allow them to be clustered together as variants of more general and broadly encompassing systems of innovation approach. The various publications mentioned above are by no means the only ones using the systems of innovation approach. Its diffusion has been surprisingly fast. In academic circles it is now widely used, and has already been the subject dominating a special issue of the «Cambridge Journal of Economics». The approach is also very much used in a policy context – by national governments as well as by international organizations like the OECD and the European Union. The approach seems to be very attractive to policy–makers who look for alternative frameworks for understanding differences between economies and various ways to support technological change and innovation.

Charles Edquist [20] pointed out that processes of innovation have evolutionary characteristics, i.e., they are path dependent, develop over time, and it is highly uncertain what the end result is going to be. The idea of optimality is absent. Systems of innovation are also subject to similar processes of change. Although the systems are often relatively stable, they also change – and in exceptional cases these changes may be rapid. Such 'systems dynamics' is expressed changes in the way R&D is carried out (such as the increased science–base of innovation and increased degree of interdisciplinary) and problems associated with technological discontinuities. Such changes have implications for the ways that systems of innovation develop and for the actors, such as firms, operating within these systems. The dynamism of the real world is characterized by transitions from relatively stable systems to more temporary and unstable «hybrid» forms.

Lundvall's book is an attempt explicitly to relate the national systems of innovation approach to innovation theory. In it, contributing authors from Aalborg University, Denmark, have placed their own previously developed innovation theories into national systems of innovation conceptual framework. This theory stresses processes of learning and user–producer interaction. In Lundvall's words – one of our starting–points is that innovation is a ubiquitous phenomenon in the modern economy. In practically all parts of the economy, and at all times, we expect to find ongoing processes of learning, searching and exploring, which result in new products, new techniques, new forms of organization and new markets. In some parts of the economy, these activities might be slow, gradual and incremental, but they will still be there if we take a closer look [44, P.8].

The «technological systems» approach was developed within the framework of a five–year research program of Sweden's Technological Systems and Future Development Potential led by Bo Carlsson [15–17]. The program deals with theoretical aspects of the study of technological systems as well as empirical studies of specific systems like factory automation, electronics and computers, pharmaceuticals, and powder technology. Although Carlsson and his colleagues do not use the same «language» ('system of innovation'), their «technological systems» approach quite similar in several respects.

A regional perspective on innovation and industrial development has also been widely used, although the term «regional system of innovation» as such might be less common. One example is Anna Lee Saxenian's analysis of «regional industrial systems» which focus on Silicon Valley, California and Route 128, Massachusetts [53]. Other examples are analyzes in terms of «industrial districts» from Alfred Marshall on. The phrase «regional innovation system» is also being increasingly used. This is indicated in Cooke, which includes an analysis of the origins of the concept [18]. The regional approach is addressed by Ellinor Ehrnberg and Staffan Jacobsson [21, 56].

Galli Riccardo thinks that Current NSI structures are, therefore, the result of a historical evolution induced by a succession of techno–economic paradigms. The transition we are currently experiencing has brought about further structural adjustments of NSIs, which are already detectable. The goals of this chapter are to provide:

1) Schematic description of paradigmatic and structural changes occurring in NSIs;

2) Presentation and analysis of the central elements of a possible model of NSI and NSI transition;

3) Contribution to generating an evolutionary policy framework for system evolution and transition;

4) Basis for an institutional approach to NSI data collection [32].

The justification for a separate policy subsystem is twofold. First, policy could play critical role in NSI transition because of the market mechanism's limitations in setting priorities and the need for non–market coordination. Moreover, it is simplistic to assume that policy consists exclusively of a set of exogenously determined tools associated with monetary incentives. Rather these tools are the result of a complex policy process involving the above mentioned priorities, the coordinated design and implementation of policies in the various priority areas; and policy evaluations. Therefore, it is appropriate to refer to a policy subsystem involving government bureaucrats, stakeholders, and academic and other experts. It is best in our opinion to consider this subsystem as consisting of a set of institutions, capabilities, and incentives. The main elements of the policy development subsystem may be summarized as follows:

1. An overall view of the innovation system, its development through time, and its connections with country economic performance;

2. Associated with this is the issue of vision generation through/for mechanisms/ institutions which, through systematic study and interaction among sectors, may lead to a set of long– and medium–term (flexible) objectives and targets for the economy and the country as a whole. This should also be based on a systematic assessment of policy implications of scientific and technological advances;

3. Determination of the salient features of the required industrial, technological, and science policies are including their relationship with macroeconomic policies;

4. Coordinated view must be based of the set of major science, technology, and industrial policy areas and their interconnections;

5. Definition of priorities and policy reformulation has needs setting various mechanisms for implementation;

6. Selection of the policy approach (e.g., extent to which it would be proactive, catalytic, and selective) in each one of the areas considered;

7. Explicit generation of policy capabilities and of the institutional and organizational requirements for the above;

8. Systematic assessment of the implications of other sectoral policies (e.g., fiscal, defence, health, environment, etc.) on the performance of NSI.

In the past, science and technology policy basically entailed planning for the supply of research, largely relying on the autoreferentiality of universities and research organizations. New policy frequently starts from demand, i.e., from an identification of R&D and innovation requirements emerging from the economy and society at large. This requires innovative mechanisms for integrating demand for and supply of R&D. Governmental commissions frequently playa role in defining guidelines for R&D programs, etc., with reference to both demand and supply considerations.

Borrowing from some recent developments in the field of political science concerning European integration, we are able to shed additional light on the embeddings of diversity in the post–national institution building process. P. Muller (La mutation des politiques publiques. Numero Special de la revue Pouvoirs, Europe, de la Communaute a l'Union, 1994.) has analyzed the transformation of public policies in Europe – what Andersen, E. S. and Eliassen, K. A. (The EC as a new political system), Making Policy in Europe (the Europeanization of National Policy–Making, London: Sage.) have called 'the Europeanization of national policy–making'. He identifies three levels of interaction between the European integration process and the national policy system:

1) The 'policy agenda;

2) The representation of interest groups;

3) The decision–making process.

The policy agenda is the sum of perceived problems at a given point in time which appears to be the subject for legitimate governmental intervention. The introduction of an issue on to the agenda is a major element in the elaboration of public policies, and the target of strategic behaviour for social and economic actors. P. Muller suggests that there is a transfer of some essential issues to the European policy agenda: the changes in agricultural policies or environmental directives before the Single European Act and, most spectacularly, the implementation of the single market are examples of this change. One could add today the Economic and Monetary Union (EMU) which constrains heavily national monetary, budgetary, and economic policies. The various policies that now constitute industrial policy (e.g., competition, trade, and regional policies, to cite a few) are strongly determined at the European level from the point of view of the issues discussed and the methods suggested for

public policy implementation. Many authors explain this new phenomenon as a result of the cultural shock created by the Commission's White Paper on The Single European Market [14].

Paraskevas Caracostas and Luc Soete are researching Cross–Border Institutions of European System of Innovation [14]. They think that understanding post–national systems of innovation (SI) requires an analysis of the institutions that have shaped it, including their features, history, and the impact they have had on NSI. Their analysis is centred on the European Union's research institutions (legal frameworks and implementation rules such as programs) and organizations (e.g., what are called «European institutions», representative bodies, committees, etc.) that influence European institution building. Both the early literature on national systems of innovation and the more recent interpretation of the concept by David and Foray [19] bring to the forefront the wide diversity of national policy instruments in the science and technology area. While some of these might have been characterized by general notions that were «mission» or «diffusion» oriented [22], recent literature suggests that such understandings hide much of the institutional nature of these systems and so do not lead the policy debate very far. The notion of some internationally valid, «best practice» institutional mechanism in the S&T area seems from this perspective not justified.

The wide diversity across the EU member countries in the amount of resources devoted to research, the structure of those resources, the importance of industry/ university relationships through, for example, the funding of the higher education system, and the institutional and organizational set–up of government support (central, federal, regional) can to a large extent be explained by the long, and in some countries rich history of S&T institutions and different administrative traditions. Each of the national systems of innovation in Europe appears in other words characterized by different sectoral specialization, different corporate governance regulations and routines, various institutional set–ups, and great contrasts in performance. A tentative periodization of the first forty years of European institution building in the field of research allows us to distinguish three phases:

1) 1957–67: the failure to implement «nuclear techno–industrial federalism»;

2) 1967–79: the tension between integration and interdependency;

3) 1980–94: intense institution building (pre–competitive consortia, framework programs, networks, and the revised treaties).

Paraskevas Caracostas and Luc Soete [14] think that the concept of system, even coupled with evolutionary approaches, transports an inherent notion of coherence. The system of innovation approach, when incorporating evolutionary features (selection, path dependency, diversity generation, etc.) and taking on board socio–historical research results and methodologies, may need to reconsider its systemic epistemology and focus instead on «non–systemic» reconfigurations of stability and change, i.e., on complex and heterogeneous sets of different, conflicting, or disconnected processes.

Basic institutions are the treaties since they determine what can be done and what decision–making procedure is to be followed. These are, of course, «hard» institutions, very difficult to modify (for research, thirty years separate the Euratom treaty from the Single European Act). As analyzed above radical institutional change mainly occurs when a broad range of institutional changes converge in a major Treaty revision (as in 1987 and 1993). But an institutional block or element may be frozen for some time and suddenly operationalized when compatibility with national institutions requires it (the case of a supplementary program for the High Flux Reactor in 1967) or when the crisis of national institutions (e.g., today the legitimacy). Crisis of research institutions in member states makes it possible (e.g., the revival of Article 130H concerning coordination of national policies with EC policy). Supporting institutions can also be broken down to various constituents: in the European research policy context, for example, the sequence of rules such as the framework program, the specific programs, committee rules, work–programs, and calls for proposals and research contracts has increasing «softness» due to more general rules governing legislative and executive powers and the equilibriums between them [14]. The analysis of institutions in relation to systems of innovation should therefore try to focus more specifically on the relations between institutional change and levels of formality inherent in the institutions and assess the «hardness» and «softness» of these levels.

Conciusions

The system of innovation approach is compatible with the notion that processes of innovation are, to a large extent, characterized by interactive learning. It could be argued that some kind of systems of innovation approach is inherent to any perspective that sees the process of innovation as interactive: interactivity paves the way for a systemic approach. Current NSI innovation structures are, therefore, the result of a historical evolution induced by a succession of techno–economic paradigms. Therefore, it is appropriate to refer to a policy subsystem involving government bureaucrats, stakeholders, and academic and other experts. It is best in our opinion to consider this subsystem as consisting of a set of institutions, capabilities, and incentives.

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ГАВРИЛЕНКО А.С.

Формування нового технологічного укладу як напрям прискорення інноваційного розвитку України

У статті досліджено сутність поняття «технологічний уклад». Виходячи із аналізу наукової економічної літератури, наведено характерні риси, які притаманні технологічним укладам. Визначено передумови формування нового технологічного укладу в економічному розвитку країни.

***Метою статті** є дослідження економічного розвитку та його взаємозв'язок з технічною еволюцією, проведення аналізу особливостей формування нового технологічного укладу як напряму прискорення інноваційного розвитку України.*

З економічної точки зору технологічний уклад є результатом складного колективного процесу формування нової моделі розвитку, що сприяє максимальній ефективності бізнес–практик різних агентів ринку та соціальному прогресу. Іншими словами, технологічна революція приводить до формування нового технологічного укладу лише в разі появи ефективних способів перетворення проривних інновацій в прибутковий бізнес. Очевидно, що без розуміння місця нової технології в бізнес–процесах відкриття залишаються лише надбанням окремих наук.

Технологічний уклад характеризується єдиним технічним рівнем складових його виробництв, що пов'язані вертикальними та горизонтальними потоками якісно однорідних ресурсів і спираються на загальні ресурси кваліфікованої робочої сили, загальний науково–технічний потенціал тощо. Тому на сьогоднішній день залишається актуальною проблема прискорення інноваційного розвитку країни в умовах формування нового технологічного укладу.

У зв'язку із становленням нового технологічного укладу виокремлено основні тенденції технологічного розвитку економіки України до 2020 року.

***Ключові слова:** технологічний уклад, інновації, інноваційний розвиток, нанотехнології, когнітивні технології, ключовий фактор.*

ГАВРИЛЕНКО А.С.

Формирования нового технологического уклада как направление ускорения инновационного развития Украины

В статье исследована сущность понятия «технологический уклад». Исходя из анализа научной экономической литературы, приведены характерные черты, присущие технологическим укладам. Определены предпосылки формирования нового технологического уклада в экономическом развитии страны.

***Целью статьи** является исследование экономического развития и его взаимосвязь с технической эволюцией, проведение анализа особенностей формирования нового технологического уклада как направления ускорения инновационного развития Украины.*

С экономической точки зрения технологический уклад является результатом сложного коллективного процесса формирования новой модели развития, способствует максимальной эффективности бизнес–практик различных агентов рынка и социального прогреса. Иными словами, технологическая революция приводит к формированию нового технологического уклада только в случае появления эффективных способов преобразования прорывных инноваций в прибыльный бизнес. Очевидно, что без понимания места новой технологии в бизнес–процессах открытия остаются только достоянием отдельных наук.