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INNOVATION POLICY AS A DRIVER OF A COUNTRY'S COMPETITIVENESS

Key words

Innovation policy, public support measures, national innovation system.

Abstract

Globalisation significantly influences the international competitiveness of a national economy. Taking the above into consideration, the ability to shape a country's innovation policy seems to be of key importance. It is crucial to direct national innovation policy in a way that would enable the country to seize all development opportunities stemming from current and future competitive advantages of the economy. Therefore, this paper analyses public support measures as the main tool of national innovation policy aimed at stimulating the economic competitiveness. The analyses include the following countries: Switzerland, Sweden, The United States, Germany, The United Kingdom, the Netherlands, France, China, India, Russia, the Czech Republic, and Poland.

1. Genesis, objectives and research methodology

Innovative enterprises are the foundation of the economy's competitiveness and therefore numerous public support measures are introduced to facilitate their development, particularly in the sector of advanced technologies. However, it needs to be emphasised that innovation policy by itself, even the most effective one, cannot provide a sufficient level of competitiveness in the long-term. The market mechanisms have the decisive character, while institutional

factors and national policies and regulations concerning, e.g. the R&D sector, innovation policy or education system, play the role of support measures [2, 5, 7, 13, 17]. However, membership in a particular political and economic structure (e.g. EU) determines the need to preserve the correlation between the innovation policy priorities and instruments of the individual member states and the EU practices. Therefore, the author of the article highlights the role of innovation policy in providing conditions facilitating national competitive growth. The detailed research objectives included (1) the identification of the relationship between innovation support measures and other elements of the national innovation system, and (2) the identification of innovation policy models in the countries covered by the study. The analyses were organised as follows:

- Analysis of the state-of-the-art in the area of innovation policy;
 - The selection of support instruments for further comparative analyses; and,
 - Comparative analyses of the support measures and conclusions.
- The following groups of countries were studied:
- Countries characterised by the highest level of innovation performance¹ and competitiveness² (in the study represented by Sweden, Switzerland, and the USA);
 - Countries with highest GDP and GDP per capita (represented by Germany, Great Britain, France, and the Netherlands); and,
 - Countries characterised by the most dynamic GDP and GDP per capita increase (represented by China, India, Russia, the Czech Republic, and Poland).

The research was based on ERAWATCH³ data.

2. Results of the analyses

2.1. Innovation policy determinants

Innovation policy is one of the components of the National Innovation System (NIS) (Fig. 1) that, simultaneously, decides on the effectiveness of this system. Figure 1 depicts the interactions between the innovation policy (executed through particular public support measures), and the remaining components of the NIS.

¹ Based on Global Innovation Index, www.globalinnovationindex.org/

² Based on Global Competitiveness Index, www.weforum.org/reports/global-competitiveness-report-2013-2014

³ ERAWATCH provides information on European, national and regional research and innovation systems, policies, and programs in the EU and beyond. ERAWATCH supports evidence-based policy making in Europe and contributes to the realisation of the European Research Area (ERA). ERAWATCH currently covers 61 countries <http://erawatch.jrc.ec.europa.eu/>

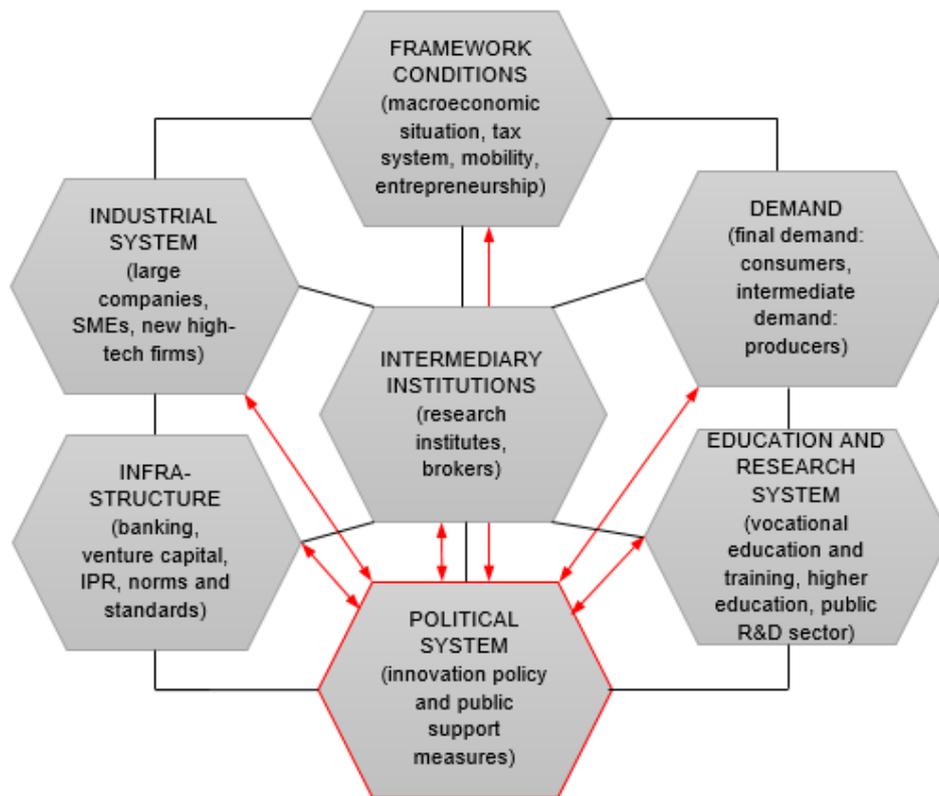


Fig. 1. Generic scheme of a national innovation system
Source: Author based on [Arnold, Kuhlman 2001, Izsak et al. 2013].

Lundvall [12], Nelson [15], Arnold, Kuhlmann [1] indicate that interactions between the individual components of the NIS can have either a positive or negative impact on the effectiveness of the application of public support measures. The interactions make it difficult to properly assign the effect to the support instrument, and make the final (i.e. market) results of the innovation policy difficult to be measured.

Because of the above, this is not only the level of competitiveness that decides upon the innovation performance of the country, but also the outcome of competition between national innovation systems or their sub-systems [8].

The differences between the NIS in countries analysed stem from numerous factors including the economic system, the level of technological development, and the dependencies between the expenditure and resources vs. production. Therefore, it is justified to design and implement innovation policies that address country-specific internal determinants of the NIS. This can be assisted by

an in-depth analysis of the functions of the NIS, which should encompass the following [3]:

- I. The creation of new knowledge (supply-side approach), including:
 - Guaranteeing R&D results in the areas of engineering, medical and natural sciences;
 - Developing competence of all actors of the NIS (individuals and organisations) through formal and informal education; and,
 - Creating a dynamic labour market complying with the needs of the business sector;
- II. Creating new markets, products and services (based on the requirements emanating from the demand side);
- III. Providing relevant business and legal constituents:
 - Providing proper conditions for the creation of new organisations (strengthening entrepreneurial drive (individual and organisational), establishing new research organisations, i.e. non-governmental);
 - Strengthening networking between organisations and markets;
 - Designing and modifying legal regulations and norms targeting barriers to innovation (i.e. patents, taxation, safety, environmental protection); and,
- IV. Support for innovative enterprises:
 - Providing access to infrastructure, financing consulting and legal advice, support for activities aimed at the intensification of commercialisation and technology transfer processes.

The analysis of the above listed functions of the innovation system should enable the design of an innovation policy in which the range of public support measures would consider all the activities of the innovation system, and simultaneously address the strengths and weaknesses of the system of a given country. Focusing only on the selected functions of the innovation process may be the reason for the ineffectiveness of the innovation policy. For instance, emphasising the need for increased R&D expenditure with the concurrent neglect of the need for the take up of activities intensifying the demand factors leads to a linear supply-oriented innovation process, in which new products and services, not necessarily meeting the requirements of the market, are developed. It is also important to prioritise challenges, i.e. even relevant, holistic orientation of support measures on a single problem of the NIS can lead to the inefficiency of these measures, if they address the challenges, which are of secondary importance for a given country. Other reasons for the ineffectiveness of the support instruments may stem from their number exceeding the budget and the level of support offered, or the improperly, and inefficiently functioning administrative apparatus that manages these measures.

However, directing the innovation policy according to the constraints of the country-specific NIS should not lead to the neglect of the experience of other

countries concerning the design, management, and the effects of the implementation of public innovation support measures. The extensive analyses of European innovation systems are conducted under the auspices of the European Commission as a part of the ERAWATCH initiative. Additionally, the classification of innovation support measures accepted in this project largely reflects the aforementioned functions of the NIS. According to the classification in question, the support measures analysed in the article are divided into the following five categories [4, pp. 44–45]:

1. R&D strategy;
2. Research and Technologies;
3. Human Resources;
4. Enterprises; and,
5. Markets and innovation culture.

Consequently, the basic criterion for the selection of instruments for the analysis was their thematic focus.

2.2. Selection of instruments for detailed analyses

The author analysed several public support measures that reflected the priorities of greatest importance to policymakers in selected countries (Table 1). The area of strategic intervention, to which the largest number of support measures in the countries analysed is addressed, concerns the second of the above listed categories, i.e. the Research and Technologies. This priority encompasses measures designed to intensify the R&D activity in academic institutions and in enterprises. In the case of the Czech Republic, India, and China, different priorities were considered to be of key importance. They include half of all public support measures in these countries. The priorities in question are as follows: Enterprises (the Czech Republic and India) and the R&D strategy (China).

Table 1. Number of public support measures used in countries covered in the analysis

Country	Areas of strategic intervention					Total number of measures
	1. R&D strategy	2. Research and Technologies	3. Human Resources	4. Enterprises	5. Markets and innovation culture	
Switzerland	8	12	8	4	3	28
Sweden	5	14	2	6	1	32
Germany	8	12	8	4	0	32
Netherlands	7	7	0	6	2	29

Country	Areas of strategic intervention					Total number of measures
	1. R&D strategy	2. Research and Technologies	3. Human Resources	4. Enterprises	5. Markets and innovation culture	
Great Britain	5	19	3	10	2	39
France	2	16	5	5	1	22
USA	2	24	6	9	1	42
Czech Republic	3	6	1	12	1	23
China	10	3	4	1	2	20
Russia	2	12	2	2	0	18
India	5	0	1	5	0	11
Poland	10	18	6	9	3	46
TOTAL	67	143	46	73	15	339

Source: Author based on <http://erawatch.jrc.ec.europa.eu/>

A great number of support measures that address individual country's strategic areas of intervention hampered detailed comparative analyses. Therefore, it was decided to investigate a representative group of measures, assuming that the analysis will cover all the countries and all the priorities represented by one selected measure.

During the analysis, it was necessary to modify the initial assumptions, because it turned out that the number of measures addressing the "Markets and innovation culture" strategic area of intervention was insufficient. In some countries, there was only one measure for this priority (i.e. Switzerland, Netherlands, France, and the Czech Republic), while in other countries, no support was provided at all (i.e. the United States, India, Russia). Moreover, this aspect of the innovation process was indirectly addressed by the instruments aimed at strengthening other strategic areas of intervention, such as "Research and Technologies," "Human Resources," and "Enterprises"⁴. For the very same

⁴ In particular, the aspects of intellectual property protection a priority within the specific area: (2) Research and Technologies, priority 2.2.2. Knowledge Transfer (contract research, licenses, research and IPR issues in public research, academic, and non-profit institutions). In contrast, the development of a culture of innovation has been included in the detailed priority 3.1.1.

reasons, the idea of conducting an in-depth analysis of support measures directed at the issues of the culture of innovation and IP protection was given up on by Izsák et al. [11], who analysed innovation policies of the EU-27, Switzerland, and Norway.

Thereby, further analyses were focused on the following four main areas of intervention: (1) R&D strategy, (2) Research and Technologies, (3) Human Resources, and (4) Enterprises with the fifth area of Markets and innovation culture not incorporated.

The representative group of measures that are the subject of the detailed analysis was selected taking into account both the qualitative and quantitative criteria. The quantitative criterion was the number of measures addressing specific priorities of innovation policy, which allowed further narrowing of the scope of analysis to measures addressing four priorities selected (i.e. 1.2.1, 2.1.1, 3.2.1, 4.3.1), out of the total of 30 detailed priorities as shown in Fig. 2.

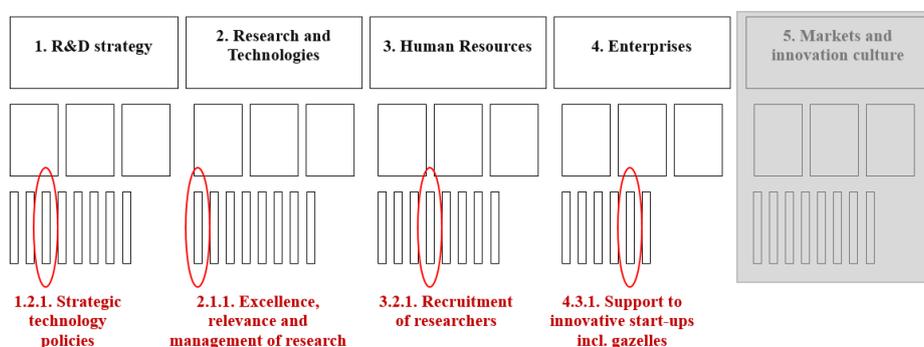


Fig. 2. Classification of areas of strategic intervention and detailed priorities of innovation policy
Source: Author.

The qualitative criterion, on the other hand, encompassed the following: the background and rationale, R&D and technological areas addressed by the instrument, the type of research and the aspect of the innovation process addressed by the measure, the period of validity of the measure, the criteria and the process of selection of projects and their beneficiaries, and the total budget of the project and the means of its financing. This selection of the criteria led to the identification of 48 support measures for further detailed analyses (Table 2).

Awareness creation and science education – Human Resources, as well as priority 4.2.2 support to organisational innovation including e-business, new forms of work organisation, etc. – the “Enterprises” strategic area of intervention.

Table 2. List of public support measures under detailed analysis by country

Country	Area of strategic intervention			
	1. R&D strategy 1.2.1. Strategic technology policies	2. Research and Technologies 2.1.1. Excellence, relevance and management of research	3. Human Resources 3.2.1. Recruitment of researchers	4. Enterprises 4.3.1. Support to innovative start-ups incl. gazelles
Switzerland	National Centres of Competence in Research	National Research Programmes	Lead-Agency Process	CTI Start - up
Sweden	Designed Materials incl. Nanomaterials	Strategic Research Centres	VINNMER	VINN NU
USA	National Network for Manufacturing Innovation	Star Metrics	NIH Director's Pioneer Award	Small Business Innovation Research Programme
Netherlands	Technical-Scientific Attaches	Open Technology Programme	Rubicon	Valorisation Grants
Great Britain	Foresight Programme	Collaborative Research and Development Programme	Collaborative Awards in Science and Engineering	UK Innovation Investment Fund
Germany	Entrepreneurial Regions	Thematic R&D Programmes	Validation of the Innovative Potential of scientific research*	High-tech Start-up Fund
France	ANR Thematic Programmes	Research and Higher Education Clusters	CIFRE convention	Technological Fund of Funds
Czech Republic	Programme BETA	Inter Non-Governmental Organisation INGO II	RETURN	START OP Enterprise and Innovation Programme
China	Innovation 2020	Programmes: 863, 973	111 Plan	National Key New Products Programme
Russia	Technology Platforms	Development of Science and Technology in 2013–2020	Scientific personnel of the innovative Russia	Start
India	Technology Development and Demonstration Program	The New Millennium Indian Technology Leadership Initiative	INSPIRE	Techno-entrepreneurs Promotion Programme
Poland	Support to networks of intermediary organisations providing innovation services at national level	Innotech (In-tech/ Hi-tech)	KadTech	New Connect

* In Germany no measure addressed the 3.2.1 priority; therefore, a measure was chosen that referred to the 3.1.1 priority.

Source: Author based on <http://erawatch.jrc.ec.europa.eu>

2.3. Conclusions from the analyses of innovation support measures

The three most prevalent categories of support measures implemented in the analysed countries, in terms of the amount and the level of funding, include the following:

- Thematic, multi-year public research programmes financing projects according to the principles of competitiveness (in contrast to the institutional support providing funding for statutory activity);
- R&D programmes jointly executed by scientific institutions and enterprises; and,
- Grants and loans for businesses with their own R&D infrastructure (direct support).

Taking into consideration the level of expenditure on R&D and innovation, the measures directed at raising awareness, disseminating information, providing advice on innovation management, and building a network of support institutions (intermediary organisations in the transfer of innovation), constitute a relatively limited share of the budgets of financial institutions. Similarly, skilled labour (particularly scientific and R&D staff) – a factor crucial for innovation development – is not sufficiently reflected in the structure of R&D expenditure in the analysed countries, where the mechanisms facilitating the development of skills are just a fraction of the total number of support instruments (which may indicate a failure of this aspect of the innovation policy in the surveyed countries).

The latest trend is to shift the support from individual institutions to projects by several entities, since the outcomes of these undertakings are considered to be more innovative and likely to generate added value (i.e. in form of large scale commercialisation). However, grants are still the most common form of financing innovative projects by enterprises, with a noticeable increase in subsidised loans. Instruments for the support of the development and implementation of organisational and marketing innovations, or technologies based on industrial design or enabling the creation of new markets have also recently gained in popularity⁵. The creation of innovative start-up companies, venture capital funds, and technology transfer mechanisms aimed at the commercialisation of R&D results remain an important priority.

⁵ Currently, more and more companies build their competitive advantage not based on signals from the market, but by creating an entirely new market. The following two strategies are used: (1) incremental innovations, where business people (in collaboration with scientists, designers, artists, suppliers and other enterprises) look for new uses for existing solutions (e.g. Swatch watch as an item of clothing), and (2) breakthrough innovations, where business people propose a combination of radical technological innovations with radical areas of application (Apple and the family of its products using the mp3 technology: iTunes, iPod, iTunes Store). Therefore, publications on R&D activities also start to include the design as an important aspect of these processes. Quoting Verganti [23].

The support instruments in the analysed EU Member States are typically valid for about 7 years, while in the USA this is 16 years. In more innovative and competitive countries, this period is longer than in less developed countries, which may be the result of the more mature and advanced national innovation systems and innovation policies implemented in them.

The analysis of support measures in the countries surveyed indicated rather stable R&D and innovation policy (particularly in the countries at the similar level of economic development), confirming that the introduction of noticeable changes requires either more time or stronger stimulus for the reform. The most important changes were introduced in Poland and the Czech Republic (the result of the accession of these countries to the EU and the access to the Structural Funds), China, India, and to a lesser extent, Russia (the result of the dynamic economic development in these countries).

The analysis also reflects a moderately uniform approach of the decision-makers as far as the type of support measures are concerned, despite occasionally significant differences in the level of the economic development between individual countries. On the one hand, this is due to the adoption and implementation of objectives common for all the countries analysed, i.e. improving the level of competitiveness and innovation performance; on the other hand, this is a result of the efforts undertaken to duplicate best practices regarding the implementation of these support measures, which proved to be successful in cooperating countries (or whose introduction stems from the membership in a particular political and economic structure, like the EU). The adoption of such a direction in the innovation policy often is equivalent to neglecting specific social, economic, and cultural conditions of the country and the related challenges to innovation policy, and means that the expected results of the introduced support measure are not achieved⁶.

However, despite some common features that are characteristic for the innovation support measures in the countries analysed, five models of innovation policy were in fact identified (Table 3).

In Switzerland, Sweden, and Germany, the emphasis is on R&D programmes executed in cooperation between the science and the business sector, and venture capital, while little attention is paid to tax allowances and reliefs.

In the Netherlands, Great Britain and France, the innovation policy is directed towards transfer and commercialisation mechanisms for innovations developed in the R&D sector (mainly to justify public expenditure on R&D),

⁶ For example, in India, the results of many national research programmes did not meet socio-economic needs of the country. The share of the private sector was minimal, and most of the programmes were managed by the government, often inefficiently and ineffectively supervising complex innovation support programmes. Quoting Santarek [2012].

support for entrepreneurship, venture capital, and indirect support measures (i.e. tax allowances and reliefs for enterprises).

Table 3. Innovation policy models

Country	Model
Switzerland Sweden Germany	R&D cooperation between science and business
Netherlands Great Britain France	Commercialisation of research results
USA Czech Republic	R&D and innovations in the business sector
China	Excellence in the science sector
Russia India Poland	Intensification of public and private R&D

Source: Author based on Izsák et al [2013].

In the USA and the Czech Republic, direct support measures play a key role, particularly those aimed at the support of R&D activity in the business sector (i.e. tax reliefs). It is quite striking that both a technology leader country and a country at a much lower level of economic development have introduced a similar set of innovation support measures. The support for the business sector in the United States stems from the prevailing need to stay ahead of the competition. In the Czech Republic, on the other hand, it is connected to the opinion that the improved competitive position of a country can be achieved through the increased intensity and complexity of R&D carried out in enterprises, as well as the enhanced technological advancement of the business sector.

In China, the intensification of R&D in both the public and the private sector is important, but with more emphasis put on the first one, particularly due to the specificity of the economic system in this country. A lot of attention is paid to the establishment of innovation clusters bringing closer the science and the business sector, and the financial participation of enterprises in the R&D activity of the public sector. In the case of China, the dependence on foreign technologies is also significant.

In Poland, Russia, and India, the focus is on boosting the intensity of R&D in the public and the private sector alike; however, the latter is considered more important. The main support instruments for the business sector include tax allowances for R&D activity and the implementation of new technologies. The greatest weakness of the innovation systems in question lies in the limited participation of the private sector in the financing of innovative R&D

undertakings. Increasing the demand for the commercialisation of the research results is often achieved through creating new or integrating the existing large state-owned enterprises (mainly in Russia). Such action calls into question the direction of the policy and raises the question of the legitimacy of filling the innovation demand gap in the business sector by the state structures.

Summary

Economic competitiveness needs to be analysed in terms of international investments and export and in terms of the capability to provide support for the business sector and creating suitable conditions for the generation of economic value, i.e. through appropriate innovation policy tailored to the socio-economic conditions of a country.

The author showed that innovative policy is an important part of the National Innovation System (NIS) and there is a strong correlation between it and other components of the NIS, for instance, the education and finance systems and the structure of the industry jointly shape the intensity with which companies engage in the R&D activity, which in turn shapes their innovation policy.

Therefore, the quantification of the direct impact of a specific support measure on the overall condition of the innovation system is difficult. Moreover, the positive results obtained from the properly designed and effectively implemented set of support measures may be neutralised by unfavourable market conditions, and *vice versa*, the result obtained in the area of innovation may be the result of favourable market conditions, not the support measures applied.

The mission of decision-makers responsible for innovation policy is to provide such a set of measures that would be in line with other elements of the NIS. At the same time, the selection of measures is a continuous learning process, because national innovation systems are in fact dynamic structures, where NIS strengths and weaknesses shift as a result of the effects obtained with the use of specific measures, which in turn calls for changes in the structure of the implemented support measures.

The dynamism and the specificity of the economic conditions explain why no optimum models of innovation policy and support measures are presented in publications on the issues of national innovation performance and competitiveness [11].

Concurrently, the globalisation of markets and closer international cooperation between the actors of the NIS show a new direction for innovation policy in which internationalisation measures will play a crucial role, rather than an inward-oriented policy mix.

The results of the analyses set the direction for further research, which include, among others, the development of recommendations for Poland to introduce new innovation support measures or to modify the currently used innovation support measures.

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Rola polityki innowacyjnej w podnoszeniu konkurencyjności gospodarki

Słowa kluczowe

Polityka innowacyjna, instrumenty wsparcia, narodowy system innowacji.

Streszczenie

Poszerzające się współzależności między krajami w decydującym stopniu wpływają na międzynarodową konkurencyjność gospodarki narodowej. W tym kontekście kluczowe znaczenie zyskuje umiejętne kształtowanie polityki innowacyjnej państwa. Istotne jest takie ukierunkowanie polityki innowacyjnej, które powinno prowadzić do wykorzystania szans rozwojowych związanych z aktualnymi oraz przyszłymi przewagami konkurencyjnymi gospodarki. W związku z powyższym przedmiot analiz w artykule stanowią publiczne instrumenty wsparcia wykorzystywane w celu intensyfikacji procesów innowacyjnych w wybranych krajach Unii Europejskiej (w tym w Polsce), a także Stanach Zjednoczonych, Chinach, Indiach oraz Rosji.