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The Role of Scientific Advice in Innovation Policy Making[1]

Introduction

Many of the policy issues that governments need to consider in their economic development plans strongly depend on the input of scientists. Scientific advice, risk assessment or management guidelines for policy makers can change the policy profiles and their impact on the economy and society. How does a science system supporting policy design and implementation work? What kind of measures can strengthen the science base for policy making? How can governments support science in research aimed at providing evidence needed for the implementation of an evidence-based policy approach? All these issues have been addressed by both national and regional governments, and they are also included in the innovation policy agenda of the European Union. One of the objectives of the bloc's Innovation Union initiative, which is the flagship initiative of the Europe 2020 strategy, is to strengthen the science base for policy making in the EU. Thus, great emphasis is placed on the role of science in providing the input for designing and implementing policies at both the European and country levels.

This paper aims to explain the rationale behind the stronger involvement of science in the policy making process and to identify the channels through which science contributes to devising comprehensive and pro-active research and innovation policies. This paper is of a conceptual nature. The main research question addressed is: what is the conceptual framework for assessing the impact of science-based policies on innovation?

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1. Why is it necessary to strengthen the science base for policy making?

Why should the science base for policy making be strengthened? The idea of bringing science to solve society's problems through providing evidence for policy has its roots in the works of the likes of Plato, Aristotle, Bacon, and Descartes (Sutcliffe and Court 2005, p. 1; Andrews 2007, p. 161). The growing role of science in public policy analysis is stressed by numerous scholars (see for instance: Ehrenberg 1999; Pielke Jr. 2007; Wilsdon 2014) as well as policy makers (House of Commons Science and Technology Committee, 2006; Wilsdon, Allen and Paulavets, 2014; Stiftung Mercator, 2015). Given adequate resources, science uses induction and deduction, gathers information and evidence, and goes through detecting patterns in evidence to formulating conceptual explanations, which can be a basis for policy recommendations (Wallace 1971, p. 18). As Andrews (2007, p. 161) points out, "any 'good' society will take advantage of new knowledge to promote progress."

The demand for scientific advice has been growing and questions that are being asked to scientists and other experts by policy makers, as well as by the whole society, range from climate change to energy choices to food safety, healthcare and poverty.

2. The role of science in the policy-making process: a literature review

Policy decisions should be rational and reasonable, and the focus of contemporary policies should be not only on economic value, but also on social and public value (Andrews 2007). Such a definition of policy goals opens up new perspectives in the debate on the role of research in policy making and broadens the spectrum of the potential impacts of science-based policies on innovation. However, such a debate should start with the conceptualization of the policy-making process to determine how science can be used in this process and what implications different models and types of scientific advice can have on innovation. All this will be analyzed in depth in the next sections of this paper.

2.1. Models of the science-policy interface and types of scientific advisory bodies

The policy-making process is always considered as a sequence of stages. Jann and Wegrich (2007) offer a simplified framework that can be useful for impact assessment analysis. They distinguish four basic stages of the policy cycle (Jann and Wegrich, 2007, pp. 45–53):

1) agenda setting: problem recognition and issue selection;
2) policy formulation and decision making;
3) implementation;
4) evaluation and termination.

This framework is used in analyses of evidence-based policy, and scholars agree that different types of evidence are needed in different parts of the policy cycle (Sutclife and Court 2005; Pollard and Court 2005; Fischer *et al.* 2007; Sutherland *et al.* 2012; Cairney 2012). These studies show that science can be useful in all stages of the policy cycle, and this conclusion implies that the impact of science on policy making can be different depending on the stage of the policy cycle in which the science input is used. However, the question is how the science-policy interface should be organized to achieve the expected impact on policy outcomes and to meet the needs of society. Therefore the models of the science-policy interface are important.

The theory of public policy distinguishes several models of the science-policy interface. The three basic models distinguished by Habermas (1971, p. 69) are:

1) the decisionist model,
2) the technocratic model,
3) the pragmatic model.

The decisionist model allows policy actors to play the main role in formulating and implementing policy objectives. Researchers focus only on exploring the means that are appropriate to solve problems. They propose means to achieve objectives set by policy makers.

The technocratic model assumes that researchers should not only address the means of achieving policy objectives, but should also set these objectives. Therefore, scientists are responsible for setting policy objectives and tools, while policy makers only deal with their implementation. Scientific knowledge is the basis for policies, and researchers can even propose policy blueprints.

The pragmatic model is based on interactions between science, policy representatives and stakeholders. Researchers and policy makers provide their input to both policy objectives and means, and these ideas should be discussed democratically with the involvement of stakeholders and society.

This classification has been discussed in many studies (see for instance Kirkpatrick 2013; Edenhofer and Kowarsch 2015) and some new elements have been added. Kirkpatrick (2013, p. 23), in his study of different models of science and policy interactions, builds on Habermas' (1971) three theoretical models and proposes a fourth model, i.e. the pragmatic-enlightened model, originally developed and tested in environmental policy assessment by Edenhofer and Kowarsch (2015). This model is based on the assumption that there is an interdependence between policy objectives and means, and that they cannot be evaluated separately. Therefore both means and objectives should be evaluated and revised in the democratic debate with the involvement of scientists, policy makers and stakeholders taking into account the direct effects and co-effects of the means (Edenhofer and Kowarsch 2015). Thus, under this model, before the final version of a policy is designed and implemented, broad and transparent public dialogue takes place.

Another approach to distinguishing models of the science-policy interface is based on the role of scientific evidence in the policy-making process. Such a classification distinguishes the following five models (assumptions), which differ in plausibility and sophistication (Young et al. 2002, p. 216):

1) knowledge-driven model, in which research determines policy choices (research leads policy);
2) problem-solving model, in which policy issues shape research priorities (research follows policy);
4) interactive model, which assumes that research and policy interact with each other in order to shape agendas for both research and policy decisions; thus policy and research are mutually influential;
6) political/tactical model, assuming that policy is an outcome of a political process and research studies supporting solutions adopted by the government are commissioned by governmental bodies;
8) enlightenment model, in which research is not directly involved in current policy problems (research only informs policy about evidence).

All these models have some limitations, which might affect the impact of science on policy and the economy. The knowledge-driven model and the problem-solving model assume that there is a linear relationship between research and policy decisions, but the direction of influence is different. The limitations of these two models may arise from insufficient scientific evidence or its limited relevance to the key problems of society. In the interactive model, it is difficult to discern how strong the relation between science and policy is, and which side (policy or science) has the leading role. Therefore it is nearly impossible to measure the impact of science on policy and the economy. In the political/tactical model, the constraint is the politicization of science, which can affect the science impact. In the enlightenment model research conducted for policy purposes can help set the stage for policy making, so the effects of science on policy and the economy mainly appear indirectly (Young et al. 2002, p. 217).

The models of the science-policy interface determine the role of scientists in the policy-making process. According to Pielke Jr. (2007, pp. 1–5), there are four roles that scientists can play in the policy-making process. The first one is that of “pure scientist,” who can provide some scientific information on request, but does not want to be involved in using this information. The second role is the “science arbiter,” who serves as a resource for policy makers and shows policy options available to solve the problem, but does not tell what is preferred. The third role of a scientist in policy making is that of an “issue advocate,” when the scientist tries to convince policy makers to choose one of many alternative solutions to a problem. The fourth role is that of an “honest broker” who provides policy makers with relevant and comprehensive information. As Pielke Jr. observes, honest brokering is usually best achieved through a group of experts working together with different knowledge, experiences, and views. Similar to the role of the "issue advocate," scientists who are "honest brokers" are explicitly engaged in decision alternatives as they offer policy choices and suggest a variety of options (Pielke Jr. 2007, p. 4).

However, it is important to understand the role of science in the policy-making process as it may shape the impact of science-based policies on innovation.

How does a specific model of the science-policy interface influence the way in which science impacts on policy and an economy? A good example is the case study of "mammography wars" by Kirkpatrick (2013). It showed that a shift from technocracy to a pragmatic-enlightened model whereby incorporating the public to shaping health policy increased its impact on society. This finding has been confirmed by Edenhofer and Kowarsch (2015) for the impact of environmental policy on the economy.

To sum up this analysis of the models of science-policy interactions and their implications for the economy, it should be noted that most scholars agree there is no linear relationship between research results and policy outcomes regardless of the science-policy interface model (Marston and Watts 2003; Wilson et al. 2008; Newman et al. 2012; Wilsdon and Doubleday 2013 and 2015). Therefore, the role of science in policy making and the impact of science-based policy on innovation and competitiveness should be based on the assumption of non-linear interrelationships between them.

Furthermore, there is a wide diversity of structures under which scientific advice is organized. The size, type and power of a scientific advisory body can determine the impact of science on policies and thus on innovation and the economy as a whole. The institutional set-up of the advisory process depends on the cultures and traditions of countries (Bijker et al., 2009). Wilsdon (2014, p. 7) classifies scientific advisory bodies according to the area of advice and the level at which it is offered. The following advisory structures can be distinguished:

1) advisory councils, such as a high-level council for science and innovation policy, which usually consists of senior scientists and representatives of industry and civil society;
2) advisory committees addressing detailed technical and regulatory issues in areas sensitive for societies, such as the environment, health, food safety, and security;
3) national academies, learned societies and networks advising for different policy types, including science and technology policy;
4) chief scientific advisors that provide scientific advice for the whole government or individual departments.

However, this is not a complete list as it does not take into account in-house research conducted by governmental agencies.

The OECD (2015, p. 13) offers a comprehensive classification of major types of scientific advisory bodies in the field of science and innovation policy. They can work under four basic organizational structures:

1) advisory councils or committees, which are usually deliberative bodies embedded in the government or having independent status with governmental mandate;
2) permanent or ad hoc scientific/technical advisory structures, which might be either in-house research organizations or operate independently outside the government;
3) national academies, professional societies and research organizations, which consist of researchers representing scientific communities and bringing in scientific evidence on different issues, either at their own initiative or in response to questions asked by the government;
4) individual scientific advisors and counselors, appointed formally or giving advice through informal networks.

The potential policy impact of scientific evidence and advice can be diverse, depending on the nature of the advisory body's mandate (OECD 2015, p. 23). Different types of scientific advisory structures produce various outputs, such as reports, protocols, scenarios, forecasts, and research papers. Their impact on policy making and thus on the whole economy may vary depending on how they are incorporated into the policy-making process (Bijker, Bal and Hendriks 2009). Therefore coordination between different structures is needed (Wilsdon 2014, p. 3) and the impact of science on policy and the economy may depend on the strength and effectiveness of this coordination.

2.2. Science for policy and policy for science

The role of scientific experts in the policy-making process can have a narrow or broader scope. They provide advice on science and technology policies (including involvement in determining budgets and the structure of research and the innovation system), in what can be defined as a "policy for science" approach. A broader scope of scientific advice for policy making means providing scientific advice on regulatory or general policies, an approach that can be described as "science for policy" (Wilsdon 2014, p. 3; OECD 2015, p. 13). A clear distinction between these two areas cannot be always made, but when measuring the impact of science on policy it is important to remember that the advisory and requirements for decision-making processes might be different in both cases.

How to ensure a flow of high-quality knowledge in the policy-making process? Not only quality but also the selection of the research method can be important for research outcomes and their impact on the policy-making process (Stromsdorfer 1985; Nutley 2003; Packwood 2002; Shaxson 2005; Newman et al. 2012). There are several important components of scientific evidence robustness identified in the literature: credibility, generalizability, reliability, objectivity, and rootedness (Shaxson 2005). These features can be explained and interpreted within the framework of the public policy theory. Credible scientific evidence for policy making has a clear line of argument in order to be sure that conclusions are based on reliable analysis and synthesis of the literature and data. Generalizability refers to the wide or contextual applicability of research results. Reliability in science-based policy means the ability to use evidence for the monitoring and evaluation of policy actions. Objective evidence is not influenced by assumptions of values and rootedness, or authenticity; it is about being open minded and taking into account the nuances of the evidence (Shaxson 2005; Wilson et al. 2008; Newman et al. 2012).

Furthermore, sound and robust evidence for policy is not enough to guarantee its high impact on the economy. Another aspect of the role of a scientific advisor in shaping policies is to go beyond the scientific content of a particular problem and provide information about methodological issues and concepts underpinning scientific evidence as well as about research limitations (Wilsdon 2014, p. 3).

Another important factor is the appropriate use of scientific evidence. Rational utility-maximizing decisions by policy makers may deliver socially irrational collective outcomes (Griggs 2007, p. 174). Therefore, the theory of public policy underlines three elements that are crucial in the policy decision-making process: rationality, networks, and learning (Fischer 2003; Fischer et al. 2007; Morçöl 2007; Brand 2012).

In particular, the dialogue between different groups of actors–researchers, policy makers, experts, and business representatives–leading to policy learning and improvements in producing and using research evidence is necessary at all stages of the policy cycle (Wilsdon et al. 2008, p. 9). In this context, it seems that the impact of the science base on policy and thus on the economy is shaped by the quality of evidence for policy making produced by science as well as by its rational application in the policy-making process.

3. The functions of science-based policy

A review of public policy theories supported by some empirical studies (Shaxson 2005; Fischer et al. 2007; Da Costa et al. 2008; Fobé and Brans 2011, 2013; Cairney 2012; Wilsdon 2014) makes it possible to identify the basic functions of science in policy making:

- Informing policy, i.e. providing scientific evidence on how different policy options can impact the outcomes; producing insights regarding trends and challenges; creating new ideas and policy options; transmitting information and evidence to policy makers as an input to policy conceptualization and design;
- Facilitating policy implementation, i.e. building a common awareness of the current performance of countries/sectors, etc. as well as future challenges; furthermore, “science diplomacy,” networking and collaboration can be used in the pursuit of shared science and policy goals;
- Facilitating participation in policy making, which means that scientific evidence can influence the public opinion, increase stakeholder involvement, and improve policy transparency and legitimacy;
- Evaluating policy efficiency, i.e. assessing how different policies impact outcomes;

- Reshaping future science and policy agendas as well as shaping R&D budgets. This function means that a policy-making process that brings together scientific advisers, policy makers and practitioners makes it possible to share ideas and better structure future science and policy agendas strengthening the exchange and learning across different systems; moreover, R&D budgets can be altered as a result of scientists' policy recommendations (in the case of "policy for science");
- Reconfiguring the policy process, which means that new scientific methods can be applied to policy analysis in order to better address challenges;
- Symbolic science function assuming that scientists can influence society's values and trust, in particular create confidence in the policy rationale by communicating the evidence base to the public.

4. Summary and Conclusion

The aim of this paper was to identify factors that should be taken into account in order to explain the role of scientific advice in policy making.

This paper shows that effective policy development requires a high-quality and effective system of scientific policy advice as well as appropriate use of evidence and advice by policy makers. There are at least two strands of scientific advice that can improve policy making. The first one is related to solving current economic and societal problems, and is often referred to as evidence-based policy. The second strand is foresight exercise, which is aimed at foreseeing future development trends, identifying future problems and addressing them with appropriate policy tools. Both strands can be viewed as a broad category of science-based policy. Furthermore, there is a growing recognition in the literature that identifying solutions to policy challenges often requires research going beyond one discipline. In such cases a multidisciplinary or interdisciplinary approach to science-based policy is needed.

The theory of public policy underlines the following factors that can determine the impact of science-based policies:

- Content of scientific input (quality of evidence and its relevance),
- The appropriate use of scientific evidence and rationality of its application,
- The organizational aspects of the policy advice process: the stage of the policy cycle in which science input is used, the model of the policy-science interface, the size, type and power of the scientific advisory body, and the nature of the advisory body mandate.

Most scholars agree that there is no linear relationship between research results and policy outcomes.

There are many factors that can determine the impact of a greater involvement of science in policy making on innovation.

First, it is important to know whether and where scientific knowledge is needed in the policy-making process.

Second, there can be different models of the science-policy interface, from the so-called decisionist model to a pragmatic one (Habermas 1971), and the model defines the role of science in the policy-making process. There is also a variety of structures and bodies for scientific advice identified in the literature on public policy, such as planning and forecasting bureaus, strategic advisory councils, specialist and technical advisory councils, sector councils, independent experts, and governmental research institutes (Bijker et al. 2009). Furthermore, the type of advisory body often implies the function that science can have in the policy-making process. These functions range from planning and scenario building, through policy assessment exercise to think-tank advice.

Third, the scope, quality and relevance of research underlying policy decisions can determine the impact of science-based policies on innovation.

Fourth, the channels through which scientific advice to policy makers can influence innovation should be identified as they might matter for the scope of this impact.

And last but not least, it is important to identify the type (area) of the impact of science-based policies on innovation.

All the above mentioned factors determining the impact of science-based policy on innovation should be taken into account to conduct empirical research on the potential impact of scientific advice provided to policy makers on innovation.

The conceptual framework provided in this paper will be used in further research on this topic, which will focus on evaluating the role of science-based policies in boosting innovation in European Union member states. The empirical analysis will be based on a survey conducted among policy makers in all EU member states representing national and regional governments. The evaluation of the impact of science-based policy on innovation will cover the three key factors identified in this paper: (1) the content of policy advice, (2) the use of scientific evidence, and (3) the organization of the policy advice process. Further empirical research will also make it possible to determine how the impact of science-based policies is related to the model of policy-science interactions as well as the stage of the policy cycle at which scientific advice is used.

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ROLA DORADZTWA NAUKOWEGO W KSZTAŁTOWANIU POLITYKI INNOWACYJNEJ

Streszczenie

Celem artykułu jest wskazanie czynników, które należy uwzględniać przy wyjaśnianiu roli doradztwa naukowego w kształtowaniu polityki innowacyjnej. Artykuł pokazuje, że kształtowanie efektywnej polityki w dziedzinie badań naukowych i innowacji wymaga istnienia sprawnego i wydajnego systemu doradztwa naukowego oraz właściwego wykorzystania tego systemu przez polityków. Wpływ opartej na naukowych podstawach polityki innowacyjnej na innowacyjność gospodarki zależy od: a) zakresu i jakości badań naukowych, b) właściwego i racjonalnego wykorzystania osiągnięć nauki, c) organizacyjnych aspektów systemu doradztwa naukowego.

Słowa kluczowe: badania naukowe, innowacje, polityka innowacyjna, doradztwo naukowe

JEL: O30, O38

THE ROLE OF SCIENTIFIC ADVICE IN INNOVATION POLICY MAKING

Summary

The aim of this paper was to identify factors that should be taken into account in order to explain the role of scientific advice in innovation policy making. This paper shows that effective policy development in the area of research and innovation requires a high-quality and effective system of scientific policy advice as well as appropriate use of advice by policy makers. The impact of science-based policies on countries' innovation performance depends on (a) content of scientific input (quality of evidence and its relevance); (b) the appropriate use of scientific evidence and rationality of its application, and (c) the organizational aspects of the policy advice process.

Key words: research and development, innovativeness, innovation policy, scientific advice

JEL: O30, O38

РОЛЬ НАУЧНОГО КОНСУЛЬТИРОВАНИЯ В ФОРМИРОВАНИИ ПОЛИТИКИ В ОБЛАСТИ ИННОВАЦИЙ

Резюме

В статье указываются факторы, которые следует учесть в анализе роли научного консультирования в формировании политики в области инноваций. Автор утверждает, что формирование эффективной политики в области научных исследований и инноваций требует наличия эффективной системы научного консультирования, а также надлежащего использования этой системы политиками. Влияние опирающейся на научные основы политики в области инноваций и инновационный характер экономики зависит от: а) диапазона и качества научных исследований, б) надлежащего и рационального использования достижений науки, в) организационных аспектов системы научного консультирования.

Ключевые слова: научные исследования, инновации, политика в области инновации, научное консультирование.

JEL: O30, O38