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INNOVATION POLICY THROUGH THE LENS OF ECONOMIC THEORY

Abstract

The paper comprises a comparative analysis of provisions of neoclassical, institutional, neo-Schumpeterian economic theories and the developmental tradition in terms of reasons for and limits to the government interventions into innovation. The theory behind the innovation policy has been improved and systemized in accordance with these economic approaches, creating a firm foundation for scientifically substantiated choices of political tools aimed at solving problems in innovation and eliminating their causes. Research results highlight that any choice of political tools must take into account recommendations of various economic theories and the features of the specific country, i.e., whether it is developed or developing, post-industrial, industrial or agrarian, its culture and history, economic and political circumstances etc. Theoretical arguments serve as the substantiation for proposals on the need to reconceptualize the support network and innovation incentives in Ukraine.

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Literature Review and Problem Statement

The grounds for state intervention in the field of innovation and the importance of relevant policy instruments are growing and changing as innovation processes evolve and become more complex. Thus, while in the 1960s the focus of researchers was on science and scientific policy, over time it shifted to technology and technology policy, and, starting from the 1990s, to innovation and innovation policy (Fagerberg, 2015). In this regard, the theoretical understanding of innovation policy, its feasibility and tools for its implementation attracts attention of the academia. On the part of politicians and international organizations, the increased interest in innovations is connected with their exceptional role in accelerating economic growth, increasing the welfare of the population and overcoming global challenges.

Among the well-known Western specialists who devote their research to innovation policy, C. Edquist and S. Borrás stand out (Edquist, 2005; 2019; Borrás & Edquist, 2013). In particular, Borrás and Edquist (2013) use the analysis of different types of policy instruments and their evolution over time to justify the conclusion that innovation policy instruments should be designed and combined in a way to solve specific problems of the innovation system. In this way, they believe, a holistic, systematic approach to the implementation of innovation policy will be ensured.

In recent years, a whole series of studies has appeared, devoted to «transformational changes» in innovation policy. For example, the work of A. Isaksen, M. Trippl and H. Mayer (2022) substantiates the need to update and reassess the goals of innovation policy to ensure its compliance with global environmental and social demands, such as climate change, aging society, health care, digitalization, growth of social and territorial inequality. Scientific and methodological foundations and recommendations for the implementation of a mission-oriented approach to the innovation policy of the European Union (EU) were developed by M. Mazzucato. He defines mission-oriented innovation policy as a systemic state policy aimed at solving a growing number of global challenges within a defined budget and time frame by developing and implementing a coordinated package of political measures, legislative initiatives and projects in the field of science, technology and innovation (Mazzucato, 2018a; Mazzucato, 2018b). M. Bugge, A. Andersen and M. Steen (2022) established that the implementation of missions to overcome the most pressing global problems of today largely depends on the resources, actors and institutions available in the regions, as well as the established system of relationships between them. M. Casula (2022) examines how innovation policy is being transformed in the EU on the example of two of its member countries – France and Germany. He points to different directions of innovation policy development in these countries, which use a different mix of policy instruments according to their internal institutional contexts.

In Ukraine, many scholars also devote their research to studying the theoretical and applied aspects of drafting and implementing innovation policy. Among them are I. Bazhal (2021), I. Yehorov (2017), V. Omelyanenko (Omelyanenko et al., 2022), O. Popovych (2019), V. Khaustova and O. Reshetnyak (Ma et al., 2022). In particular, V. Omelyanenko, O. Omelyanenko O. and M. Vernydub (2022) summarized approaches to determining the relationship between the Sustainable Development Goals and innovation policy, identified the problems of their integrated implementation and possible benchmarks for evaluating the effectiveness of innovation policy.

In general, the scientific output of both foreign and Ukrainian researchers is deep and diverse, and therefore can be used as a basis for further scientific research in this area. At the same time, the existing scientific developments mostly relate to individual, primarily applied, aspects and areas of innovation policy, researchers pay much less attention to the justification of its theoretical foundation from the standpoint of various economic theories. At present, such a study should be conducted because of the complexity and network-like nature of the modern innovation process, which requires the use of a significant number of political tools, oriented simultaneously at different components of innovation systems depending on the existing innovation problems and their causes.

In view of the above, the **aim of the article** is to analyze and systematize the theoretical foundations of innovation policy from the standpoint of various

economic schools as a scientific basis for the selection and use of relevant political tools for solving innovation problems and eliminating their causes.

The methodology and methods of the study consist of a systematic approach to the analysis of processes and phenomena, methods of analysis and synthesis, logical generalization and systematization, neoclassical, institutional, neo-Schumpeterian economic theories, the developmentalist tradition. The paper uses mainly secondary sources such as scientific works of contemporary foreign and Ukrainian researchers on the problems of innovative economic development.

Research Results

In order to make a scientifically sound choice of innovation policy tools, it is necessary to refer to the theoretical foundations of innovation policy. This study analyzes the provisions of neoclassical, institutional, neo-Schumpeterian economic theories and the developmentalist tradition in terms of the grounds for and limitations of state intervention in the field of innovation. «Political instruments» here refers to the actions and measures, with the help of which the state tries to solve specific problems preventing the creation, implementation and dissemination of innovations. This could include the implementation of public expenditures in the form of tax benefits, innovation credits, etc., other interventions, such as regulation, provision of consulting services, creation of innovation infrastructure.

Neoclassical arguments in favor of state interventions in the field of innovation. The neoclassical school argues for government intervention in the field of innovation in case of market failures, when the market is unable to balance public costs and benefits. For example, when an enterprise does not pay for air or water pollution, and therefore uses them for free, harming the environment and human health.

There are four main causes of market failures in the field of innovation: asymmetric information, externalities and the associated lack of innovation financing, coordination failures, and underdeveloped markets.

Information is asymmetric when one party knows more about a certain activity than the other. For example, an inventor knows much more about the features and advantages of his development than a potential investor. The latter is more likely to be skeptical about the possible payback of investments from innovative developments, especially if they are at the initial levels of technology readiness[1]. Inventors usually do not have convincing arguments for investors regarding the feasibility of investing in their developments, which determines the

[1] For more on TRL1–TRL9, read Research and Development Output of NAS of Ukraine (2017).

low probability of receiving such funding. A similar asymmetry occurs with respect to the enterprise, which in the best case (if it is innovatively active) will prefer to support modest innovations or the development of foreign technologies rather than dare to direct funds to the development of radical innovations with a high degree of uncertainty about their commercial success. In the absence of alternative sources of financing, the enterprise may not even have free funds that could be directed to financing research and development (R&D). On the part of the state, the antidote to such a market failure should consist in sponsoring fundamental and applied science (as innovatively-developed countries do), sharing innovative risks with investors and business, taking over part of the costs and reducing uncertainty regarding the market success of the development. For instance, the government can finance the work of laboratories that will bring the development to TRL5 and higher levels, offer business tax breaks and other government subsidies, in the form of either cash, credit or tax. *State subsidies* in this case mean «any state aid» that «increases producers' incomes above those that would have been obtained without this intervention» (Schwartz & Clements, 1999).

Externalities, in particular *knowledge*, also affect the innovative behavior of enterprises. It is a public good, and therefore, its acquisition leads to the repeated use of new knowledge by a wide range of other persons, and with relatively small costs compared to the costs of its production. It follows that the social return on business investment in knowledge creation is significantly greater than the level of profitability of the initial investor (Jaffe, 1998). Enterprises, investing funds in the creation of knowledge, cannot receive either a full return or compensation for the positive «fringe benefits» of their investments for other enterprises, companies and consumers. Therefore, it would be logical to assume that their investments in research and development will be in amounts for which the rate of return on R&D costs is maximum, in other words, in most cases, enterprises will not risk the development of radical innovations.

The same is true with regards to the costs for *personnel training*, from which the employees themselves, other organizations or other countries in general receive benefits due to labor migration or emigration. To adjust externalities, the state can increase the state procurement of knowledge-intensive goods and services, state orders for the implementation of certain R&D and the development of specific innovations, training of specialists, and provide state subsidies. The scale and size of government subsidies should be greatest at the initial stages of the innovation chain and gradually decrease as higher TRL levels are approached.

It is worth noting that state procurement and government subsidies have played an important role in the emergence of revolutionary technological breakthroughs in recent decades. After all, all the most important technologies of today contributing to economic growth are the so-called general-purpose technologies (aviation technologies, space technologies, semiconductors, the Internet, nuclear

energy, nanotechnologies) that were initiated by the state (Jacobs, 2013). For example, supercomputers, autonomous robots, computer simulation software, weather radar, magnetic resonance imaging, automated DNA sequencing machines, GPS, microchips, touch screens, the Internet, and self-driving cars have all been funded by the US government (Monteil, 2020).

Both Compaq Computer Corporation and Intel started with America's Seed Fund grants; Apple also received 500,000 US dollars from the state at the initial stages of development (which is equivalent to about 1.8 million US dollars today); the developments of Stanford University graduate students (L. Page and S. Brin) were funded by the National Science Foundation, thanks to which Google was formed in 1998 (Jacobs, 2013; Hart, 2004). Tesla Motors, SpaceX, and SolarCity have received billions of dollars in government loans, contracts, tax credits, and other subsidies over the years. Quite recently the aerospace company SpaceX concluded a state contract with NASA in the amount of 2.89 billion US dollars (Lalljee, 2021). In all these examples, the state acted as a venture capitalist, assuming the role of an entrepreneur and the associated risks.

Coordination failures arise due to the complexity of innovation processes. Development of innovations requires a large number of organizations and enterprises with different functions and roles to communicate and synchronize their joint efforts, but the market is far from always able to ensure such cooperation. The latter faces many obstacles, including the lack of motivation among the stakeholders to interact with each other, differing interests and high costs associated with partnership. Appropriate political instruments – clusters and innovation networks, innovation vouchers, collaborative grants – can help solve this problem.

Underdeveloped markets are mostly typical for developing countries whose technological level is too low. Innovation processes are inhibited due to an underdeveloped market for start-up and venture capital, lack of specialized services for supporting innovative business, in particular for the protection of intellectual property rights, testing and approval of scientific development, its certification and promotion to the market. State intervention measures should provide a boost to underdeveloped markets through financial and non-financial support, provision of services and development of innovative infrastructure.

Intervening in the work of the market, the state, however, can itself perform its functions inefficiently, leading to *government failures.* Some representatives of neoclassicism believe that the consequences of government intervention are more severe than the consequences of market failures and it is better to let the market deal with the failure itself than to let politicians and bureaucrats fix it (Buchanan, 1975). Government failures include, in particular, asymmetric information and self-seeking behavior.

Asymmetric information occurs when politicians and civil servants, due to the activities of lobbyists and their detachment from market relations, have dis-

torted or limited information about costs and revenues in a certain industry, prospects and ways of its development. Their ignorance of the real needs and problems of business, in particular related to innovative activities, can result in wrong decisions and wasted resources.

Self-seeking behavior of state leaders, politicians and bureaucrats consists of them pursuing their own interests, clamping down on business with taxes, covering for and encouraging corruption, trying to retain power by any possible means, including state funds. Thus, the state may not be an active participant in innovation, moreover, it may purposefully obstruct them. After all, the structural transformation of the economy naturally leads to the redistribution of income and changes in the existing balance of power in the country and, as a result, hurts the interests of some (usually the ruling political elite) and opens up new opportunities for others. Therefore, in an ineffective state, the restructuring of the economy will run into a state «blockade», which will freeze initiatives and preserve stagnation. However, even assuming that politicians and civil servants act in the public interest, and the information they possess is complete and undistorted, the state may still lack the financial resources and qualified managers to properly implement the policy.

Government failures are a huge problem for many countries. However, this does not mean that an effective government that deserves the trust of the population cannot exist. Japan and South Korea are a vivid example of this, because the economic success of these countries owes a lot to the competent, dedicated ruling political elite and bureaucracy, who work not for their own profit, but for the people and their welfare, which earned them public trust and support (Hawrylyshyn, 2009).

Despite the fact that the neoclassical school has been dominant since the 1960s, economic theory is not limited to it. There are at least eight other economic schools (Austrian school, developmentalist tradition, institutionalism, Keynesianism, classicism, Marxism, neo-Schumpeterianism, behavioral economics), each of which has its own arguments in favor of government interventions into innovation. Below, the arguments of three economic schools are considered in more detail: the developmentalist tradition, institutionalist and neo-Schumpeterian schools.

Arguments of the developmentalist tradition. Developmentalists focus primarily on finding ways to overcome gaps in the levels of economic and technological development between rich and poor countries. They consider the increase of production capacities (not just any, but high-tech) to be the best tool for ensuring the economic development of the country. However, in poor countries, high-tech production cannot develop without the intervention of the state, since the market will constantly return the economy to the specialization in raw materials, low-productivity, energy- and resource-intensive production. That is why the state should intervene in this process, applying a wide range of economic and legal tools, in order to stimulate the development of high-tech industrial production and change the sectoral structure of

the economy in the course of its transformation. It is recommended to achieve such structural changes by providing state subsidies to manufacturers of high-tech products, increasing the volume of public procurement, introducing taxes on the export of raw materials or banning it altogether to stimulate the development of the processing industry, supporting technological upgrades of production by licensing advanced foreign technologies and involving foreign specialists, building roads, railways, telecommunications networks and other infrastructure at the expense of the state. The developmentalist tradition emphasizes that public policy must be based on specific circumstances of time and place. That is, the government decisions that work for economically powerful countries (for example, free trade) can harm industrially weak countries; the technologies that were recently considered new and progressive may now turn out to be unpromising and outdated.

Arguments of the institutionalist economic school. Unlike neoclassical theory, institutionalists do not emphasize supporting free competition and finding the optimal distribution of limited resources when justifying state interventions at the policy level. Instead, they focus, first, on the study of *institutions* – official regulations (formal, legally defined rules according to which the economy works) and informal rules (systems of values and traditions that influence people's behavior, shape and change it) that facilitate or hinder the implementation of policies, and secondly, on the analysis of *transaction costs* (North, 1990). The latter significantly expand the neoclassical understanding of costs, which is limited only to production costs. Transaction costs include costs for organizing innovative activities, searching for information, partners, investors, conducting negotiations, and protecting intellectual property rights. In a broad sense, transaction costs are also expenses for preventing corruption, ensuring law and order, maintaining the judicial system, etc.

According to institutionalists, participants in innovative relations, depending on each other, are not selfish and rational in their actions. Their behavior is influenced by laws, traditions, habits, instincts, and beliefs. Therefore, it is institutions that determine what they can and cannot do in a specific situation, limiting or stimulating their behavior. When institutions do not work or are ineffective, there are grounds for government intervention to improve the work of existing or introduce new institutions for the support of knowledge and innovation and thus create a favorable institutional basis for the innovative development of the country.

Arguments of the neo-Schumpeterian economic school. Representatives of neo-Schumpeterism, which also includes the school of evolutionary economics, borrowed key concepts from the biological evolutionary theory (diversity, heredity and selection) and the principles of historicism (the importance of taking into account geographical location, local culture and the history of a certain country and its territories) and introduced them into economic science (Hodgson, 2003; Stoelhorst, 2005). Followers of J. Schumpeter's ideas (Freeman, 1987; Lundvall, 2010; Nelson, 1993) first identified the non-linear nature of innovation, proposing the concept of a national innovation system (NIS), which emphasizes

its open dynamic nature in relation to the external environment. This distinguishes neo-Schumpeterianism from neoclassical and institutional theories, which tend to consider economic processes and phenomena in stasis.

According to OECD experts, national innovation systems, especially those of developing countries, face systemic failures that can hinder innovative activities of enterprises and industries (OECD, 1997). Systemic failures occur due to the lack of connections between NIS participants, the gap between fundamental research in the public sector and the needs of the industry, the inefficiency of technology transfer institutions, low ability of enterprises to receive and master the relevant information. To level them, experts suggest developing networks of business connections (networking) and consider the firm absorptive capacities (OECD, 1997).

At the same time, as noted in the monograph edited by Vyshnevskyi and Zbarazskaia (2013), this approach bypasses the important (from the point of view of institutionalists and neo-Schumpeterians) dependence of the NIS on the past trajectory of development (i.e., path dependence problem) and the national specifics of the country. So in this case, it is better to use evolutionary terminology, which takes into account these issues and defines the shortcomings of NIS as fitness failures.

Evolutionary economic theory, developed by R. Nelson and S. Winter (1982), is increasingly seen as a modern alternative to the neoclassical mainstream. It considers scientific, technical and organizational progress at the micro level to be the main driving force of economic development. The main category of evolutionary theory is «routine», which refers to all normal and predictable patterns of behavior of firms, acting as an analogue to «genes» in biology. According to R. Nelson and S. Winter (1982), routines (as a given template) and innovation (as a dynamic process of transformations) are interrelated, mutually determined entities, since innovations are based on past routines but, at the same time, they set the evolution of future routines in time. The search and selection of more efficient routines is determined by the environment to which firms adapt. This constitutes the main element of a continuous evolutionary process (Nelson & Winter, 1982).

The choice of political instruments is not as clearly presented in the evolutionary theory as in previous economic theories. Evolutionists do not make special attempts to determine the optimal innovation policy, presumably due to the microeconomic approach of this theory. Rather, evolutionary theory leans towards the state intervention that facilitates the firms' search and selection of better routines as future innovations. The state interested in this must create an environment that will promote change in routines and form an innovation-oriented model of company behavior.

The conducted analysis showed that various economic schools justify the need for state intervention in the field of innovation in different ways (Table 1).

Table 1

View of select economic schools on state intervention in the field of innovation at the policy level

Features	Economic School			
	Neoclassical	Developmental tradition	Institutional	Neo-Schumpeterian
Economic agents	Rational in their actions, guided by their own interests	No clear and unanimous position	Follow formally established rules, traditions, habits, instincts, and beliefs	Rather unselfish, able to sacrifice their interests for the sake of others
Grounds for state intervention	Market failures	Closing the gap between the economic and technological development of rich and poor countries	Lack of necessary and/or inefficiency of existing institutions, high transaction costs	Systemic failures taking into account the trajectory of past development and the specifics of the country's social system, especially its cultural heritage
Reservations regarding state intervention	Government failures	Government failures	Government failures	Government failures
Innovative problems and solutions targeted by the state influence	Externalities, asymmetric information, coordination problems, underdeveloped markets	Predominance of low-productivity, energy- and resource-intensive industries in the structure of industrial production in poor countries	Unfavorable institutional environment for innovation	Lack of connections between NIS participants, gap between fundamental research and the needs of industry, ineffectiveness of technology transfer institutions, low innovative activity of enterprises, etc.
Political tools for solving innovative problems	State procurement of science-intensive goods and services; state orders for the implementation of R&D and the development of innovations; state subsidies; collaborative	State subsidies to manufacturers of high-tech products; state procurement of innovations; taxes on the export of raw materials or its prohibition to stimulate the devel-	Regulatory instruments that provide for the development of laws and regulations in the fields of intellectual property rights, tax relations, public procurement,	Tax benefits; innovative loans; loan guarantees; public procurement; creation of incubators, accelerators, science and technology parks; innovative vouchers and collaborative grants; develop-

Features	Economic School			
	Neoclassical	Developmental tradition	Institutional	Neo-Schumpeterian
	grants; innovative vouchers; information and advocacy; development of innovative infrastructure	opment of the processing industry; licensing of advanced foreign technologies and involvement of foreign specialists; construction of roads, railways, telecommunication networks and other infrastructure at state expense	innovative infrastructure, the activities of research institutions and HEIs; establishment of competition policy rules; rules promoting public-private partnership; application of environmental norms, etc.	ment of innovative clusters/networks and the capacity building of enterprises for the development of innovations, firms' search and selection of the best routines as future innovations
Effectiveness criteria of political instruments	Ratio of spent resources and achieved results regarding the solution of a specific innovative problem	Comparison of development indicators of innovative processes in poor and rich countries	Ratio of spent resources and transaction costs to achieved results in solving a specific innovative problem	Comparison of the over-time development indicators of innovative processes

Neoclassicists explain it in the context of market failures, although some of them support non-intervention and claim that the state is an ineffective manager, unable to cope with market failures better than the market itself. Representatives of the *developmentalist tradition* advocate for temporary state protectionism and state intervention in poor countries due to the inability of the market to ensure the development of high-tech industries there. *Institutionalists* argue in favor of creating favorable formal and informal regulations and rules to ensure the successful flow of innovation processes. Representatives of the *neo-Schumpeterian school* interpret state intervention through the prism of systemic failures, taking into account the features of the social system and the trajectory of the country's past development.

However, none of these economic theories is able to comprehensively substantiate the need for state interventions in the field of innovation. Therefore, when choosing political instruments, one should take into account the arguments of multiple economic schools and focus on the features of the country being considered (whether it is developed or developing, industrially powerful or weak), as well as the entire range of the involved cultural, economic and political factors.

Conclusions

The research results confirm that choosing and finding an effective combination of innovation policy tools is a difficult task, especially considering the possible government failures. Each economic school considers innovation policy from a very particular angle and provides its own conclusions and proposals for accelerating innovation processes based on its own understanding of the economy as such, the forces and motives that govern the behavior of economic agents, and other factors. However, it should be noted that the position of a single economic school is hardly ever appropriate and efficient for all countries and circumstances. Thus, when choosing political instruments, it is necessary to take into account the arguments of different economic schools, the level of development of the country, and the peculiarities of its social and institutional systems in order to arrive at a scientifically sound decision.

For example, purely neoclassical instruments of innovation policy might succeed in developed economies, where the market mechanisms function properly, institutions are effective, and transaction costs are relatively low. However, in developing countries like Ukraine, such tools would clearly not be enough to overcome stagnant innovation processes and launch structural changes in the economy. The reasons for this include ineffective institutional environment, peculiarities of past development trajectories and past social norms of these countries, the short term taking priority over the long-term policy, lack of an effective NIS, as well as routines that determine the sporadic nature of interactions between its participants.

Ukraine, in particular, needs to rethink its concept of innovation policy tools, taking into account the substantiations of multiple economic schools and the accumulated European and international experience. At the same time, many Ukrainian politicians believe that the success of another country can be easily imitated and the results achieved by them can be reproduced at home. However, they forget that successful approaches and practices are usually affected by local conditions and are organically embedded, and therefore it is impossible to reproduce them in their original form without taking into account the unique spectrum of economic, political, socio-cultural factors of a certain country. This, however, does not mean that politicians should avoid studying good practices. Rather, when the decision to implement them is made, there should be an honest assessment of whether there are enough financial and human resources for their implementation and whether the existing conditions and institutions of Ukraine will contribute to their consolidation and successful reproduction. Without this, systemic failures are much more likely to occur, since the employed approaches will not correspond to the social and institutional structures of Ukraine, and therefore will hinder the development of an effective NIS and the innovative recovery of the country.

Further research could substantiate practical recommendations for the use of relevant tools of innovation policy in Ukraine based on the existing problems and their causes. This will help accelerate the processes of innovative recovery and ensure the sustainable development of the national economy in the wartime and the post-war period.

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