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The Schumpeterian Approach to Technological Changes in Different Economic Systems

Abstract. Technology change is one of the aspects which should be analysed by various economic relations. The logic of regional systems concerns the integration of enterprises and regional institutions with their environments, which in turn provide them with necessary production factors such as: labour, entrepreneurship, material and non-material infrastructure, social culture, and institutions. The aim of this paper is to analyse the role of technology in the process of creating and using knowledge and its impact on the economic efficiency of the companies which function within their boundaries. The analysis is conducted using an Schumpeterian approach which gauges the influence of technology on the degree of knowledge utilisation and innovation levels in enterprises from regional economic systems.

Keywords: innovation, technology, Schumpeter

Introduction

The most characteristic feature of modern economies is the development of technological activity as a decisive factor of economic growth and in terms of international economic cooperation. Technological activity and the efficiency of innovation utilisation influence the changes in competitiveness, mainly in non-price competitiveness.

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Most developing countries (DC) are in a period of an intensive modernisation of their production capabilities. Their structure is a very outdated and does not meet the demands of international trade competition. Meanwhile, technology is very important for the DCs in order to grasp the opportunities that the liberalisation of the international flows of the production factors and globalisation bring.

The main aim of the article is to describe and interpret two processes of change in the transitive economies: 1. the impact of the technological changes of DCs, and 2. the role of innovation in the formation of the economic structures within them and competitive features in the context of Schumpeterian approach.

Some Issues of Schumpeterian Approach to Innovation Changes

The modern wave of innovation has led to significant qualitative changes in the world economy. The consumption of material and energy resources in industrial production has decreased. For the last two decades, the growth rate of global production has been higher than the rate at which resources and energy are used. This means that economic growth happens under the conditions of negative income elasticity of demand for natural raw materials and energy resources, which leads to a lower demand for these goods in the global economy thus undermining the income of countries which specialise in exporting them.

Thanks to technology diffusion, an equalisation of technical capabilities is taking place in enterprises located in different countries, which has resulted in increasing technological parity. At the national level, a similar tendency can be observed, referred to as technological convergence, or ‘catch-up’. In the process of technology diffusion, a key role is played by transnational corporations, which achieve it through a geographical integration of dispersed R&D functions/operations and a subordination of these functions to the global strategies of their mother companies.

The changes embodied in innovation are a key development factor. ‘... *innovation, as conceived by us, is at the center of practically all the phenomena, difficulties, and problems of economic life*’ (Schumpeter, 1939, p. 87).

The Schumpeterian approach to innovation processes focused on the supply side, which allowed him to restrict his perception of technological progress to the purely technical aspects of R&D. He identified, therefore, technological progress with an increase in global productivity of production factors, that is with a situation when production growth is greater in comparison with the growth of expenditures.

Innovations, identified with technological progress, have – like labour and capital – their own independent productivity. From the formal perspective of production functions this means that product growth is possible without increasing labour or capital inputs. In this case, productivity is measured by the end product.

Innovations are stimulated by technological possibilities, while changes in productivity increase or decrease in innovativeness, i.e. supply factors. On a macroeconomic scale, this causes the development of those branches where capital productivity growth is becoming increasingly easier and less costly (it lessens the effect of the law of diminishing returns). Moreover, the pool of available production techniques which serves as the basis for investment growth remains undepleted.

The supply approach was introduced into the theory of innovation by Schumpeter and taken up by, among others, Nathan Rosenberg and Simon Usher (Rosenberg, 1971, pp. 43-72). The entrepreneurs, who expect future benefits, take the risk of implementing innovations based on inventions and carry out necessary investments in innovative undertakings. By changing the structure of the market, innovation rewards innovating companies with temporary monopolies and enhanced profits. Then, new innovators emerge which ensures a diffusion of technological progress and does away with privileged firms by creating competitive entities.

The character of technological change is determined by factors which influence the extent and pace of the growth of technical knowledge. Schumpeter emphasises the supply-side sources of innovation (external in relation to the enterprise) because a steady stream of inventions made by relevant research or scientific entities exist in an economy. This, in turn, is supposed to stimulate economic development by building a new economic structure and market order. The market and competition among businesses are the main factors of this process.

Every important innovation is embodied in a 'New Firm', which stems from the economic depletion of production means and tools. The degree to which these are used up determines the pace and range with which new solutions are introduced. The functioning of this type of companies is not of a permanent nature and largely depends on their involvement in the innovation process. Innovation is associated with the appearance of new persons whose skills enable firms to venture into so far unexplored fields of activity. In economies there is fairly strong social resistance to innovations which obliterate the current socio-economic structures. If a 'New Firm' is established, this resistance is less pronounced. In a corporate structure (oligopoly), innovations are carried out by the existing firms and in particular their managing personnel (Schumpeter, 1939, p. 95).

In light of the above, one can distinguish three elements comprising the process which reflect the diversification of the directions and absorption methods of innovation effects:

- The influence of technical changes will take place along different paths and at different levels: from production process to overall economic effects;
- The nature of these changes evolves with the passage of time;
- Also, the entities which take advantage of innovation will change.

This implies that every company has its own individual way of reaching the effects of innovation. It can result from both demand and supply factors. Moreover, the innovation process is adjusted to the conditions currently governing the market and its participants. The changes give rise to a new structure of company operations, achieved from lower production costs and the benefits obtained from new technologies, as well as a new overall economic order related to the emergence of a new market.

The aforementioned classification refers to the Schumpeterian theory by treating innovation as technical and organisational change aimed at achieving a new, more advantageous state (economic order). From this point of view, the most vital thing to understand is the essence of the technical changes included in processes and products and the way in which these changes impact the economy. The level of R&D expenditure, i.e. the possibility to create new solutions, is the major factor behind technical change, whereas the number of implementations and the level of total factor productivity (TFP) are the measures that reflect its effects. Both of these categories make up a uniform innovation process: from basic research to various changes in production (Clark, 1999, pp. 95-96). R&D expenditures must be clearly differentiated from non-innovative activity (e.g. routine).

Regarding the influence of innovation on innovation systems, Schumpeter's most valuable legacy is his analysis of the role of monopolist companies in the innovation processes (Schumpeter's Theorem). At the early stages of the technological revolution, many small firms compete with one another to achieve a monopoly and above-average profits. Schumpeterian theory of 'bandwagon' effects points out that, with time, the benefits of this rivalry are eroded as new entrepreneurs enter the market, gain the upper hand, and frequently become the market leader. In the later period of intense diffusion, these benefits allow companies to achieve competitive advantages, increase the number of internal innovations or the volume of R&D expenditure (as was the case with Microsoft) (Freeman, 2003, p. 3).

The destructive nature of innovation-based competition, which leads to the bankruptcy of firms which fail to keep up with technological changes, is the main premise of Schumpeterian analysis. Two categories of innovation processes can be distinguished:

- conservative, typical of experienced companies;
- disruptive, usually occurring in firms that are new in the market.

Profitability, which is the main factor that drives innovation, is seen differently by small firms than by large corporations. Therefore, an interdependence exists between innovation and the structure of the market, as is manifested in the following two hypotheses concerning innovation:

- 1) the traditional hypothesis holds that the free market is more conducive to innovation;

- 2) the Schumpeterian one, which assumes that an oligopoly structure is more favourable since it commands more efficient resources.

Nowadays, this approach is reflected in the concept of 'national innovation systems' (Lundvall, 1992, p. 215), which shape the structure and evolution of economies via innovation.

The Schumpeterian 'creative destruction' permeates the basic aspects of macroeconomic activity, not only in the long term, but also in the area of economic fluctuations, structural changes, or the functioning of markets. On the microeconomic level, it denotes countless decisions concerning the creation and destruction of a certain order of production. The decisions are often comprehensive and regard both strategic and technological issues. Not only does their efficiency depend on managerial skills, but also on the type and range of institutional mechanisms. The failure of this kind of process has numerous macroeconomic implications which interact with the course of 'creative destruction'. There are several obstacles to a smooth progress towards new production concepts. They comprise natural factors, originating from the complexity of transactional processes, and man-made factors: erroneous economic ideas, inappropriate selection of instruments for attaining social objectives, institutional constraints, cyclical changes, or the flexibility of economies. This allows one to explain such economic processes as unemployment, investment or salaries.

Innovation Creating in Different Economic Systems

The differences between innovation systems are caused more by their environment than by external factors. The consolidation and development of innovation are impossible without political and economic stability or openness of markets. Nevertheless, under the circumstances of globalisation, it is difficult to assess what elements of innovation systems have the highest chance of survival and growth. This usually depends on the participants of those systems (enterprises), their innovation performance, technology transfer, as well as on their future competitive position in international markets.

Technology transfer plays a major role here because its tools are an integral part of innovation change. They should be stable, complex (support for innovation cannot happen independently of support for technology transfer) and co-ordinated since institutions should participate in the creation and diffusion of technical innovation and must closely co-operate, with one institution as the co-ordinator of the entire process. Taking the above into consideration, one can distinguish two strictly interrelated processes that determine the efficiency of innovation systems:

- the development of enterprise sector and market environment; their influence on the innovation capacity of companies and technological infrastructure;

- the transfer of technology and its role in creating efficient management structures capable of enhancing internal and external competitiveness and co-operation.

When analysing these processes, one must take into account the interdependencies between the spheres of science, technology and entrepreneurship, as well as their institutional and macroeconomic aspects. It is institutions that make it possible to monitor the business environment and to introduce changes in the way business entities operate. What is more, they play a crucial role in determining the competitive ability of companies and the pace of economic development.

An interactive process, on the other hand, involves learning by the exchange of information with other local entities. Enterprises located in close vicinity to one another maintain more frequent contacts, which stimulates new forms of co-operation for knowledge acquisition and creation. As a result, innovations induced by new knowledge come into being (Arrow's model) (Arrow, 1962).

Social learning consists mainly in the relationships that enterprises establish with other entities. They can assume various forms: (i) the relationships among companies (co-operation, competition, supplies); (ii) the relationships between firms and institutions (co-operation, dependence), and (iii) the relationships between enterprises and individual creators of knowledge (information, co-operation).

A major role is also played by political institutions which shape the innovation processes in a given region by providing operating procedures and financial resources and by creating regional innovation policy. In a properly functioning system, all these entities form a network of dependencies and interactions regarding the flow of knowledge, resources and qualifications.

All these interrelations are tremendously important for the innovation potential and competitive position. Internal connections concerning knowledge flows are believed to be of great significance in innovative regions, but interactions with external bodies as regards support for the development of knowledge seem no less relevant. Formal networks require some sort of financial (or material) compensation, whereas informal ones occur spontaneously and are free of charge. Static relations, on the other hand, involve exchange of "ready-made" fragments of knowledge or information, and are dynamically associated with activities aimed at learning-by-interacting.

A number of data indicate (Maskell, Bathelt & Malmberg, 2006, pp. 997-1008) that enterprises which belong to such networks gain access to knowledge (both codified and context-related) and information from increasingly varied sources. Besides, the co-operation between knowledge makers and knowledge users is becoming more encompassing and more intensive.

Directions and Range of Technological Changes

International connections and innovation mechanisms allow new knowledge to be acquired and transformed into higher productivity and higher income (Ciborowski & Skrodzka, 2019, p. 1-21). The efficiency of innovation is measured by the innovation potential of an economy understood not only as the commercialisation of R&D results, but also as the degree of openness to foreign ideas, broadened synergy and interaction among forms or between firms and the science base as well as the fostering of entrepreneurship. Thus, the following set of indicators of innovation efficiency can be distinguished:

- technological commercialisation – every kind of knowledge used in enterprises should be commercialised;
- openness to foreign ideas – interest in and ability to obtain global resources of knowledge;
- transfer of knowledge and technology – enterprises which compete on a global scale must acquire knowledge and qualifications through new forms of international co-operation;
- entrepreneurship – ability to gain new development opportunities and implement them efficiently.

The success of innovative products and processes requires, therefore, not only expenditure on R&D, but also on training, marketing, material endowment and design. Although general data on R&D expenditure do not show its efficiency, they do define a link with the innovation process.

Many European enterprises, both from the industrial and service sectors, notice the significance of innovation, develop products and process activities. The amount of innovation investment of industrial firms is debatable; however, the number of innovative enterprises is too small and the ratio between innovation expenditure and income is too low. Achieving a high level of growth in the long term requires increased expenditure and a greater propensity to take risks.

Assessment of potential innovation success should take into account implementation effects, i.e. the volume of income from the sales of new products or cost savings achieved due to new technologies. Taking this type of data into consideration allows the level of entrepreneurship to be assessed and the determination of how innovation success reflects market behaviour.

The current information revolution is characterised by the rapidly increasing quality of ICT equipment and software accompanied by a diminished tendency to raise prices. The maximisation of consumer utility and the maximisation of producer's profits are reflected in the changes of relative prices resulting from substitutive processes in particular fields. The sudden surge of technological

advantages was, therefore, possible due to the greater share of ICT in GDP and in capital resources, along with the simultaneous significant decrease in prices.

To sum up, the most important issues related to the influence of innovation on the process of technological convergence are as follows:

- intensity of innovation – low level of innovation is part of the syndrome whose other components are the result of lower productivity and weaker international competitiveness;
- lack of innovation in strategic development priorities – it hampers the ambition and the motivation of firms to strengthen their technological competences and to develop new types of activities;
- limited internal sources of innovation – investments in R&D and in the promotion of technological capabilities are insufficient;
- organisation and management – many enterprises do not make use of the opportunity to adopt new modes of functioning;
- rapid growth and greater innovativeness of the SME sector;
- emergence of knowledge and experience gap. This is particularly noticeable among firms operating in global markets with their ever-expanding resources of knowledge, technology, globalisation and the emerging e-commerce business. The absence of radical organisational changes aimed at adjusting to the developments in the world economy can marginalise some firms;
- sudden increase of science and technology resources – the growing possibility for enterprises to adopt new production, organisational or financing techniques;
- better exploitation of the strengths of the science base;
- wider application of ICT infrastructure;
- better alignments between suppliers and recipients of technology;
- better use of technological infrastructure in enterprises
- the pursuit of sustainable development goals.

The last twenty years have been, therefore, a revolution in the perception of the role and significance of innovation both in the social and economic spheres. Unfortunately, innovation policy does not always keep pace with these changes. Nevertheless, a substantial number of policy initiatives are a response to the challenge of the global economy.

Weaknesses in innovation policy required appreciable and dynamic import of complete technologies into firms. This is the reason for future expenditure growth in order to purchase elements of the innovation process such as patents, licenses or know-how. Therefore, the innovation policy is interesting from the point of view of arrangements in export and import of technical change components. The possibilities of technological foreign trade should be considered through the prism of the present possibilities of long-term growth.

On the other hand, globalisation processes increase access to new technologies, but this requires a greater range of openness. Thus, structural and institutional solutions concerning the possibilities of supporting the development of innovation are needed which may positively influence the increasing pace of economic development and the competitive position (Ciborowski, 2018, p. 41-52).

A positive direction in the structural solutions can be noticed. However, an overall investigation of the problem of innovation in connection with the functioning of other branches of the economy is needed (science, production spheres). Creating new solutions for the technology transfer is a factor equally significant to the increase of innovation .

Conclusions

The developing countries are mostly considered as a group of countries able to adopt technology. This is reflected by the existence of the technological gap in relation to the highly developed countries. This forces the developing countries to coexist economically with a background of different production technologies, and the products which are a result of different levels of technological advantage. On the other hand, technological gaps strengthen the market competitiveness and create an incentive for exploiting the technological advantage by leading companies or countries. This, in turn, creates an encouragement for imitating innovation processes and the technology transfer.

The economic situation of the developing countries does not allow for maintaining scientific abilities on the scientific base and making its use in creating technology. The cause lies in the worsening of the innovation quality, a limitation of the country's spending on R&D resulting from budget difficulties and their low effectivity. Thus, there is a need for a change in the structuring of financing the innovations, which could increase the effectivity measured by the number of patents and open up the possibilities of the capacity processing.

An increase in the productivity in the developing countries is connected with an increase of the material and human capital and a decrease in the work force. The value added of the companies has risen significantly, and the effects of the changes in productivity since the beginning of the nineties are fairly stable.

Globalisation processes grant greater access to the developing countries to new technologies, but this requires a greater range of openness. Thus, structural and institutional solutions concerning the possibilities of supporting the development of the innovation are needed which may positively influence the speeding up of economic development and the competitive position.

A positive direction in the structural solutions can be noticed. However, an overall look at the problem of the innovation in connection with the functioning of

other branches of the economy is needed (science, production spheres). A factor equally significant to the increase of innovation is creating new solutions for the TT. This concerns mainly changes in the domestic processes of the TT which have not yet been worked out by those countries.

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