

SOCIAL APPROPRIABILITY OF SCIENTIFIC AND TECHNOLOGICAL KNOWLEDGE

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Contents

1. Introduction
 2. The Existing Approaches
 - 2.1. The linear innovation model approach
 - 2.2. The approaches in the field of economics of innovation
 - 2.3. The analysis of intellectual property and patenting
 - 2.4. The sociological approaches
 3. The integration of social knowledge
- Bibliography
Biographical Sketches

Summary

The study of social appropriability of scientific and technological knowledge is important in understanding technological innovation. Current definitions of «appropriability» –based on a notion of scientific and technological knowledge as intangible goods– focus on the capacity of an economic agent to appropriate the benefits generated in the process of application of this knowledge. Several sociological, political, economic and the legal approaches also address the theme of «appropriability». The article shows that it is necessary to understand appropriability as a social, polysemic and multidimensional phenomenon.

1. Introduction

The study of social appropriability of scientific and technological knowledge is important in understanding the role played by scientific knowledge in modern societies. Current definitions of appropriability of scientific and technological knowledge are aimed at explaining the capacity of certain economic actors to take advantage of the benefits generated by the application of knowledge, usually conceived of as an «intangible good».

However, as a social phenomenon, the appropriability of scientific and technological knowledge should be understood in a more complex way. The production of scientific and technological knowledge includes some kind of representation of its real or potential use. At some stage during the decision-making processes, a real or potential external actor, capable of appropriating the knowledge produced, is being constructed. This is particularly true when drawing up research agendas, selecting lines and objects of research, structuring R&D institutions and work teams.

By adopting new heuristic and analytical tools from the sociology of science and the sociology of technology, it is possible to develop a methodological framework that will answer such questions as:

- How do significant social actors (research groups, policy makers, businessmen, technicians, end users) interact in drawing up agendas ?
- How do actors other than research groups participate in the construction of research agendas ? How do they take part in the generation of scientific and technological knowledge ?
- What impact does the set of socio-cognitive factors, which condition research groups' specific choices, have on the dynamics of knowledge *transfer*?
- What is the impact of « social appropriability » during the research process?

2. The Existing Approaches

It is possible to distinguish different (and not mutually exclusive) ways of addressing the issue of the social appropriability of scientific and technological knowledge: the linear innovation model, the approaches in the economics of innovation, the analysis of the technological innovation dynamics in differentiated economic sectors, the management of intellectual property rights and the sociological analysis of relationships between science and society.

2.1. The linear innovation model approach

Thinking about science and technology has been largely dominated by a linear model that connects scientific research to the market (the so-called *science-push* model). The very notion of a «science-push» model is to be found in Vannevar Bush's famous report, *Science-The Endless Frontier* (1945). According to this model, the development of productive innovations and the appearance of new technologies on the market follow a temporal sequence that begins in research activities, goes on to a phase of product development that leads in turn to the production and marketing of innovative goods.

This linear innovation model which grounds innovation on basic research involves a particular conception of the appropriability processes. Transferability of scientific and technological knowledge is assumed to be guaranteed by a mechanism of free circulation on open markets or by the implementation of policies fostering technological diffusion. Producers' interests in the new high-quality knowledge are taken for granted.

By the end of the 1960s, a new conception arose: the *demand-pull* model. It was stressing the role of the demand in directing technological change and motivating scientific research. By inverting the linear causality, the terms of the sequence are kept intact. The internal logic of the *demand-pull* model takes for granted the transferability (and appropriability) of scientific and technological knowledge under conditions of explicit demand.

Both models reached a *normative status* that remains in force to the present day. Indeed, the science push and demand pull models continue to be widely used despite changes in orientation in Science and Technology Innovation Policies implemented since the end of the 1980s. Moreover, the «science» push model is a part of the scientific community's common sense. It also permeates the common sense of many policy makers, mainly in the analysis and policies proposed for «knowledge transfers» between R&D units and productive firms.

The simplicity of the linear models underestimates the real complexity of «transferability» and «appropriability» of knowledge. According to the linear conception, policy planning is the major responsible for the quality of knowledge transfers, including the adaptation of a technology to the local context, the awareness of limitations, the scope of implementation, and so on. It is probably an overstatement of the real capacities of the public sector (See *Policy Making Process in Science and Technology*). Perhaps the crucial problem stems from the fact that the linear model opposes the «supply» side (the spillovers from R&D institutions) to the «demand» side (firms' capacity for absorption and catching up) as if they were two completely different poles. The question of appropriability is thus reduced to that of the difficulty in creating the supply for knowledge in the marketplace and the closeness of demand from productive firms that would be their users.

2.2. The approaches in the field of economics of innovation

When studying the dynamics of technological innovation, the issue of appropriability of knowledge is stated in economic terms. Appropriability is defined as the capacity of a firm to appropriate the profits generated in the process of production and distribution of goods and services. In micro-economic theory, research is depicted as an activity that is the result of an investment decision, oriented toward the maximization of the firm's profits. The critical element for this decision is the return on investments. Since neoclassic economy considers scientific and technologic knowledge as free goods, appropriability is not a relevant concept.

The notion of «social appropriability» of the benefits of research –as opposed to their private appropriability– was introduced in the early sixties, both by R. Nelson and K. Arrow, when they showed that the social return of investment in research exceeds the private returns to individual firms.

Later on, in the new evolutionary or neo-Schumpeterian theoretical framework of the economic analysis of innovation, appropriability of innovations becomes a more significant concept. The degree to which firms can obtain economic returns from

different kinds of innovation, i.e., the degree of appropriability of innovation, is an explanatory element in the understanding of the innovation processes. According to G. Dosi, innovative efforts are a function of both the demand structure and the conditions of appropriability.

Some economists showed the importance of sectorial dynamics in the development of innovations. They examined differences between economic sectors such as mechanical and chemical industries, electronics and informatics, high technology industries, and the like. The differences between sectors are rather marked in terms of time, rates and modalities through which innovations are generated, disseminated and used. They explain these differences as an interplay of factors such as: opportunities for innovation; demand patterns; and regimes of appropriability (understood as the degree in which firms can get economic returns from different kinds of innovation). Along with the nature of the knowledge necessary in each sector, these factors would explain also the differences between various organizational forms, and the characteristics of the innovative research systems.

There exist many ways by which appropriation is implemented: patents, secrecy, period of leadership, costs and copying time, effects on the curve of learning, and sales and services activities, levels of differentiated technical efficiency related to scale economies.

D. Mowery and N. Rosenberg have criticized the neo-classical approach because it explains appropriability exclusively in terms of market failures. The main argument is that, for micro-economic theory, the firm is a «black box» whose structure and internal mechanisms are unknown. Thus, the analysis of appropriation of research results needs to be complemented by an analysis of the conditions affecting the use of R&D results. As Mowery and Rosenberg write in their introduction to the book *Technology and the Pursuit of Economic Growth*: «Utilization of the results of research is heavily influenced by the structure and organization of the research system within an economy, a topic on which the neoclassical theory is either silent or incorrect».

When analyzing the inside of the «black box» of the firm, new dimensions are made apparent. The transferring and use of the technical and scientific information required in the innovation process appears as an intensive knowledge process. The firm's capacity to assimilate knowledge is brought into play. Adopting a new technology, assessing a new technique, introducing a feasible research problem to an external group are actions that require a considerable technical expertise in the firm.

The neoclassic point of view relates to a linear model: technological innovation is perceived as the mere application of scientific knowledge –generated «upstream» –to the designing of new products and the development of new processes –«downstream». Since the analysis focuses on the incentives of firms investment in R&D, the inner structure and the production process are secondary aspects. The theory almost pays no attention to the process through which research is transformed into commercial innovation.

In the neo-Shumpeterian point of view, a successful technological innovation is a process which affects both the technical and economic levels. The present state of technological knowledge is projected forwards to fit a significant category of desire and needs of the consumers. Innovation implies the close cooperation of marketing, R&D, and production activities.

It was E. Von Hippel who incorporated the role of the technology users. He showed that «active users» are a source of innovation. Later on, when the systemic and multidirectional character of the innovation was explored, this perspective converged with that of the learning process involved in the dynamics of innovation. Thus appeared the concept of «learning by interacting» between users and producers, a term coined by Bengt-Åke Lundvall. The interaction of users and producers creates a «vertical network» of knowledge. By considering the role of the users in the generation of technological knowledge, the dynamics of appropriation becomes more complex.

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