Diffusion processes in the knowledge economy in terms of theoretical approaches

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Abstract

The paper deals with various theories of diffusion of information and knowledge as a basis for regional development. The content of theory is to examine how, why and with what intensity is spreading new knowledge, skills, innovation and technological changes in the knowledge economy.

Key words: Diffusion, diffusion theory, knowledge, innovation, knowledge economy.

JEL Classification: R00

1 Introduction

According to several economic analysts asymmetry in access to information, knowledge or externalities is basic to understanding various aspects of regional economy. It is about level of performance development in individual countries or companies; about international differences in growth and level of generation, adoption and diffusion of knowledge, innovation and technology change. The impact of information, knowledge and its dissemination on regional development is significant.

2 Diffusion processes in the knowledge economy

Information is essential for knowledge, its spread and information is crucial in defining the concept of diffusion. According to Arrow [1] information plays a strategic role in optimization of economic activity in the market system. Differences in approach to information impacts on use in price function to allocation, coordination and monitoring of economic activity under optimal conditions. The uncertainty is compatible with competitive equilibrium system, where all players have equal access to the same information under the same condition. If the above conditions are not met, the system shows the price variations. Information access is determined by coordination and transaction costs, while limiting factor is the amount of coordination costs. [2] Information is a strategic input for decision, for production and consumption. From an economic point of view, information and knowledge are commodities, their markets are imperfect [3].

The cognition arises through assimilation and integration of information as a result of process acquiring knowledge. According to Roomer's model of long-time growth, just the cognition is mediated input important to performance development. When a company invests in knowledge, so creates an additional pool of knowledge, which is greater than the sum of its parts and as the overall benefit to the company. [4] Investments increase knowledge and experience and produce higher outcome in public and private sector. All empiric studies and models are based on four theoretical approaches: diffusion theory; adaptability theory; domestic approach; use research of satisfaction.

The article is primary focused on the diffusion theory. Adaptation theories are devoted to the description and explanation of adaptation decisions through several social, cognitive and behavioral approaches to research of relationship between attitude and behavior of individuals. Domestic approach is based on sociology, examines adaptation processes of new Technologies and knowledge in everyday life. It is focused on social consequences of technologies and services. The approach doesn't have limits to study of individual and summary factors. Domestication process has usually five sub processes – imagination, appropriation, objection, integration and conversion [1]. Research on the use of satisfaction is based on media research, sociology and originally was focused on media and mass communications [13]. It is focused on individual user or adapter, who seeks satisfaction in technologies oriented on his individual needs and motivation. This theory is similar to theory of rationality and benefit.

Diffusion theories are focused on research of spread of knowledge, skills, innovation and technology change (what, why, intensity). There were defined basic terms by E.M. Rogers and E.F.Shoemaker in area of diffusion theory [7]. They were described the procedure of innovation spread in time through communications channel and the adaptation model. They find the adaptation is difficult despite of benefits of new discoveries. The adaptation procedure has several steps - appearance, interest, trial, decision, and adoption. Information about users and their willingness to adopt innovation are special importance in terms of diffusion of innovation or technology change**.**

Nelson [8] states that access to information is crucial in improving the country's performance and overall economic growth: economical development process as a diffusion process leads to the rejections of two basic assumptions of neoclassical model – that all firms in all countries have the same production function and that the markets reach equilibrium." It is necessary to explain international and interregional diffusion and impacts for economic strategies and politics.

There is possible to analyze the behavior of participant in diffusion process (supply side or demand side) used the microeconomics models. Diffusion theories of technology and technical innovation are oriented on explanation this phenomen: why, if a technology appears better than another, this is not immediately accepted by all firms.

There are two opposite points of views in terms of international diffusion:

- The older approach (60th years) is focused on microeconomic analytical framework created to product cycle and epidemic model. It is oriented on capacity of country to accept praxis through imitation and on international differences in relative input costs and in prices of new capital goods.
- Later in the mid 80's was developed model which focuses on the adoption of macroeconomic conditions, such as investment demand and technological characteristics of innovations.

Causes of international and inter-firm differences in speed and intensity of innovation diffusion can be viewed from two perspectives:

- aspect of query delay (the time between import and use of final product);
- aspect of imitation delay (the time between using of innovation and creating of new services).

In terms of product cycle the speed and extent of international innovation diffusion depends on capacity, development level of country and possibility to follow advanced models of innovation. The imitation delay is result of three aspect of development [9]:

- *delay of foreign reaction* – the time between first acquaintance with the innovation and its application in production;
- *delay of domestic reaction* – related to the size of domestic market, the time until local producers are relevant part of domestic market;
- *learning period* – the time necessary to understand for successful application of innovation

These approaches have led to formulation of hypotheses about the skip options, i.e. later industrialized countries are able to accept technology innovations faster than earlier industrialized countries and the adaptation capacity can differ from innovation capacity [10]. During the seventies and eighties theory of product cycle was developed by Vernon [11] and Hirsch [12]. They have assumed that outcome level of country, its technology capacity, trade openness; foreign direct investment and diffusion capacity are interconnected.

Basic factors, which affect differences in diffusion size and time, are:
- investments (including all investments decisions);
- creating of critical volume of subjects, who have accepted innovation;
- the supply of products as a result of innovation;
- technology aspects of innovations;
- behaviour of transnational companies.

Economy theory states several diffusion models (f. E. epidemic model, equilibrium model, models called by authors David, Stoneman, Antonelli). It can be identified different levels of diffusion aggregation (picture 1.1):
- internal (intra-firms) diffusion;
- inter-firms diffusion;
- global (general) diffusion.

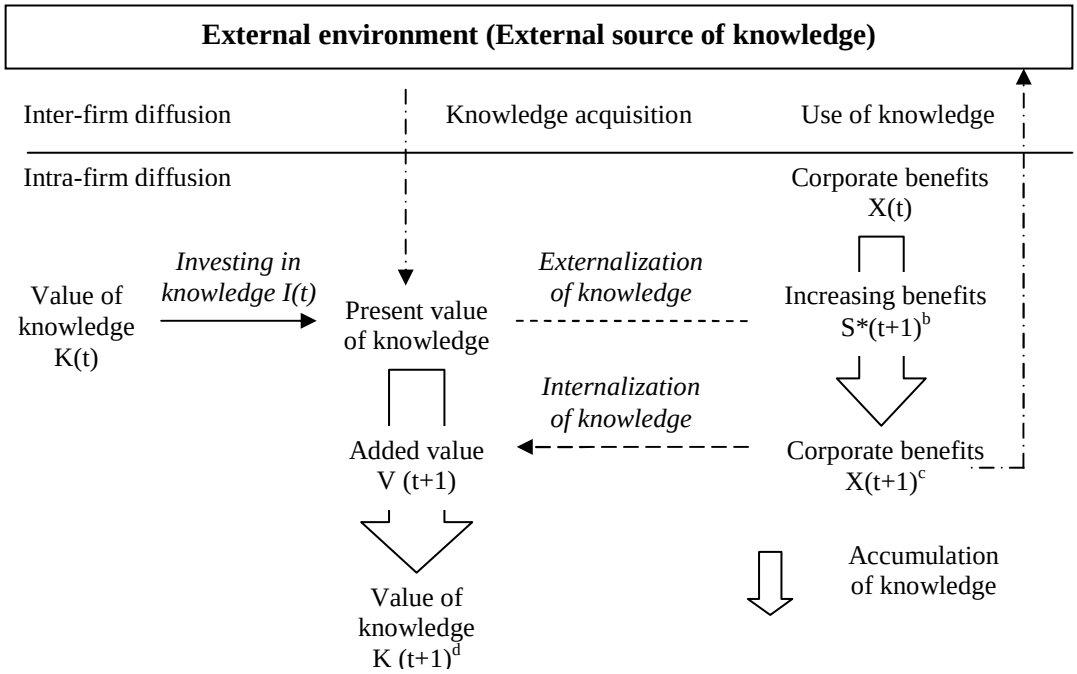

Fig. 1.1 Processes related associated with intra-firm and inter-firm diffusion [14]

Epidemic models (f. E. Mansfield, Griliches) are based on analogy of spread of technology change with spread of disease, i.e. for spread is necessary a contact of individuals. The diffusion is logistic curve (S-curve). Epidemic model of diffusion does not take into account

factors: return of investments in time (as an impact of dynamic processes supply side); changes of population, interest of innovation, economic situation etc.

The localization of technology change is of special importance. Approaches to localization of technology change can be divided in orthodox and heterodox. The orthodox approach is based on the assumption, that the change is generated through processes of acquisition of new technique and technology (i.e. the processes of „learning"). Heterodox approach is based on the acceptation the decision on information and on rationality due the information asymmetry. The companies adopt those changes that are appropriate for economic environment and that are in relation to actual techniques and technologies.

Localized technology change is a result of two factors:
- Activity in acquiring the new techniques and technologies (i.e. factor of "learning").
- Costs factor of the application of new techniques and technologies given the technical limits and compatibility (physical and personal).

The most important impacts of localized change are:
- Increase of technical and technological heterogeneity between firms – the techniques and technologies are different available for the firms (because firms have different costs structure, different skills, personal structure, different size etc.);
- modification of the market structure and the change of conditions for capital mobility and for market entry.

In 1985 the agency EPA in Japans have developed a concept of **„information activity index"** for the analyzing of information impact to national economy and to regional economy. This index is based on identifying of information activities according to sectors and according to professions.

3 Conclusion

Diffusion of knowledge is an important aspect of regional development. It is object of many theoretical and empirical studies. There are many models describing spread of knowledge not only in economy but also into firm. Diffusion of knowledge or new technology is complex process and depends on several factors (f. E. the size of company, willingness to learning, electivity of communication, personal capacity etc.).

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References

[1] ARROW, K.J. 1969. The Organization of Economic Activity: Issues Pertinent to the Choice of Market versus Non-Market Allocation. In the *Joint Economic Committee* 31st Congress, The Analysis and Evolution of Public Expenditures: the PPB System, USGPO, Washington.

[2] ANTONELLI, C. 1988. *New Information technology and Industrial Change*: The Italian Case. A Report from the FAST-Programme of the Commission of the European Communities. Kluwer Academic Publishers for the Commission of the EC.

[3] STIGLITZ, J.E. 1989. *Markets Market Failure and Development*. American Economic Review May 1989.

[4] ROMER, P. M. *Increasing Returns and Long – Run Growth*. Journal of Political Economy (October 1986).

[5] SCOTT, M. F. G. A New View of Economic Growth. Clarendon Press, Oxford, 1989.

[6] AJZEN, I. a FISHBEIN, M, (1975) *Belief, Attitude Intention and Behaviour: an Introduction to Theory and Research*. Reading, MA. Addison-Wesley, AJZENA, I. a FISHBEINA, M, (1980). Understanding Attitudes and predicting Social behaviour. Englewood Cliffs, NJ, Prentice Hall.

[7] ROGERS, E.M., SHOEMAKER, F.F. (1971) *Communication of Innovations*: A Cross-Cultural Approach (2nd ed.) New York. The Free Press.

[8] NELSON, R. R. A *Diffusion Model of International Productivity Differences in Manufacturing Industry*. American Economic Review (December 1968), s. 1219 - 1248

[9] POSNER, M.V. 1961. *International Trade and Technological Change.* Oxford Economic Papers.

[10] ANTONELLI, C. *The Diffusion of Advanced Telecommunications in Developing Countries*. OECD, Paris 1991.

[11] VERNON, R. *International Investment and International Trade in the Product Cycle*. Quaterly Journal of Economics (May 1966).

[12] HIRSCH, S. *Location of Industry and International Competitiveness*. Oxford University Press. London, 1967.

[13] STONEMAN, P. *The economics of technological diffusion*. Wiley-Blackwell, 2002, ISBN 0631219773, 9780631219774.

[14] TSAI, C.M. (2007). *Integrating intra-firm and inter-firm knowledge diffusion into the knowledge diffusion model.* Expert System with Applications. 34(2008), s. 1432-1433